The 2022 Martin S. Feldstein Lecture

Managing a Turn in the Global Financial Cycle

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It is a tremendous honor for me to give the Martin Feldstein Lecture. Marty was an exceptional colleague at Harvard and inspired my journey from academia to the policy world. His influence in research went well beyond public finance. In fact, one of his most cited papers is a contribution to international economics, widely referred to as the Feldstein-Horioka puzzle. Marty showed empirically that most savings tended to be invested at home, which can be puzzling if international capital markets are well integrated.

In reality, capital markets have many frictions, and my lecture today focuses on the implications of these frictions for policy in emerging and developing economies. I hope to show how policy questions arise at the International Monetary Fund (IMF), the research that gets done to answer these questions, and finally, how this research influences policymaking.

It is an opportune time to discuss this topic because after two years of easy financial conditions around the world, with monetary policy rates kept at record lows to prevent a COVID-driven depression, we are witnessing a tightening in global financial conditions. Almost all central banks are raising interest rates to deal with historically high

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Source: IMF Global Financial Stability Report (April, 2022);

Figure 1

inflation because of strong demand recoveries from the pandemic, alongside disruptions to supply and elevated energy and food prices exacerbated by Russia's invasion of Ukraine.

As can be seen in Figure 1, global financial conditions have tightened significantly, especially for emerging markets and developing economies, excluding China. According to Figure 2, over 30 percent of emerging markets are paying interest rates over 10 percent on their sovereign foreign-currency bonds, which is close to the levels seen during the

EMBIG is the Emerging Markets Bond Index Global. Yields and spreads are in percent
Source: Bloomberg Fin
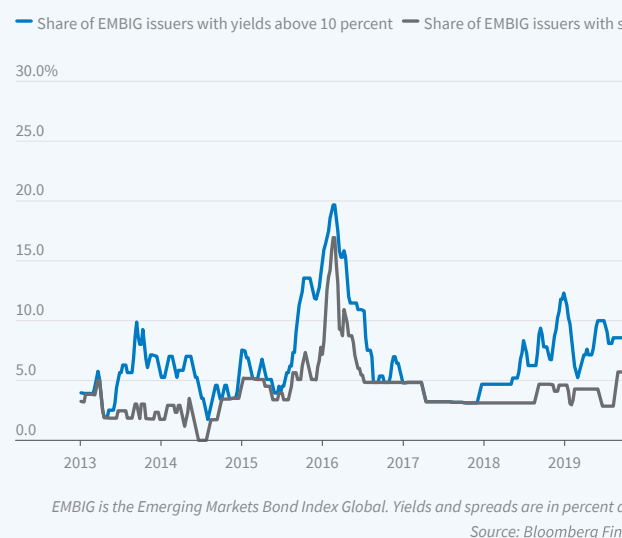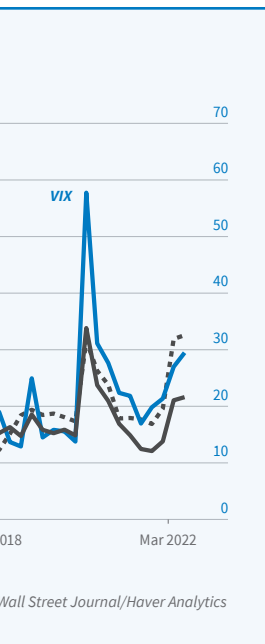
Figure 2

Great Financial Crisis of 2008. In addition, as is typically the case when global financial conditions tighten, the US dollar has strengthened against a wide basket of currencies [see Figure 3], raising costs for countries that have borrowed in dollars. All of this is occurring in the aftermath of a pandemic, during which debt in emerging and developing economies has grown significantly.

A key policy question therefore is how emerging and developing economies should respond to this tightening cycle that is driven to an important degree by rising US monetary policy rates. The textbook answer would be to let the exchange rate be the shock absorber. An increase in foreign interest rates lowers domestic consumption. By letting the exchange rate depreciate, and therefore raising the relative price of imports to domestic goods, a country can shift consumption toward domestic goods, raise exports in some cases, and help preserve employment.

However, many emerging and developing economies find this solution of relying exclusively on exchange rate flexibility unsatisfying. This is because rising foreign interest rates come along with other troubles. They can trigger so-called "taper tantrums" and sudden stops in capital flows to their economies. In addition, the expansionary effects of exchange rate depreciations on exports in the short run are modest, consistent with their exports being invoiced in relatively stable dollar prices.[1]

Figure 4, on the following page, depicts one such taper tantrum episode in 2013, when the US Federal Reserve signaled an end to quantitative easing and a lift-off in rates, possibly earlier than expected. This communication triggered a sharp increase in borrowing costs for emerging markets, with median spreads increasing by more than 200 basis points even though there was no meaningful immediate policy action by the United States. Figure 5, on the following page, documents episodes of sudden stops with growth impact, which are defined as an abrupt stop or reversal in capital flows to emerging and developing economies

that in turn generate a sharp fall in growth. These episodes capture a sudden tightening of borrowing constraints in emerging markets because of a perceived lower capacity of the country to repay. While they are less frequently observed than taper tantrums, they have larger adverse welfare implications for the country.

Consequently, several emerging and developing economies have in practice used a combination of conventional and unconventional policy instruments to deal with turns in the global financial cycle. Unlike the textbook prescription, they not only adjust monetary policy rates but also rely on foreign exchange intervention (FXI) to limit exchange rate fluctuations, capital controls to regulate cross-border capital flows, and domestic macroprudential policies to regulate domestic financial flows. This common practice, however, lacks a welfare-the-


Nominal Broad US Dollar Index

Source: Board of Governors of the Federal Reserve System, Nominal Broad US Dollar Index, retrieved from FRED, Federal Reserve Bank of St. Louis
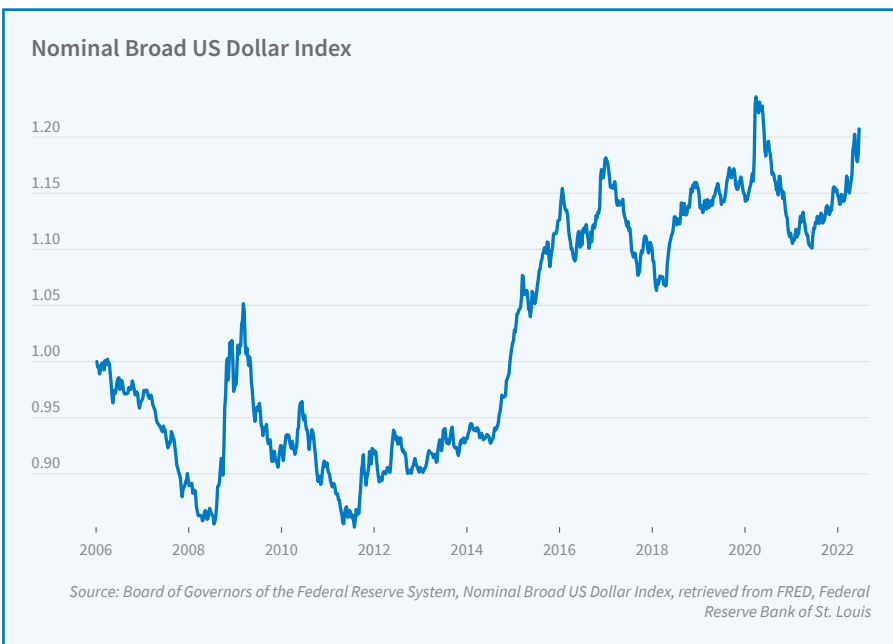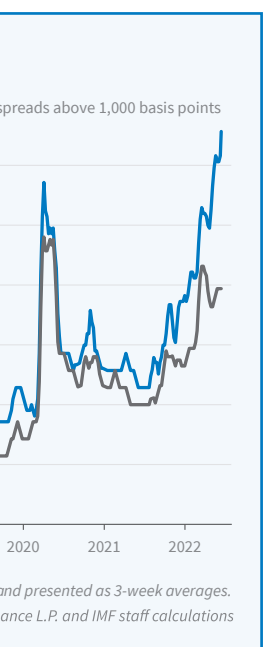
Figure 3

oretic framework to guide the optimal joint use of these tools. This shortcoming limited the policy advice the IMF could give to several of its members. Accordingly, to enhance IMF advice, David Lipton, the former first deputy managing director of the fund, championed the need to develop an Integrated Policy Framework that jointly examines the optimal use of conventional and unconventional instruments.

Over the last few years, a large body of work, both theoretical and empirical, has been developed at the IMF. In today's lecture, I will focus on the theoretical work that I have been involved in with coauthors Suman Basu, Emine Boz, Francisco Roch, and Filiz Unsal.

There already exists an extensive literature on the various frictions in an open economy, but most of this literature focuses on a single friction at a time. In practice, multiple frictions coexist, and policy tools affect multiple frictions at the same time. Consequently, the challenge is to build a tractable model that

VIX

Source: Wall Street Journal/Haver Analytics

spreads above 1,000 basis points

and presented as 3-week averages.
...ance L.P. and IMF staff calculations

facilitates an analytical understanding of the interaction of frictions and policy tools. This analysis is developed in two of our studies.[2] I will share some insights from this work, and encourage you to read the papers themselves, which cover a lot more ground.

I will first describe some of the frictions that are prominent in the literature and that policy makers grapple with. After that, I will take up the motivating question of how countries should manage the current tightening in the global financial cycle. The optimal policy response will, as one might expect, depend on country characteristics and shocks.

Nominal rigidities in price setting are a key ingredient in models of the exchange rate. This friction underlies the classic Mundell-Fleming framework[3] and Milton Friedman's argument for the optimality of flexible exchange rates.[4] Price stickiness gives rise to the "aggregate demand externality" as formulated by Emmanuel Farhi and Iván Werning, whereby agents fail to internalize the effect of their decisions on aggregate demand.[5] This externality creates a problem when prices are misaligned and gives rise to an aggregate demand wedge — that is, a wedge between the marginal rate of substitution between
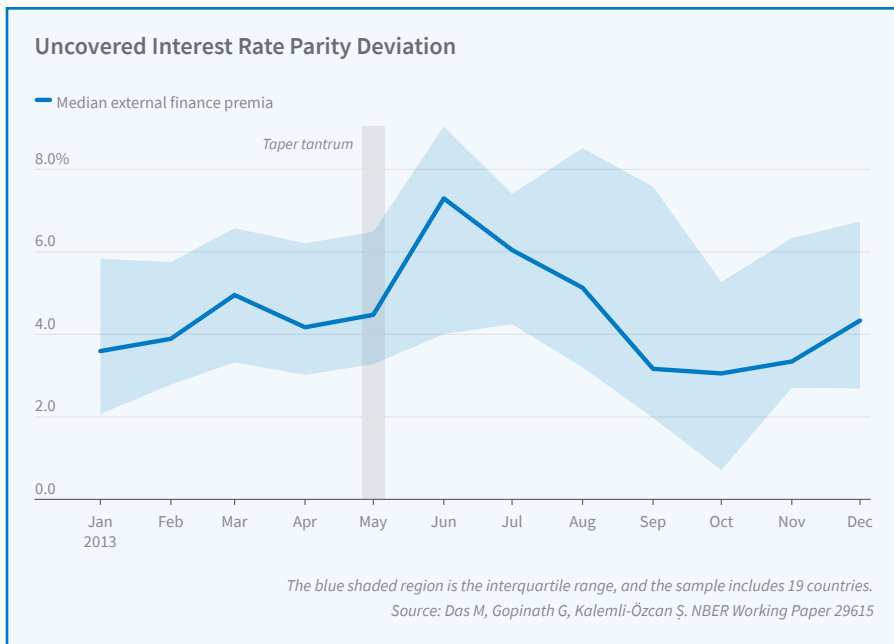
consumption and leisure on the one hand, and the marginal rate of transformation arising from the production function on the other. If prices are too high (low) relative to their flexible-price level, households consume too little (much), lowering (raising) output and pushing employment below (above) efficient levels. In the open economy context, price stickiness also leads to a "terms-of-trade" external-

ity. This arises because while firms internalize the fact that they have pricing power for their own product in international markets, they do not internalize the fact that the country also faces a downward-sloping demand curve. This externality leads to overproduction of domestic goods and a terms of trade that is less appreciated relative to the planner's optimum. While this externality is commonly explored in the literature, policymakers appear to disregard it in practice, and we accordingly mute this channel in our analysis.

A second friction that policymakers grapple with is the shallowness of foreign exchange (FX) markets, which can give rise to volatility in the price of domestic currency bonds as market sentiment changes. Owing to balance sheet frictions, financial intermediaries demand a premium to hold domestic currency bonds that carry currency risk relative to foreign currency bonds. This financial friction was recognized early on by Pentti J.K. Kouri,[6] around the same time as Robert Mundell and Marcus Fleming wrote on pricing frictions, but it received less attention in the literature until recently, when work by Xavier Gabaix and Matteo Maggiori reenergized research in this area.[7]

The shallow-market friction gives rise to what we call the "financial terms of trade externality."

Uncovered Interest Rate Parity Deviation

— Median external finance premia

Taper tantrum

The blue shaded region is the interquartile range, and the sample includes 19 countries.
Source: Das M, Gopinath G, Kalemli-Özcan Ş. NBER Working Paper 29615

Figure 4

Sudden Stops of Private Capital Inflows

Number of sudden stops

A sudden stop is a drop in (net private capital inflows)/GDP of at least 2 ppt relative to the average value in the previous 2 years, or approval of an IMF program in excess of 500 percent of quota. The stops displayed coincided with a drop in the GDP growth rate, relative to the previous 5-year average, in the lowest decile.
Source: Basu S, Perrelli R, Xin W. "Performance Uncertainty and Ranking Significance of Early-Warning Models."

Figure 5

Firms or households that issue debt in domestic currency do not internalize the impact of their decisions on the premium charged by financial intermediaries, which varies with the overall level of debt of the country. This externality gives rise to an uncovered interest parity wedge, which is the excess return paid to intermediaries for holding domestic currency bonds. This wedge has implications for policy when financial intermediaries are foreign owned, as payments to intermediaries are a net loss of resources for the country.

In addition to shallow FX markets, another common friction in emerging and developing economies arises from borrowing constraints and so-called "currency mismatch" in households' and firms' balance sheets. The ability of domestic agents to borrow is restricted by the extent of pledgeable collateral, which is often denominated in domestic currency. As a consequence, when the exchange rate depreciates, the ability to borrow in foreign currency is reduced. Since households and firms do not internalize the impact of their decisions on the exchange rate, there is a pecuniary externality that in turn impacts the aggregate demand wedge, leading to inefficient outcomes.

I now turn to the question of how to manage a turn in the global financial cycle. We derive the optimal policy response ex a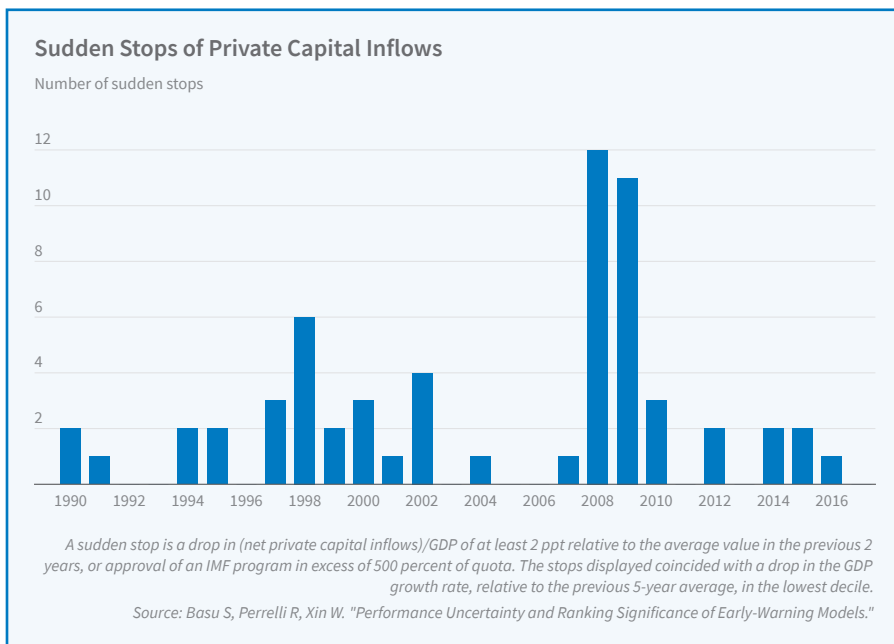nte — prior to the shock — and ex post — during the shock — as the solution to the planner's problem with commitment. The optimal policy depends on the particular frictions at play and the nature of the shock. Table 1 presents various scenarios that may apply in practice. In all cases, prices are assumed to be sticky.

The upper-left quadrant represents the textbook case that characterizes a developed, small, open economy with dominant currency pricing. Such a country has deep FX markets, meaning that financial intermediaries do not require an excess return for holding the country's domestic currency bonds, and its external debt is far from the debt limit. The only friction is the nominal rigidity in prices and the associated aggregate demand externality. In this case, when the foreign interest rate rises, it reduces domestic consumption of all goods, including home goods, and opens an aggregate demand wedge. The optimal policy response is exchange rate depreciation, which increases the relative price of imports to domestic goods and thereby shifts consumption from imports toward home goods. This expenditure switching delivers the needed reduction in imports and external debt, while the country's exports and domestic consumption of home goods and domestic output remain unchanged. Exchange rate flexibility therefore suffices to close the aggregate demand wedge.

The upper-right quadrant characterizes a country whose debt is far from its debt limit, but which has shallow FX markets, resulting in an uncovered interest parity wedge. Consider here a taper tantrum shock, where noise traders — irrational or position-limited traders who buy and sell domestic currency bonds regardless of the level of returns — decide to sell their holdings of domestic currency bonds.

If the country's FX markets are deep, as in the case of the upper-left quadrant, this shock would have no real effects because there would be a large pool of other investors who would buy the bonds without any effect on prices. However, if the FX markets are shallow, other financial intermediaries require a higher excess return on the country's debt to absorb the bonds offloaded by noise traders, resulting in higher borrowing costs for the country. To offset this shock, the following policies can be deployed: policy rates can be raised so that domestic bonds pay a higher interest rate, capital inflow taxes that are paid by intermediaries can be cut so that the effective return they earn increases, or policymakers can deploy FXI, whereby the central bank buys the offloaded domestic bonds and sterilizes the purchase by selling foreign currency bonds.

In the case where noise trader shocks are symmetric, it turns out that optimal policy calls for leaving the policy rate alone and relying exclusively on a reduction in the tax on capital inflows and FXI. The reason is that when the policy rate is changed, it affects the consumption decisions of domestic agents and leads to excessive deleveraging. On the other hand, the cut in capital inflow taxes benefits financial intermediaries without raising borrowing costs for domestic agents. The reason that optimal policy calls for both FXI and capital inflow tax cuts is that each instrument is costly. Cutting capital inflow taxes results in a loss of resources to foreigners, while foreign exchange intervention forgoes carry profits. The joint use of both instruments insulates the economy from nonfundamental shocks like noise trader shocks. This overturns the result of the textbook case: optimal policy calls for an unchanged policy

	Deep FX Markets	Shallow FX Markets
Far from Debt Limit	Foreign rate increase — policy rate and exchange rate depreciation	Taper tantrum — capital control subsidy, buy local currency and sell FX, no change in policy rate or exchange rate
Near Debt Limit	Sudden stop — ex ante capital control, ex post policy rate cut and depreciation	Sudden stop — lower ex ante capital control, ex post policy rate cut and depreciation

Table 1

rate and exchange rate, and instead the country should rely on capital controls and FXI, which are more targeted to addressing the problem.

The lower two quadrants consider the case of a sudden stop shock, when a financial tightening leads to a tighter borrowing constraint for the country and limits the foreign currency value of its external debt. This shock is relevant when the country's debt is close to its debt limit, unlike in the case of the upper two quadrants. A tightening of the borrowing constraint generates a drop in demand. When prices are sticky, this reduction in demand opens an aggregate demand wedge because output is too low relative to efficient levels. In this case, the optimal policy response calls for a cut in interest rates and a depreciation of the currency, which stimulates higher consumption today and tilts demand toward domestic goods. However, if a country's debt is in foreign currency and the pledgeable collateral is in domestic currency — in other words, there is currency mismatch on the balance sheet — a depreciation exacerbates the shock by further tightening the borrowing constraint. In this case, policy needs to trade off the distortion in the aggregate demand wedge against the tightness of the debt limit. Accordingly, exchange rate depreciations cannot close the output gap ex post. Optimal policy requires the imposition of ex-ante capital controls that limit the extent of ex-ante foreign currency borrowing by domestic agents. The situation is improved when debt is partially in domestic currency because the ex-post exchange rate depreciation reduces the foreign currency value of the debt that needs to be repaid. In some circumstances, a greater reliance on domestic currency debt instead of foreign currency debt can lead to a lower optimal level of ex-ante capital controls.

To mitigate the negative impact of exchange rate depreciations on balance sheets, policymakers in emerging and developing economies often regulate the currency mismatch on the balance sheet of domestic-owned financial intermediaries. By encouraging reliance on domestic currency borrowing, policies that engineer a state-contingent exchange rate depreciation can lower the foreign currency value of the debt owed externally in adverse states, and shift demand toward domestic goods in those states. There is a side effect, however, when the country's FX markets are shallow (lower-right quadrant): restricting domestically owned financial intermediaries from taking on currency mismatch does not just reduce the size of the FX market that intermediates domestic and foreign currency bonds. It also tilts the composition of active intermediaries toward those owned by foreign investors. This side effect worsens the financial terms of trade externality because the increase in the premium to be paid to intermediaries is a net loss of resources from the country's perspective. Consequently, the optimal level of regulation of currency mismatch depends on FX market depth and, in particular, banning FX mismatches entirely may be suboptimal when FX markets are shallow.

To summarize, the optimal policy response to a tightening in the global financial cycle depends on country-specific circumstances. When a country's financial markets are deep and its debt is well below the debt limit, the textbook prescription of relying exclusively on interest rates and flexible exchange rates can work well. But there are other cases when such a policy response does not suffice. In fact, after noise-trader shocks that disrupt the economy, the deployment of instruments such as foreign exchange interventions or capital inflow controls dominates the use of exchange rate flexibility.

The work at the IMF goes beyond theory to empirically evaluate the effectiveness of different policy instruments and to put in place safeguards to ensure that unconventional instruments are not deployed as a substitute for necessary macroeconomic adjustment. In addition, there may be dynamic trade-offs from excessive reliance on uncon-ventional instruments. For example, government intervention in financial markets may delay the development of deep FX markets. Accordingly, Integrated Policy Framework advice goes hand in hand with advice that the IMF provides to countries on structural reforms, ensuring that short-term actions do not detract from long-term reforms. In the fall of 2020, the IMF Board approved work on the Integrated Policy Framework,[8] and this work was an essential ingredient in the 2022 reform of the IMF's Institutional View on Capital Flows, which now puts greater emphasis on stocks of debt in addition to flows and allows the pre-emptive use of capital flow management measures to address financial stability risks even when there is no surge in capital inflows, especially when a country's debt is in foreign currency.[9] Armed with the Integrated Policy Framework toolkit and policy recommendations, the IMF is much better placed than it was previously to address the growing demands from member countries for advice on how to best respond to the tightening of the global financial cycle.

[1] "Dominant Currency Paradigm," Gopinath G, Boz E, Casas C, Díez F, Gourinchas PO, Plagborg-Møller M. *American Economic Review* 110(3), March 2020, pp. 677–719.
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under Fixed and Under Floating Exchange Rates," Fleming J. Staff Papers, International Monetary Fund 9(3), November 1962, pp. 369–380.
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[8] "Toward an Integrated Policy Framework," International Monetary Fund Policy Paper, October 2020.
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[9] "Review of The Institutional View on The Liberalization and Management of Capital Flows," International Monetary Fund Policy Paper, March 2022.
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Age Discrimination's Challenge to the American Economy

Patrick Button and David Neumark

Age discrimination is an important problem and challenge in the United States and elsewhere, given that policymakers are trying to lengthen work lives of older people in response to population aging. We have been studying many dimensions of age discrimination, measuring its importance in the US economy, understanding the impact of policies intended to combat it, and exploring alternative ways that protections against age discrimination can be strengthened.

Age Discrimination in Employment

Indirect evidence on age discrimination comes from comparing observed behavior of older and younger workers. For example, older workers typically have longer unemployment durations. This difference grows during economic downturns like the Great Recession. However, this could reflect differences in the jobs that older and younger workers are willing to accept, rather than age discrimination in hiring. Similarly, workers near traditional retirement ages, especially women, experienced larger employment losses during the COVID pandemic and the related recession, which could be due to age discrimination but could also reflect factors such as greater sensitivity of older workers to the risk of infection in the workplace.[1]

One approach to isolating the effect of age discrimination is to use survey data on self-reports of the experience of age discrimination.[2] Evidence from this approach indicates that workers do perceive age discrimination. Moreover, this perception leads to a higher likelihood of leaving the job and a lower likelihood of remaining employed — illustrating how perceived age discrimination can frustrate the goal of encouraging employment at older ages.

Researchers studying discrimination — including age discrimination — have turned increasingly to experimental methods, especially correspondence studies, to provide rigorous evidence on discrimination in hiring. Hiring is important to extending working lives because many workers take jobs at older ages subsequent to their career jobs. Correspondence studies create artificial applicants and measure discrimination as differences in callbacks for job interviews. We conducted a large-scale correspondence study designed to provide evidence on age discrimination in hiring, overcoming potential biases in past studies[3] through the implementation of new econometric methods.[4] We submitted résumés in response to ads for jobs that

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Button's research focuses on discrimination, primarily age and disability discrimination. They have quantified discrimination using correspondence studies — sending résumés of older and younger workers to job openings and comparing callback rates for interviews. In addition, they have studied the labor market impacts of age and disability discrimination laws on older workers and individuals with disabilities.

With funding from a National Science Foundation CAREER grant, Button has been branching out into quantifying discrimination in less-studied markets and against less-studied minority groups. They are currently studying discrimination on the basis of sexual orientation and race in access to mortgage loans, and discrimination against transgender people, racial and ethnic minorities, and individuals with Medicaid in access to mental health care — "talk therapy" — appointments.

As the inaugural executive director of The Data Hub: Tulane Center for Data Literacy, they are working to establish courses, co-curricular programming, and community relationships that expand data literacy and data analysis at Tulane and in the community.

employ large numbers of fairly low-skilled workers of all ages, and that hire both older and younger workers, including administrative assistants and secretaries (female applicants); janitors and security guards (male applicants); and retail sales (both genders). We sent off applications of otherwise identical young, middle-aged, and older fictitious workers to more than 13,000 positions in 12 cities — more than 40,000 putative applicants. Overall, the callback rate was higher for younger applicants than for older applicants, pointing to age discrimination in hiring [Figure 1]. These results — which hold up in a number of more sophisticated analyses — provide evidence of discrimination against both older women and older men, with the evidence also indicating that women face worse age discrimination than men.

These findings are consistent with many other studies that find evidence of age discrimination in hiring, especially for women.

There is other evidence of age discrimination in hiring from nonexperimental approaches. In data from a single company hiring across multiple stores, a change in hiring procedure from in-person interviews to age-blind online assessments was rolled out over time. The in-person interviews, in which the interviewer could assess age immediately, led to lower hiring of older applicants. Older applicants fared better in the age-blind online assessments, getting more interviews — likely because of more work experience — but adverse treatment of older applicants emerged after the interviews, when age became apparent.[5]

Age Discrimination Laws

The US Age Discrimination in Employment Act (ADEA) passed in 1967, only a few years after legislation prohibiting discrimination based on race, ethnicity, and gender. Many states also have their own age discrimination laws, and these

Callback Rates by Age, Sex, and Sector

■ Ages 29–31 ■ Ages 49–51 ■ Ages 64–66

	Ages 29–31	Ages 49–51	Ages 64–66
Administrative (women)	14%	10%	8%
Sales (women)	29%	26%	18%
Sales (men)	21%	21%	15%
Security (men)	24%	22%	22%
Janitors (men)	32%	33%	26%

Source: Neumark D, Burn I, Button P. NBER Working Paper 21669, and published as "Is It Harder for Older Workers to Find Jobs? New and Improved Evidence from a Field Experiment," Journal of Political Economy, 127(2), 2019, pp 922–70

Figure 1

David Neumark is Distinguished Professor of Economics and codirector of the Center for Population, Inequality, and Policy at the University of California, Irvine. He has previously held positions at the Federal Reserve Board, the University of Pennsylvania, Michigan State University, and the Public Policy Institute of California, and is currently a visiting scholar at the Federal Reserve Bank of San Francisco and a senior research fellow at the Workers Compensation Research Institute.

Neumark has made research contributions in numerous areas of labor economics that intersect with major public policy issues. These include the measurement of labor market discrimination, where his contributions include the use of matched employer-employee data to test for discrimination and innovations in the application of audit and correspondence studies.

Neumark was also a contributor to the "new minimum wage research," studying the use of state-level minimum wage variation to estimate minimum wage effects. His subsequent work examined the effects of minimum wages on the income distribution, human capital, and earnings. He also studied the complementarities between minimum wages and the Earned Income Tax Credit, as well as the labor market impacts of city living wage laws.

He has also contributed to the analysis of age discrimination, studying how stronger age discrimination laws complement policy reforms intended to increase labor supply of older workers, conducted a large-scale field experiment testing for age discrimination, and developed methods to test for age stereotypes in job ads. He has also consulted on large class-action discrimination lawsuits.

are sometimes stronger than the ADEA, in part by allowing larger damages to be awarded in court.

There was some concern when the ADEA was enacted that it would result in fewer long-term employment relationships between firms and workers because firms would find it difficult to use implicit contracts that rewarded older workers for high effort and productivity throughout their careers. However, this fear was not realized. The ADEA and earlier state laws appear to have strengthened long-term relationships, perhaps because the primary effect was to assure workers that they would not be arbitrarily terminated in their 40s or 50s after making long-term contributions to the firm.[6]

There is ample evidence that age discrimination laws have been effective in boosting employment of older workers.[7] For example, we have matched information on state laws to the data collected in the correspondence study we described earlier. In states where age discrimination laws allow larger damages, there is less evidence of age discrimination against older women and men applying for retail jobs.[8]

The evidence from this study also partially allays another potential concern—that stronger age discrimination laws deter hiring of older workers by raising the cost of firing them. We do, however, find some evidence for this concern in the aftermath of the Great Recession, when stronger state age discrimination laws were associated with weaker outcomes for older workers.[9]

Another type of evidence comes from comparing the effects of Social Security reforms intended to encourage later retirement across states with stronger versus weaker age discrimination laws. Increases in the full retirement age coupled with lower benefits at the early retirement age of 62 had a greater impact — delayed benefit claiming, and higher employment at older ages — in states where the laws were stronger.[10] This evidence points directly to complementarities between supply-side policies to encourage longer work lives and laws reducing age discrimination.

The experimental evidence described above points to stronger age discrimina-tion against women than men. This may be partly attributable to intersectional discrimination by age and gender. Because Title VII of the Civil Rights Act, which in part prohibits sex discrimination, is separate from the ADEA, the courts have not recognized, under the ADEA, intersectional claims of age discrimination against older women.[11] Reducing age discrimination against older women could be particularly important for financial security at older ages, as many women outlive their husbands and eventually become impoverished.[12]

Age Stereotypes and Age Discrimination

Enforcement of laws prohibiting age discrimination in hiring relies first and foremost on comparing the age distribution of hires to the age distribution of applicants. Hiring a disproportionately low share of older applicants provides prima facie evidence of discrimination. But if employers can discourage older workers from applying in the first place, they may be able to avoid or limit such evidence, allowing them to discriminate with greater impunity.

How might employers do this? There are fairly well-known stereotypes of older workers, such as that they are less sophisticated with technology, or less physically fit. We used the text of job ads from the correspondence study described above to study whether the same employers found to be discriminating against older workers also used job-ad language with age-related stereotypes. This is based on methods from computational linguistics and machine learning, which we use to measure the "semantic similarity" of job-ad language with typical age stereotypes. It turns out that the same employers who discriminated against older men in the experiment also tended to use more subtly ageist language in their job ads.[13]

Moreover, use of these age-related stereotypes in job ads does appear to deter older workers from applying for jobs. A survey on the Amazon Mechanical Turk platform shows that job-ad language identified as semantically similar to age stereotypes is actually perceived as ageist.[14] More strikingly, in an experiment posting artificial job ads that randomly vary short phrases in job ads to sometimes convey even subtle age stereotypes, older workers respond strongly, with substantially fewer older workers applying to the jobs with stereotyped job-ad language. These ads attract workers who are 2.5 years younger on average, and can reduce the share of applicants over age 40 by 10 percentage points or more.[15] Calculations suggest that the implied effect in reducing the share of older job seekers who are hired is of the same magnitude as the effect of direct age discrimination measured in the correspondence study.

Disability Discrimination

Although we have focused to a large extent on age discrimination and the ADEA, one can also think about discrimination based on disability as related to age discrimination, given that work-related disabilities increase with age, especially beyond age 50 or so. Ageist stereotypes may also lead to perceptions that older workers have, or eventually will have, disabilities. While the Americans with Disabilities Act attempts to provide protection from disability discrimination, many states have stronger or broader disability discrimination laws that better protect against disability discrimination.

Two studies that compared hiring rates of older workers and younger workers by state age and disability discrimination laws found that disability discrimination laws have small positive effects or no effects on older workers.[16] Recent work also finds that these state laws reduce reliance on Social Security Disability Insurance, likely by removing some discriminatory barriers to employment.[17]

Policy Implications

The research documenting the existence of age discrimination and pointing to possible ways to enhance protections against it has important policy implications. Policymakers are likely to enact additional supply-side pol-

icy changes — including Social Security reforms — to incentivize work at older ages. If they do not also combat age and disability discrimination, then these supply-side changes may do more to reduce retirement benefits than to increase work at older ages. Our research documents that this problem could be more severe for older women, who already face lower retirement benefits and longer life expectancy.

[1] "Early Evidence on the Impact of COVID-19 and the Recession on Older Workers," Bui T, Button P, Picciotti E. NBER Working Paper 27448, June 2020, and *Public Policy & Aging Report* 30(4), October 2020, pp. 154–159.
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Crisis Innovation: Historical Evidence, Insights, and Open Questions

Daniel P. Gross and Bhaven N. Sampat

The COVID-19 pandemic has brought into focus the potential value of innovation in a crisis: big, new, urgent problems may demand novel solutions. Early on in the pandemic, there were calls from both scientists and policymakers for a focused R&D effort to combat the disease, many invoking past R&D efforts like the Manhattan Project as strategic metaphors for a wartime approach to the pandemic response.[1]

Over the past several years, we have been immersed in studying crisis innovation, primarily through the lens of World War II, when the United States mobilized the country's fledgling innovation system to tackle dozens of urgent wartime R&D needs, resulting in outputs as varied as radar, mass-produced penicillin, malaria treatments, and atomic fission. This effort was primarily organized and led by a new government agency, the Office of Scientific Research and Development (OSRD), which identified military research priorities and contracted with firms and universities across the country to perform the necessary research, prototyping, and early-stage manufacturing before new technologies could be produced at scale. In addition to supporting research and development, OSRD actively promoted diffusion. The OSRD-sponsored effort was a watershed moment in innovation policy, marking the federal government's first significant investment in research and supporting advances that were instrumental to the Allied victory and transformed civilian life after the war ended.

As perhaps the largest single shock in the history of the US innovation system and the most expansive crisis R&D effort, we were drawn to studying it more closely. The long historical lens, together with rich detail from primary records from the National Archives present an opportunity to examine the nature of crisis R&D problems, organizational and policy approaches to crisis innovation, and the short- and long-run impacts of crisis R&D investments. Our research complements other studies of large, government-directed R&D projects like the Apollo program[2] and of other settings in which innovation may be valuable, such as environmental catastrophes.[3]

Mobilizing Research for War

To gain a deeper understanding of crisis R&D problems, we first analyze the wartime research effort.[4] Initially formed in June 1940 as the National Defense

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Recurring themes in Gross' work include crisis innovation and its impacts on the innovation system; automation and its effects on firms, workers, and labor markets; and incentives and other tools for managing creative workers within organizations. His work frequently uses historical examples of industries undergoing significant technological change as contexts to investigate recurrent or modern economic questions.

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In addition to his work on World War II and crisis innovation, his current research studies pharmaceutical patent policy, innovation, and access to medicines in the United States and globally; the roles of the government in pharmaceutical innovation; and the history and political economy of the National Institutes of Health.

Research Committee, proposed by and led throughout the war by Vannevar Bush, OSRD grew from an eight-person nucleus to a 1,500-person, multibillion-dollar research funding agency enlisting and coordinating civilian science to address wartime R&D problems. Even before the US formally entered the war, it operated with urgency, but what began as a steady grind turned into a sprint after the bombing of Pearl Harbor.

Lacking precedent for an operation of this scale, OSRD improvised much of its structure and procedures as it evolved. The apparatus that emerged had several notable features. Its organizational form and routines balanced structure with flexibility. It had an explicitly applied focus, working closely with military partners to identify research priorities and contractors — primarily universities and privately owned companies — to work on them. It devised novel incentive mechanisms around patent policy and indirect cost recovery to encourage contractors' participation, and where necessary set up new research centers. Urgency also led OSRD to take on a major role in coordinating research efforts, handoffs to manufacturing, and diffusion. As Bush deputy James Conant wrote, "The basic problem of mobilizing science during World War II was the problem of setting up rapidly … organizations which would connect effectively the laboratory, the pilot plant, and the factory with each other and with the battlefront."[5]

Under this end-to-end approach, OSRD and its partners produced major advances in dozens of areas. These included foundational progress in radar, electrical communication and computing, jet propulsion, and atomic energy; antibiotics and applications to infectious disease; influenza and other vaccines; the malaria treatment chloroquine; new approaches to managing wartime hardships such as sleep and oxygen deprivation, cold temperatures, nutrient deficiency, and psychological stress; and new techniques for treating injuries and wounds. The most important innovation, however, may have been organizational: a new approach to harnessing science and technology to tackle big problems, to which we return below.

Effect of OSRD on Technology Cluster Patenting

Change in the number of patents produced by affected technology clusters, relative to 1930

The shaded region represents 95% confidence interval
Source: Gross D, Sampat B. NBER Working Paper 27375

Figure 1

Enduring Impacts on Innovation

Though its first-order impact was to help bring the war to a successful end, OSRD's impacts were broad and long lasting. One was its effect on the economic geography of American innovation. We find, and illustrate in Figure 1, that OSRD catalyzed technology hubs around the country, triggering decades-long growth in inventive output as well as downstream entrepreneurship and job growth in regions that were heavily engaged in wartime research — including the Boston/Route 128 and Silicon Valley high-tech regions, among others.[6]

A key residual question is why these effects were so long lived. Preliminary evidence suggests they were a result of self-reinforcing agglomerative forces rather than sustained postwar federal R&D investments, as they do not seem to vary with the intensity of local postwar government-funded patents.

We find similar long-run impacts in the biomedical sciences. Though medical research accounted for less than 5 percent of OSRD's budget, it set the stage for a postwar surge in drug development and changes in medical practice.[7] Both here and elsewhere, OSRD's work supported the incubation of new industries, from a research-intensive pharmaceutical industry to radar and microwave communications. In additional work with Maria P. Roche of Harvard Business School, we have examined the effects of OSRD's radar research program — operated primarily through a large new organization created during World War II to lead this effort, the MIT Radiation Laboratory — on industry development.[8] The Rad Lab created new collaborative structures that persisted long after the war ended, pioneering a new approach to science at scale ("Big Science") through large central laboratories. This project also set in place building blocks of emergent high-tech industries around radar and electronics, incubating a deep well of new technical knowledge, extensive human and organizational capital in a new field, manufacturing capabilities, and — crucially — an anchor customer in the military.

The war presented myriad other challenges to the US innovation system, among them protecting wartime technology from foreign enemies. To this end, Congress in 1940 gave the US Patent and Trademark Office authority to order that an invention in a patent applica-
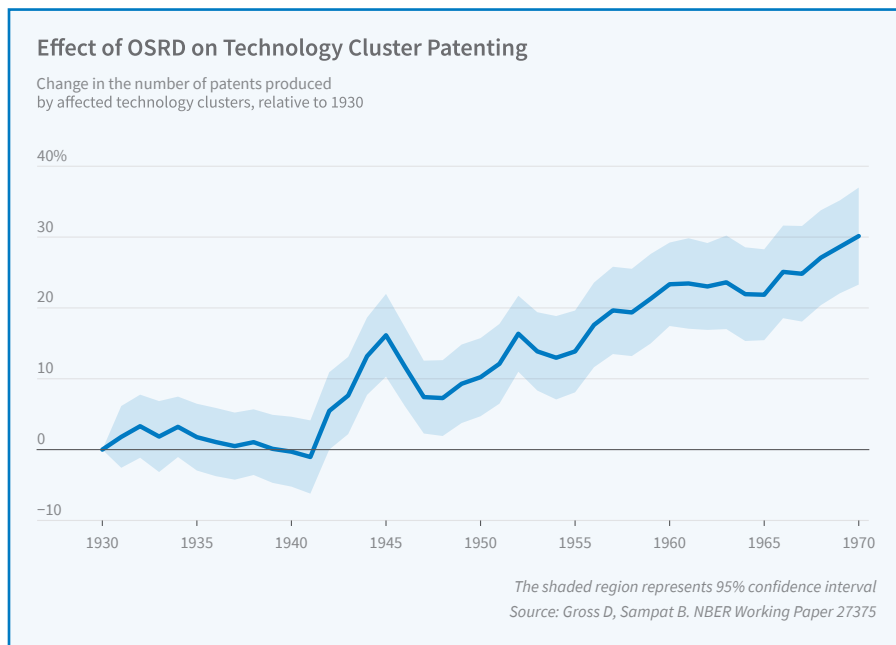
tion be kept secret, and to withhold patent rights and prohibit disclosure until that secrecy order was rescinded — an authority it retains today. Such orders were issued widely during the war, particularly in areas important to the war effort, including atomic energy, radar, cryptography, synthetic materials, and petroleum refining. At the war's height, more than half and in some cases 90 percent of patents in these technology areas were "going dark." Gross has examined the effects of compulsory secrecy on the functioning of the innovation system and found that it had wide-ranging impacts, driving implicated firms that were not government suppliers to pivot away from patenting in affected subjects, precluding commercialization, and impeding follow-on innovation — bringing into relief the key functions of intellectual property and openness in the US innovation system.[9] On the other hand, a range of evidence indicates that this policy achieved its intended effect of keeping sensitive technology out of the public view, underscoring basic tradeoffs between security and technological progress, whether in hot wars, cold wars, or peacetime.

The Birth of Modern Innovation Policy

OSRD also left a large imprint on innovation policy. This in part arose through a wide range of direct institutional legacies, including the seeds of postwar science-funding agencies and a network of federally funded research centers. Important, too, was Bush's vision. Near the end of the war President Franklin Roosevelt asked Bush to reflect on lessons from the wartime effort for postwar innovation policy, and Bush's response, a report to the president titled "Science, the Endless Frontier," famously made the case for government funding of basic research on the grounds of its high returns for economic growth, national security, and public health. Though many of the specific institutional features Bush advocated were not adopted — most notably his call for a single agency, a "National Research Foundation," focused on funding basic

research — the report has shaped innovation policy debates for the ensuing 75 years. It advanced a linear model of innovation — drawing a line from fundamental research to technology development to commercialization — and argued that research policy should focus on funding basic research, leaving applied endeavors to industry. The latter argument anticipated the Nelson-Arrow "market failure" rationale for funding basic research.[10]

Insights, Open Questions, and Unresolved Debates

Economics has a long tradition in studying innovation, but like the Bush report, this tradition emphasizes its role in advancing long-run economic growth and human welfare in peacetime through incremental technological progress. Yet crisis problems are big and immediate, and as World War II scientific leaders like Conant noted, crisis R&D must draw on "the basic knowledge at hand." Rather than promoting gains, crisis innovation policy aims to limit losses. Where modern peacetime R&D policy aims to address market failures by funding research that is unlikely to be efficiently provisioned in private markets, crisis R&D policy seeks technological solutions to specific problems. With distinct objectives, constraints, and time horizons, crises may require different economic and policy frameworks.[11]

What can be learned from the OSRD example for crisis innovation and other big R&D problems? In Bush's words, it "brought into being a pattern of administration … which stands as a richly suggestive guide for other undertakings."[12] One insight that emerged from comparing the problems for which the OSRD model may be relevant, and the problems for which it is incomplete or ill suited, is that OSRD was much broader than the Manhattan Project alone. More than a singular, focused moonshot, it was many moonshots pursued all at once, collectively managed from the center. Thus, though we agree with previous assessments that the Manhattan Project may only be relevant for specific classes of problems,[13] the

OSRD approach may be more broadly applicable to crises and other challenges when multiple urgent problems need solving. One example may be the COVID-19 pandemic.[14] The most successful piece of the COVID-19 response — the vaccine development effort under Operation Warp Speed — was explicitly modeled on the Manhattan Project. Yet the pandemic presented dozens of other problems that might have benefited from a coordinated R&D attack.

Many questions raised in and after World War II extend to peacetime. Postwar policy debates introduced a range of issues, including the role of government in basic versus applied research, the geographic distribution of research funding, and patent policy, motivated by concerns that OSRD had concentrated its programs too heavily in a handful of elite institutions and firms and had given away rights to taxpayer-funded invention. While Bush advocated funding basic research and the best science, with scientists guiding the funding choices, another camp — US Senator Harley Kilgore (D-WV) and his allies, for example — took a contrary view, including support for applied research, a broad geographic and institutional distribution of funding, and politicians and laypeople having a say in the research agenda.

These questions and tensions persist today. For example, the recently enacted CHIPS and Science Act adds an applied focus to the National Science Foundation, and earlier in 2022, Congress created the Advanced Research Projects Agency for Health, which may also provide funding for more applied research activities than the National Institutes of Health has typically supported. The CHIPS Act also aims to develop regional technology centers across the country, particularly in regions that have not historically been loci of research activity. Some critics of these efforts invoke arguments similar to those advanced by Bush, though an interesting question neither Bush nor Kilgore considered, but which has been raised by some scholars, is whether a broader distribution of resources might also broaden public support for science and govern-

ment R&D spending.[15]

A third set of unresolved questions relates to government patent policy. The rules governing intellectual property that were adopted by many agencies in the postwar era can be traced back to choices made by OSRD. While the 1980 Bayh-Dole Act universalized a policy of allowing recipients of government R&D funding to retain title to patents, Kilgorian criticisms of "giving away" government patent rights have resurfaced periodically since the war, including in current debates about high drug prices. These questions also came up during the pandemic around who should hold intellectual property rights on COVID-19 vaccines and therapeutics to which both the public and private sector had made contributions.[16] That these and other questions remain contentious points to the continued need for research on the science of science policy, with distinct but complementary views of crises and ordinary times.

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The Value of Intangible Capital

Janice Eberly

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Intangible capital has become a large and increasingly important part of firms' capital stocks and assets, especially over the last three decades. Intangibles include data, patents, copyrights, software, audio and video material, brands, and organization capital. Shares of these assets have risen while the share of physical capital, such as plant and equipment, has fallen, despite an increase in profitability and the return to business capital. This shift has occurred in concert with other major trends, including rising industry concentration and weak productivity growth. The research agenda on these trends that I describe in more detail below includes several coauthors, principally Nicolas Crouzet, and more recently, Andrea Eisfeldt and Dimitris Papanikolaou.

In addition to intangibles' increasing prevalence, we emphasize that they are also fundamentally different from physical capital. Usually, this difference is defined by their lack of physical presence, or intangibility. But that "lack" has important implications.

First, it has traditionally meant that intangibles are difficult to measure and often excluded from accounting frameworks. The difficulty in providing valuations from secondary markets, rapid and uncertain depreciation, and the potential for unexpected obsolescence all contribute to the measurement challenge. At the same time, investments in intangibles create lasting value; coding software, developing algorithms, collecting data, conducting research, and honing methods all incur current costs that create value in the future, which is the defining hallmark of investment.

Nonetheless, lacking a measure of capital, these costs are typically expensed for accounting purposes and the associated capital does not accumulate in firms' accounting data.[1] Thus, productive investment and capital were necessarily undermeasured. The US Bureau of Economic Analysis (BEA) has worked to overcome this deficit by measuring software, R&D, and artistic originals among a limited set of aggregate accounts on intangible capital in the National Income and Product Accounts. Researchers typically create their own firm-level intangible accounts by accumulating firm spending on intangibles into an estimated stock, using a capital accumulation equation, as is done for physical capital. In the research described below, we develop such estimates and compare them to the national accounts data to document and explore the role of intangibles. Figure 1 shows the rising share of intangibles in firm-level data and in the BEA aggregates, as a share of total capital.

The lack of physical presence means that intangibles may produce output differently than physical capital does. How does one use capital that lacks a physical presence? It must be represented or stored in some way, such as on paper or in a computer or server. But the information represented by the
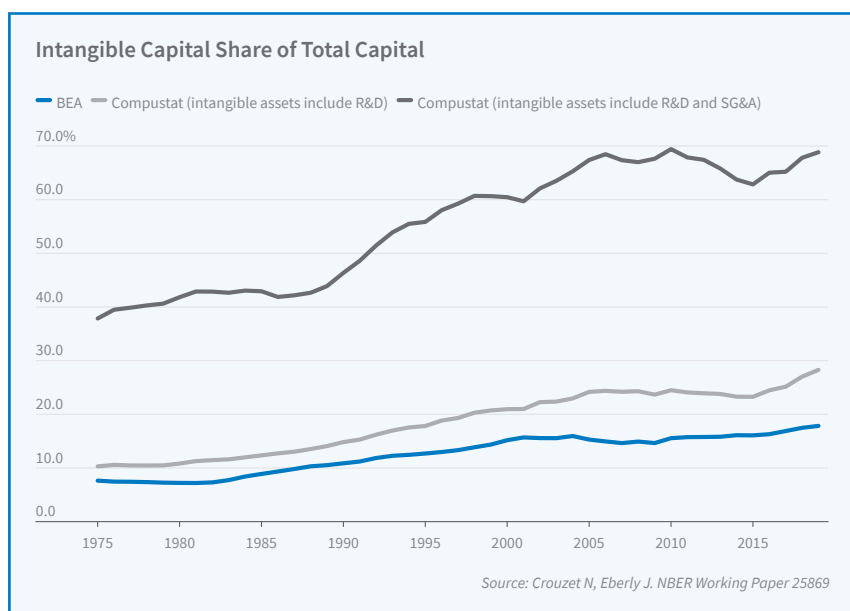

Intangible Capital Share of Total Capital

Source: Crouzet N, Eberly J. NBER Working Paper 25869

Figure 1

intangible can be used many times over — even simultaneously — without disrupting the original capital. This property — nonrivalry — makes it fundamentally different than physical capital. A machine tool cannot be used simultaneously in different factory locations. But a design blueprint, data, or software can. Nonrivalry gives rise to economies of scale and scope in intangibles that are not available to traditional physical capital.

This benefit has limits, however. The lack of physical presence also means that it can be harder to establish and protect ownership of intangibles. A machine tool can be locked in a factory or warehouse. Intangible capital, on the contrary, can be copied, often electronically or by word of mouth, by repeating ideas or data without ever taking physical possession, since it is not a physical asset. This inability to exclude other users erodes the value of the intangible, since it is hard to control its use exclusively. Hence, intangibles often have special protections through intellectual property rights, trademark laws, and noncompete clauses.

In early work to develop these ideas, Lewis Alexander and I showed that the pattern of investment mirrors the logic of labor "hollowing out" in the 2000s.[2] For industries that require a local presence, such as in energy and telecommunications, physical capital investment continued. However, investment shifted away from pro-

duction sectors that were often relocated abroad. But growth in high-cognitive sectors took a new form. Physical capital investment was lackluster, but investment in intangible capital grew. Industries such as high tech and health care saw rapid growth in earnings, profits, and valuations, but physical capital did not follow as it historically would have. Instead, intangibles became a larger share of the capital stock. Figure 2 shows the decline in physical capital investment at the aggre-

gate level, a trend opposite to that of the rise in intangibles in Figure 1.

This shift toward intangibles among some of the fastest-growing industries in the economy prompted a closer look at the role of intangible capital in aggregate investment and industry dynamics. Many of these industries have also seen increasing concentration, which could arise from market power or from productivity advantages among leading firms. In work with Crouzet on the retail sector, where there has been a long-standing trend toward greater concentration, we found that weaker physical capital investment and rising concentration were associated with rising productivity.[3] Moreover, this rising productivity was correlated with greater intangible investment, both over time and in subindustries.

We expanded on this theme in a paper for the Federal Reserve Bank of Kansas City's Jackson Hole Economic Symposium, where we showed that accounting for intangible capital can account for up to two-thirds of the unexpectedly low physical capital investment in the US since 2000.[4] Figure 3 shows the aggregate investment gap and the effect of controlling for intangible capital. Intangibles make up this gap in two ways. First, firms derive value from their entire capital stock, both physical and intangible. If intangibles generate value, then firm valuations, like Tobin's q, will appear too high compared to physical capital alone. Hence, adding measures of intangible capital to

Physical Capital Investment Rate

The two Compustat investment rates reported are the industry-wide average (dark gray line) and the ratio of industry total capital expenditures to industry total property, plant and equipment (light gray line). In the BEA data, investment is defined as the ratio of investment in physical assets to their replacement cost.

Source: Crouzet N, Eberly J. NBER Working Paper 25869

Figure 2

Economy-Wide Investment Gap

The shaded region covers -2 to +2 standard errors around the investment gap.

Source: Crouzet N, Eberly J. NBER Working Paper 25869

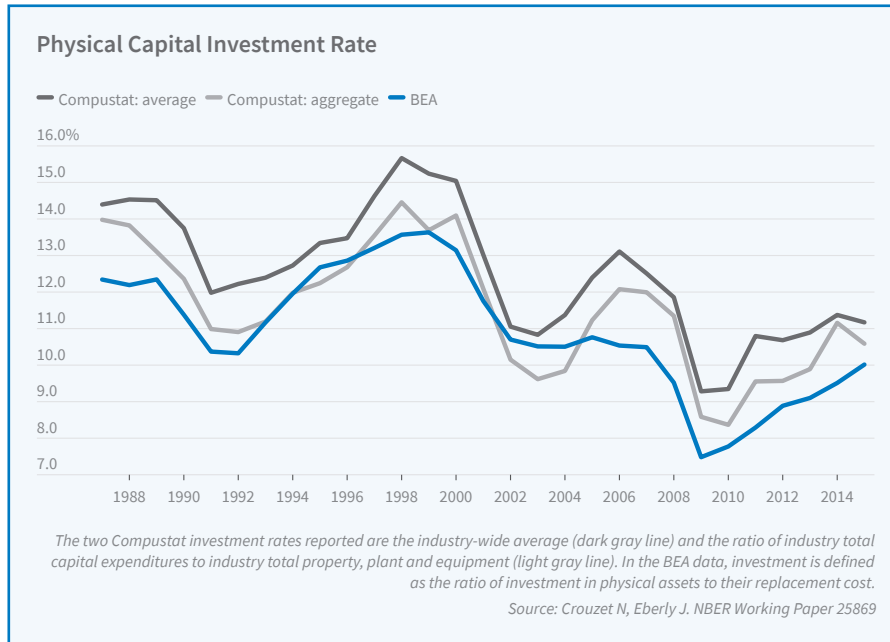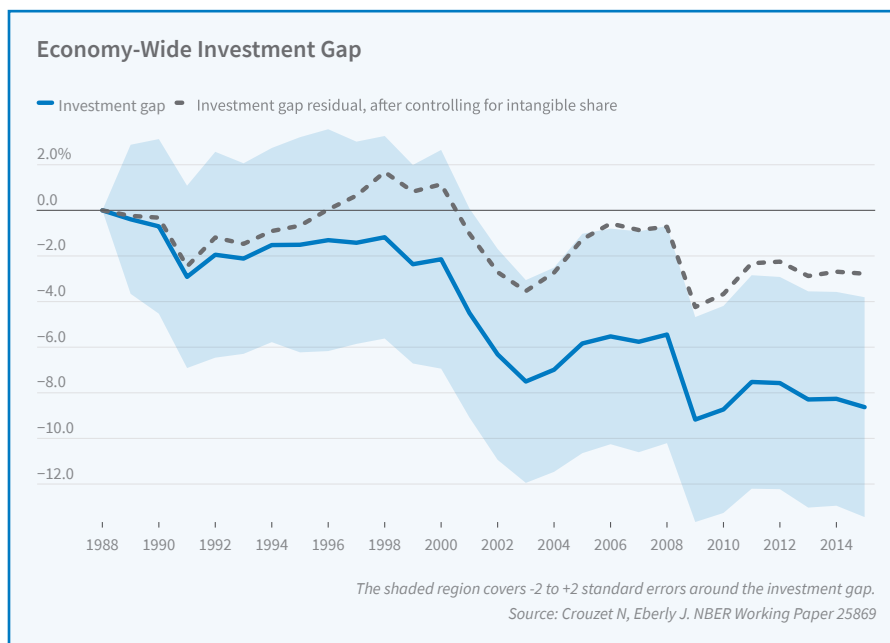**Figure 3**

the estimate fills the gap between firm value and physical capital investment. In addition, intangibles may result in higher productivity or market power. We find that the rising role of intangibles is most apparent in firms that lead their markets and increase their market share, and hence increase concentration. This shift is associated with higher productivity in some sectors, notably the consumer and retail sectors. However, evidence of rising market power is stronger in health care, which in our data is dominated by pharmaceutical and medical device firms.

The potential role of intangibles in productivity growth raises intriguing questions. Low productivity growth in the US has been a long-standing worry and a challenge to rising living standards. One suggestion to raise productivity growth is to increase investment. In another recent paper, Crouzet and I argue that the growth in intangibles and their relative prices leads to an understatement of productivity growth.[5] In addition, market power also causes mismeasurement of factor shares, which further contributes to underestimates of productivity. These two factors interact to produce an underestimate of productivity growth that can account for one-third to two-thirds of the observed decline. Hence, productivity may be growing faster than we think, but some of it goes to rents (market power) and some to the owners of intangible capital.

Since we find coincident roles for intangibles and market power, in further work we develop an investment model that includes both, which we call "Q+" since it is based on the Tobin's q model, developed by William Brainard and James Tobin and formalized by Fumio Hayashi.[6] We show formally that there is an interaction between intangible capital and market power that goes beyond their individual roles. Intangibles contribute to output, along with physical capital, on which the owners of the firm may earn rents when there is market power. Intangibles add to these rents, which increase the contribution of intangibles to firm value. Quantitatively, we show that firm value can be decomposed into these contributions. With a narrow measure of intangible assets based only on R&D, intangibles account for about a third of Tobin's q (measured in excess of its perfectly competitive, constant returns to scale value). However, with a broader estimate of intangibles, which includes organizational capital, intangibles account for two-thirds of firm valuation, with the remainder accounted for by market power. When broken down by sectors, the results confirm our

earlier empirical findings, though here with a structural estimation. The investment gap tends to be largest in high tech and health care, explained by the combination of intangibles and market power. Figure 4 shows the gap for the health-care sector, as an example, using only R&D as the measure of intangibles, and the roughly equal shares explained by intangibles and market power.

These studies suggest that intangible capital can explain some of the puzzling trends in macro data since the 1990s. The slowdown in physical capital investment is less surprising when much of firm value, particularly in fast-growing sectors, is accounted for by intangible capital instead. In addition,

some of the same sectors exhibit rising concentration. For some, leading firms thrive due to productivity advantages brought by intangible investments. For others, intangible capital may have brought productivity advantages, but leading firms also generate market power using patent protections, for example, to maintain the exclusivity of their intangibles, avert entry, and avoid competition.

Crouzet, Eisfeldt, Papanikolaou, and I show how these empirical observations can result from nonrivalry and excludability issues associated with intangibles.[7] We allow for either partial or complete nonrivalry of intangible capital. The standard model of rival capital, such as the machine tools mentioned earlier, is a special case, but more generally, intangibles can also be used across multiple production streams, such as different locations or products. If intangibles are completely nonrival, this occurs without incurring any distortions or losses. To the extent that intangibles are partially nonrival, there is some deterioration associated with using them in multiple production streams. But with at least some nonrivalry, this feature gives rise to economies of scale or scope. Importantly, firms' size and scope are complementary with nonrival intangibles: larger firms with a greater span of activity can use intangibles more effectively. This generates the productivity advantages of intangibles in leading firms that we observe in the data. We also allow for these advantages to be eroded if competitors imitate or copy the intangible once it is in use. This means that the ability to protect, or exclude, the intangible from use by other firms can protect market power and prevent entry. For example, a firm may have patent protection on an intangible and use it broadly across many locations

Investment Gap for Physical Capital in the Healthcare Sector

Enterprise value per unit of physical capital minus one

■ Rents attributable to physical capital ■ Intangibles ■ Rents attributable to intangibles

The "intangibles" category in the above decomposition is the presence of intangible capital in the value of the firm; the other two categories are due to the presence of rents in the value of the firm.

Source: Crouzet N, Eberly J. NBER Working Paper 28988, and forthcoming in Journal of Finance

Figure 4

while preventing other firms from using it.

These special properties of intangibles allow firms to essentially expand at will, at least in some dimensions. Jonathan Haskell, Paul Mizen, and I show that this turned out to be especially useful during the COVID-19 pandemic, when intangible capital played an important role in facilitating working from home.[8] Many firms and employees had remote work capacity even before the pandemic, since some workers traveled or worked periodically from home. When the pandemic struck, workers and firms with this capability pivoted quickly to remote work, using preexisting connectivity and capacity. Our data show that the share of workers working from home rose from less than one-tenth to about a third of the workforce by May 2020. Across industries, the share of workers working remotely is highly correlated with preexisting intangible capital payments from 2019. [See Figure 5.] This relationship is consistent with the capacity of intangible capital to be deployed across the span of the firm. In this case, intangibles such as information and communications technology facilitated continued employment and operations far beyond previous usage. But since intangibles are nonrival, they could be applied throughout the firm immediately when the need arose. We estimate this to have roughly halved the impact of the pandemic on GDP at the trough, by allowing firms with work-from-home capability the resilience to keep employees on the job and to continue operating.

Figure 5

Working from Home and Intangible Capital by Industry, 2020:Q3

Source: Eberly J, Haskel J, Mizen P. NBER Working Paper 29431

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[1] Accounting rules allow some intangible investments, such as the costs of internal software development, to be capitalized. But these remain the exception rather than the rule. R&D spending, one of the dominant forms of intangible investment, is expensed in accounting data.
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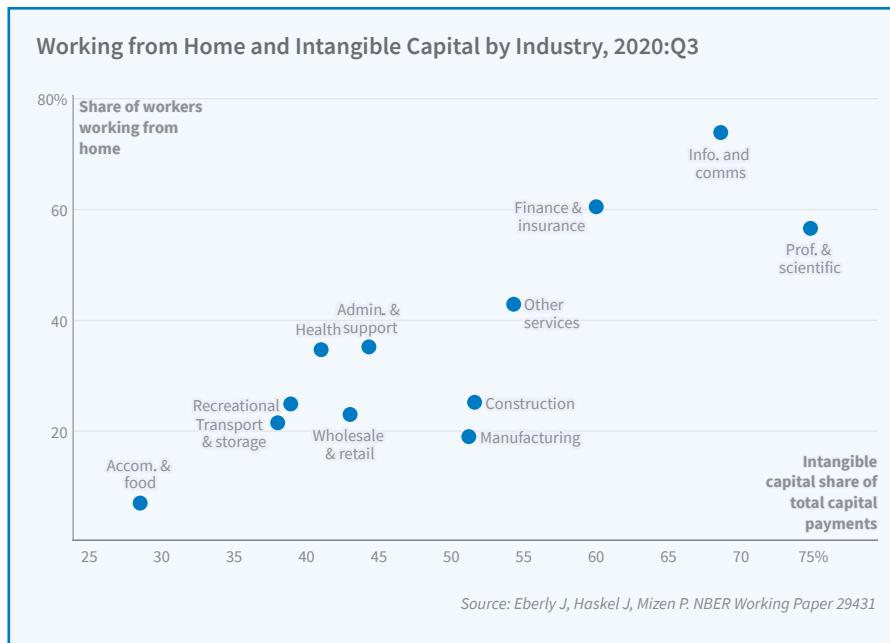Return to Text

International Tax Avoidance by Multinational Firms

Gabriel Zucman

A body of work documents profit-shifting behavior by multinational corporations. According to recent estimates, close to 40 percent of multinational profits — profits booked by firms outside of their headquarters' country — are shifted to tax havens.[1] US multinational companies appear to book a particularly large fraction of their foreign income in low-tax places.[2]

This phenomenon has attracted attention from economists and policy-makers. In 2015, the Organisation for Economic Co-operation and Development (OECD) and the G20 launched the Inclusive Framework on Base Erosion and Profit Shifting, with the goal of curbing tax avoidance possibilities stemming from mismatches between different countries' tax systems. In 2017, the United States reduced its corporate tax rate from 35 percent to 21 percent and introduced provisions to limit the erosion of the US tax base and tax some of the earnings booked by US multinationals abroad.

Recent research, however, suggests that these policies have so far made only a relatively small dent in profit shifting. More ambitious action — such as a coordinated minimum corporate income tax, to which more than 140 countries and territories committed in October 2021 — could reduce corporate profit shifting more significantly.

What Is the Scale of Global Profit Shifting?

Until recently, it was difficult to quantify global profit shifting due to a lack of data on the location of corporations' profits. Companies are generally not required to publish their profits and tax payments on a country-by-country basis.

Thomas R. Tørsløv, Ludvig S. Wier, and I attempt to address this gap by leveraging macroeconomic data known as foreign affiliates statistics.[3] These data record, among other information, the value added, wages, and profits of foreign firms — defined as firms more than 50 percent owned by foreign shareholders — in each country, including in the main tax havens. These are typically subsidiaries of foreign multinationals.

Using these data, we propose a simple method to infer profit shifting. By combining foreign affiliates statistics with national accounts data that cover foreign and local firms incorporated in each country, we estimate the profitability of foreign versus local firms in tax havens. Foreign firms turn out to be much more profitable than local firms in these territories. The ratio of pretax profits to wages is around 30 to 40 percent for local firms, but it is an order of magnitude larger for foreign firms — as high as 800 percent in Ireland. That is, for €1 of wages paid to Irish employees, foreign multinationals book €8 in pretax profits in Ireland, primarily reflecting profit shifting into the country.

Figure 1 shows that the excess profitability of foreign firms over local firms is specific to tax havens. The graph plots the difference between the profits-to-wages ratio of foreign and local firms against the country's effective corporate income tax rate in 2015. Bubble sizes are proportional to the amount of profit which we estimate is shifted. In high-tax countries, foreign firms tend to be slightly less profitable than local firms, while in tax havens — shown in blue in the figure — foreign firms are abnormally profitable.

Leveraging this differential profitability, we estimate that 36 percent of multinational profits are shifted to tax havens globally. US multinationals appear to shift more than half of their multinational profits, compared with about a quarter of profits for corporations headquartered in other countries.
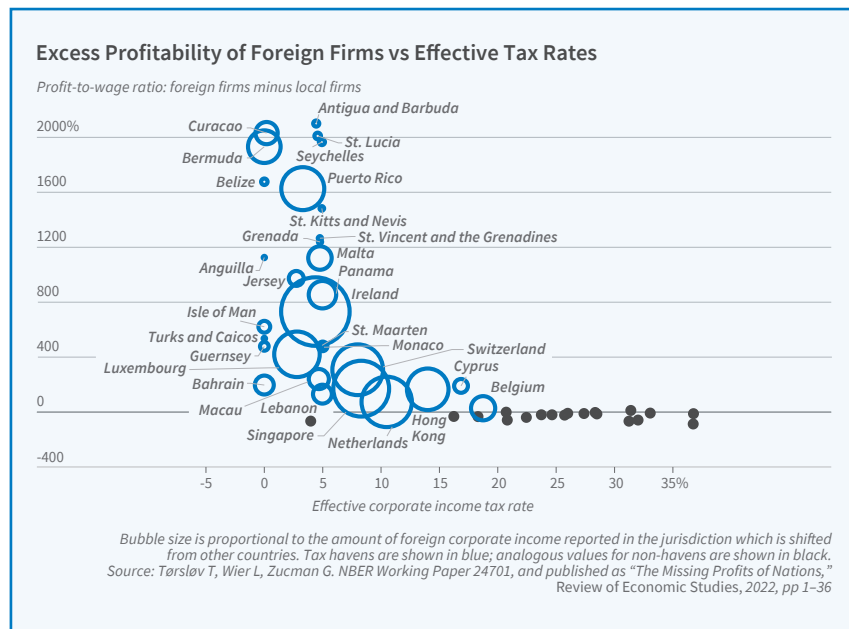

Excess Profitability of Foreign Firms vs Effective Tax Rates

Profit-to-wage ratio: foreign firms minus local firms

Bubble size is proportional to the amount of foreign corporate income reported in the jurisdiction which is shifted from other countries. Tax havens are shown in blue; analogous values for non-havens are shown in black.
Source: Tørsløv T, Wier L, Zucman G. NBER Working Paper 24701, and published as "The Missing Profits of Nations," Review of Economic Studies, 2022, pp 1–36

Figure 1

Did the Tax Cut and Jobs Act Reduce Profit Shifting by US Firms?

The Tax Cuts and Jobs Act, enacted at the end of 2017, dramatically changed the profit-shifting incentives of US corporations. The act lowered the US federal corporate income tax rate from 35 to 21 percent, reducing the gap between US and foreign rates. The US went from a worldwide tax system in which the foreign profits of US firms were, upon repatriation, subject to taxation in the United States, to a territorial tax system in which foreign profits are generally exempt from US taxes. The act also introduced three provisions to reduce incentives to shift profits to tax havens: a US tax on foreign income subject to low tax rates abroad; a reduced rate on foreign income derived from intangibles booked in the United States; and measures to limit the deductibility of certain payments that were suspected of being associated with strategies for shifting income out of the United States.

Javier Garcia-Bernardo, Petr Janský,

and I study the effect of this reform on the international allocation of US firms' profits.[4] Has the amount of profit booked in tax havens declined? And if so, are more profits booked by US companies in the United States or in other relatively high-tax countries? To address these questions, we combine and reconcile the publicly available data on the location of US firms'

profits, including survey data from the US Bureau of Economic Analysis, balance of payments data, and the public financial statements of listed companies. Two main findings emerge.

First, consistent with incentives introduced in the law, US corporations booked a larger share of their profits in the United

States after 2018 than before. This change, however, is relatively small: the share of profits booked domestically has increased by between 3 and 5 percentage points.

Second, the geographical allocation of the foreign profits of US multinationals does not appear to have been significantly affected by the act. The share of foreign profit booked in tax havens remained stable at around 50 percent between 2015 and 2020. Since the share of profits outside of the United States has only slightly declined — to about 27 percent for all US corporations — the share of total (domestic plus foreign) profits booked by US corporations in tax havens has remained between 13 and 15 percent, a historically high level, throughout the period [Figure 2].

This is not to say that the Tax Cuts and Jobs Act did not have any effect. Some firms changed their behavior, and in some cases the changes were dramatic. Six large listed companies — Alphabet, Microsoft, Facebook, Cisco, Qualcomm, and Nike — have decreased their declared foreign earnings by over 20 percentage points since 2018. A forensic analysis of these companies' financial statements shows this decline to be
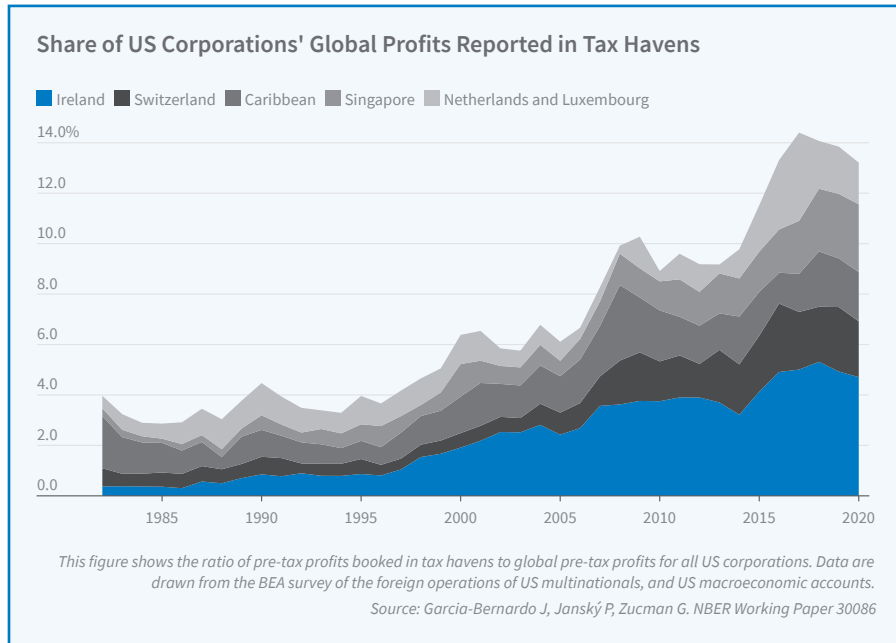

Share of US Corporations' Global Profits Reported in Tax Havens

Legend: Ireland, Switzerland, Caribbean, Singapore, Netherlands and Luxembourg

This figure shows the ratio of pre-tax profits booked in tax havens to global pre-tax profits for all US corporations. Data are drawn from the BEA survey of the foreign operations of US multinationals, and US macroeconomic accounts.

Source: Garcia-Bernardo J, Janský P, Zucman G. NBER Working Paper 30086

Figure 2

Gabriel Zucman is associate professor of economics at the University of California, Berkeley, director of the James M. and Cathleen D. Stone Center on Wealth and Income Inequality at UC Berkeley, and director of the EU Tax Observatory. An affiliate of the NBER's Public Economics Program, he is the author of articles published in journals such as *The Quarterly Journal of Economics*, *American Economic Review*, and *The Review of Economic Studies*, and has published two books.

Zucman's research focuses on the macroeconomic and distributional implications of globalization. In 2021 he was named an Andrew Carnegie Fellow. In 2019, he was awarded the Bernácer Prize and a Sloan Research Fellowship. He received the Excellence Award in Global Economic Affairs from the Kiel Institute for the World Economy in 2017, and the Best Young French Economist Prize awarded by *Le Monde* and Le Cercle des Économistes in 2018.

related to changes in profit shifting, more precisely to repatriation of intellectual property to the United States. These large firms' behaviors drive the macroeconomic decline in the share of US multinationals' profit booked outside the United States.

Transfer-Pricing Regulation and Tax Planning Services

Under the leadership of the OECD, many countries have implemented standardized regulations that strengthen information reporting with a view to curbing profit shifting. Evaluating these regulations is difficult, both because their introduction is often gradual and because researchers lack access to the necessary data.

Sebastián Bustos, Dina Pomeranz, Juan Carlos Suárez Serrato, José Vila-Belda, and I attempt to overcome these limitations by evaluating the effect of the transfer-pricing regulations introduced by Chile in 2011.[5] This reform expanded information reporting requirements on international transfers by multinationals, changed legislation to make it easier for the tax authority to enforce transfer-pricing rules, and increased resources devoted to the enforcement of these rules by the tax authority. It transformed Chile from a laggard to a leader in the implementation of OECD transfer-pricing standards.

Chile is a good laboratory to study the effect of transfer-pricing regulations because the Chilean authorities maintain detailed, high-quality administrative corporate tax data and customs data, which we were able to access for our analysis.

Our results suggest that the reform did not significantly reduce profit shifting. The propensity of multinationals to make tax-motivated payments to their foreign affiliates for intellectual property, interests, or services did not change. There is no evidence that the reform affected the prices of goods traded internally by multinational companies. Consistent with these results, corporate tax payments do not appear to have increased.

To better understand these results, we complement our quantitative analysis with in-depth interviews with transfer-pricing experts, including tax advisers from consulting firms and in-house accountants. These interviews reveal that the Chilean reform led to a surge in the demand for tax advisory services to comply with the new regulations. Providers of tax advisory services upsold clients additional tax planning services, leading to a boom in the employment of transfer-pricing experts in Chile. These results suggest that taking into account the supply of tax planning services is important for understanding the dynamic of tax compliance in general, and profit shifting in particular.

Changes Ahead?

Although recent policy initiatives do not appear to have had large effects on profit shifting, reforms that are currently being discussed may have more substantial effects. In October 2021, more than 140 countries and territories agreed to implement a minimum corporate income tax of 15 percent. Such an agreement — details of which are still being finalized — would mark a milestone because it would be the first international agreement constraining tax rates. Since the end of the 1990s, high-income countries have signed agreements to harmonize their corporate tax bases, but these agreements are silent regarding tax rates.

If well implemented, a minimum tax of this kind would remove incentives for countries to offer rates lower than 15 percent since these low rates would be offset by additional taxes owed in other countries, such as the headquarter country of a multinational company. This would reduce the incentive for firms to shift profits across national borders.

Some observers have noted that the proposed 15 percent rate is lower than what working-class and middle-class households typically pay in taxes in high-income countries. It is also lower than the average statutory rate that corporations face in those places. There is a chance that such a low reference point might trigger an additional reduction in statutory corporate tax rates, potentially reinforcing the race to the bottom with corporate taxation observed since the 1980s. Moreover, the agreement includes carveouts allowing corporations with sufficient activity in low-tax countries to be exempt from the minimum tax.

In an EU Tax Observatory report, Mona Barake, Paul-Emmanuel Chouc, Theresa Neef, and I show that the revenue potential of a minimum tax is large, but that revenues depend crucially on the rate chosen and on whether substantive carveouts are allowed.[6] In the United States, the European Union, and the main developing countries combined, a 25 percent minimum tax without carveouts could generate $575 billion per year in additional corporate income tax revenues — about four times as much as the current 15 percent agreement.

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Six New Directors Elected to NBER Board

Peter Hancock, Constance Hunter, Karin Kimbrough, Anne McCants, Andrew Racine, and Ann Huff Stevens were elected to the NBER Board of Directors at the board's September 2022 meeting.

Hancock is the former president and chief executive officer of American International Group, Inc. (AIG). His long career in the financial services industry focused on the measurement and management of risk in various market settings. Prior to joining AIG, he served as the chief financial officer and chief risk officer at JPMorgan, where he led the firm's fixed income unit and founded its global derivatives business. He was also vice chairman of KeyBank and a cofounder of Integrated Finance, Limited. Hancock received his undergraduate degree in politics, philosophy, and economics at the University of Oxford. He is currently a William Pitt Fellow of Pembroke College at the University of Cambridge. He will be an at-large board member.

Peter Hancock

Hunter, the representative of the National Association for Business Economics, is an executive vice president at AIG. She is the global head of strategy and environmental, social, and governance initiatives, with a particular focus on strategic opportunities associated with the transition to a cleaner energy future. Prior to joining AIG, she was the chief economist at KPMG. Hunter was an undergraduate economics and sociology major at New York University and holds an MA from the School of International and Public Affairs at Columbia University. She is a member of the board of directors of the National Association for Business Economics and served as the organization's president in 2019–20. She is a lifetime member of the Council on Foreign Relations.

Constance Hunter

Kimbrough, another at-large member, is the chief economist at LinkedIn, a leading online professional network, where she leads a team of economists and data scientists that focuses on the intersection of economics, markets, and policy. She previously served as assistant treasurer at Google, managing director and head of macroeconomic policy at Bank of America, and as a vice president of the Federal Reserve Bank of New York. Kimbrough received her undergraduate degree in economics from Stanford University, a master's in public policy with a focus on international economics from Harvard University's Kennedy School of Government, and her doctorate in economics from the University of Oxford. She is a member of the board of directors at Fannie Mae and serves on the Academic Advisory Council of the Federal Reserve Bank of Chicago.

Karin Kimbrough

McCants, who represents the Economic History Association on the NBER board, is the Ann F. Friedlaender Professor of History and a Margaret MacVicar Faculty Fellow at MIT. She is a past president of the International Economic History Association, vice president of the Social Science History Association, and a past vice president of the Economic History Association. She is editor of the *Journal of Interdisciplinary History*. McCants' research focuses on historical demography, early modern trade and consumption, the provision of charity, and the links between economic growth and living standards. She received a doctorate in history from the University of California, Berkeley, a master's in economics from the University of California, Los Angeles, and an undergraduate degree in economics and European studies from Mount Holyoke College.

Anne McCants

Racine is a system senior vice president and chief medical officer at the Montefiore Health System in the Bronx, New York, and a professor of pediatrics at Albert Einstein College of Medicine. A pediatrician and economist, he has carried out research on the contribution of economic factors such as poverty to the health status of infants, children, and adolescents. He is a former member of the national Committee on Child Health Financing of the American Academy of Pediatrics (AAP) and chaired the AAP's task force on poverty and child health. Racine received his PhD in economics and his MD from New York University, and his undergraduate degree from Harvard College. He completed his internship and residency in pediatrics at Boston Children's Hospital.

Andrew Racine

Stevens, the inaugural representative of The University of Texas at Austin on the NBER board, serves as dean of the College of Liberal Arts and holds the David Bruton, Jr. Regents Chair in Liberal Arts. She was previously a faculty member and chair of the Department of Economics and founding director of the Center for Poverty Research at the University of California, Davis. Stevens' research focuses on labor economics. She has analyzed the effects of job loss on workers and their family members as well as the dynamics of poverty spells. Stevens earned her undergraduate degree in economics and political science from American University and her doctorate in economics from the University of Michigan. She was a faculty member at Rutgers University and at Yale University before her move to the University of California, Davis.

Ann Huff Stevens

In addition to these new appointments, the NBER board elected three long-serving members, George Eads, Jacob Frenkel, and Laurence Meyer, to emeritus status.

Elizabeth E. Bailey, 1938–2022

Elizabeth Bailey, who joined the NBER board of directors in 1993, served as vice-chair of the board in 2002–05 and as chair in 2005–08, and became an emeritus member in 2020, passed away August 19 after a long battle with Parkinson's disease. She was 83.

An expert on regulatory economics and industrial organization, Bailey was a pioneer on many dimensions. After graduating from Radcliffe College, she worked as a technical programmer at Bell Laboratories for more than a decade. She was attracted to economics, and earned a master's degree in economics from the Stevens Institute of Technology followed by a PhD from Princeton University, where she was the first woman doctoral graduate in economics. She subsequently joined, and led, Bell Labs' Economic Research Department.

Bailey was appointed a commissioner of the Civil Aeronautics Board in 1977 and played a central role in the deregulation of the US airline industry. Later, she joined the faculty at the Graduate School of Industrial Administration at Carnegie Mellon University, first as a professor and then as dean. In 1991, she moved to the Business Economics and Public Policy Department at the Wharton School at the University of Pennsylvania, where she was the John C. Hower Professor of Business and Public Policy, emeritus at the time of her death.

Bailey was a trustee of the Brookings Institution and Princeton University and served as a board member at Altria, CSX, and TIAA-CREF. In 2009, the American Economic Association's Committee on the Status of Women in the Economics Profession honored her with the Carolyn Shaw Bell Award, which recognizes leadership in promoting the status of women in the economics profession.

NBER Directors Appoint 38 Research Associates

The NBER Board of Directors appointed 38 research associates, 36 of whom were promoted from faculty research fellows, at its September 2022 meeting. 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 24 different colleges and universities; they received graduate training at 16 different institutions. The names and universities of the new research associates and their primary NBER program affiliations are listed below.

Elizabeth Ananat	Columbia University	Children
Natalie Bau	University of California, Los Angeles	Economics of Education
Peter Bergman	University of Texas at Austin	Economics of Education
Emily Breza	Harvard University	Development Economics
Mariana Carrera	Montana State University	Health Economics
David Chan	Stanford University	Health Care
Gabriel Chodorow-Reich	Harvard University	Monetary Economics
Wenxin Du	University of Chicago	Asset Pricing
Itzik Fadlon	University of California, San Diego	Economics of Aging
Peter Ganong	University of Chicago	Public Economics
Kinda Cheryl Hachem	University of Virginia	Monetary Economics
Martin Hackmann	University of California, Los Angeles	Health Care
Jessie Handbury	University of Pennsylvania	International Trade and Investment
Samuel Hartzmark	Boston College	Asset Pricing
Alex Hollingsworth	Indiana University	Health Economics
Sabrina Howell	New York University	Productivity, Innovation, and Entrepreneurship
Nir Jaimovich	University of California, San Diego	Economic Fluctuations and Growth
Ruixue Jia	University of California, San Diego	Political Economy
Eliana La Ferrara	Harvard University	Development Economics
Matt Marx	Cornell University	Productivity, Innovation, and Entrepreneurship
Kyle Meng	University of California, Santa Barbara	Environment and Energy Economics
Conrad Miller	University of California, Berkeley	Labor Studies
Antony Millner	University of California, Santa Barbara	Environment and Energy Economics

Athey and Marinescu Take Leave for Antitrust Posts at Department of Justice

Susan Athey

Two NBER research associates have been tapped for leadership positions in the Antitrust Division of the US Department of Justice.

Susan Athey, an affiliate of the Industrial Organization Program, is serving as chief economist, and Ioana Marinescu, a Labor Studies Program affiliate, is principal economist.

Athey is the Economics of Technology Professor at the Graduate School of Business, and a professor of economics, at Stanford University. Marinescu is an associate professor at the University of Pennsylvania School of Social Policy and Practice. Both researchers will be on leave from the NBER for the duration of their government service.

Ioana Marinescu

Two Research Associates Nominated for Treasury Department Posts

Brent Nieman

Brent Nieman, a research associate in the International Finance and Macroeconomics (IFM) and International Trade and Investment programs, has been nominated for the position of Deputy Under Secretary for International Finance and Development, and Jay Shambaugh, also an affiliate of the IFM program, has been nominated to be Under Secretary for International Affairs, at the US Department of the Treasury.

Nieman is the Edward Eagle Brown Professor of Economics and William Ladany Faculty Scholar at the Booth School of Business at the University of Chicago. Shambaugh is professor of economics and international affairs at the Elliott School of International Affairs at George Washington University. Both will be on leave from the NBER for the duration of their government service.

Jay Shambaugh

Stange and Turner Join US Department of Education

Kevin Stange

Kevin Stange and Lesley Turner, both affiliates of the Economics of Education Program, have joined the newly created Office of the Chief Economist at the US Department of Education. This office is tasked with "conducting rigorous research to further key elements of the Department's learning agenda."

Stange, an associate professor of public policy at the University of Michigan's Gerald R. Ford School of Public Policy, and Turner, an associate professor of economics at Vanderbilt University, will be on leave from the NBER for the duration of their government service.

Lesley Turner

Conferences

International Seminar on Macroeconomics

The International Seminar on Macroeconomics took place June 20–21 in Athens, Greece. Research Associate Kristin Forbes of the Massachusetts Institute of Technology, Research Associate (on leave) Pierre-Olivier Gourinchas of the University of California, Berkeley and the International Monetary Fund, and Ricardo Reis of the London School of Economics organized the meeting. These researchers' papers were presented and discussed:

- **Luís Fonseca**, European Central Bank, and **Katerina Nikalexi** and **Elias Papaioannou**, London Business School, "The Globalization of Corporate Control"

- **Linda S. Goldberg**, Federal Reserve Bank of New York and NBER, and **Signe Krogstrup**, Bank of Denmark, "International Capital Flow Pressures and Global Factors"

- **Grace Weishi Gu**, University of California, Santa Cruz, and **Galina Hale**, University of California, Santa Cruz and NBER, "Climate Risk and FDI"

- **Marta A. Santamaría**, University of Warwick; **Jaume Ventura**, CREI, Universitat Pompeu Fabra, and NBER; and **Uğur Yeşilbayraktar**, Universitat Pompeu Fabra, "Exploring European Regional Trade"

- **Olivier Jeanne**, Johns Hopkins University and NBER, and **Damiano Sandri**, International Monetary Fund, "Global Financial Cycle and Liquidity Management" (NBER Working Paper 27901)

- **Alberto Cavallo**, Harvard University and NBER, and **Oleksiy Kryvtsov**, Bank of Canada, "What Can Stockouts Tell Us about Inflation? Evidence from Online Micro Data" (NBER Working Paper 29209)

- **Zhen Huo**, Yale University; **Andrei A. Levchenko**, University of Michigan and NBER; and **Nitya Pandalai-Nayar**, University of Texas at Austin and NBER, "Utilization-Adjusted TFP across Countries: Measurement and Implications for International Comovement" (NBER Working Paper 26803)

- **George A. Alessandria**, University of Rochester and NBER; **Shafaat Y. Khan**, The World Bank; **Armen Khederlarian**, University of Connecticut; **Carter B. Mix**, Federal Reserve Board; and **Kim J. Ruhl**, University of Wisconsin-Madison and NBER, "The Aggregate Effects of Global and Local Supply Chain Bottlenecks: 2020–2022"

Summaries of some of these papers are available at www.nber.org/conferences/international-seminar-macroeconomics-2022

Distributional Consequences of New Energy Technologies

A conference on Distributional Consequences of New Energy Technologies took place June 23–24 in Cambridge, MA and online. Research Associates Catherine Hausman of the University of Michigan and Arik Levinson of Georgetown University organized the meeting, which was supported by Alfred P. Sloan Foundation grant #2020-14025. These researchers' papers were presented and discussed:

- **Jackson Dorsey**, Indiana University, and **Derek C. Wolfson**, University of California, Berkeley, "Income and Racial Disparities in Markets for New Energy Technologies"

- **Andrew R. Waxman** and **Sheila Olmstead**, University of Texas at Austin, "Measuring the Welfare and Distributional Effects of Co-benefits of Carbon Capture, Utilization, and Storage Technology"

- **Dallas Burtraw**, **Maya Domeshek**, **Christoph Funke**, **Daniel L. Shawhan**, and **Steven Witkin**, Resources for the Future, and **Burçin Ünel** and **Ana Varela Varela**, New York University, "Distributional Impacts of Carbon Capture Technology"

- **Jonathan M. Colmer**, University of Virginia, and **John L. Voorheis**, US Census Bureau, "The Distributional Consequences of the Clean Energy Transition"

- **Josh Blonz** and **Erin E. Troland**, Federal Reserve Board, and **Brigitte Roth Tran**, Federal Reserve Bank of San Francisco, "The Canary in the Coal Decline: Appalachian Household Finance and the Transition from Fossil Fuels"

- **Cuicui Chen**, **Chunyu Guo**, and **Daiqiang Zhang**, State University of New York, Albany, "Distributional Consequences of Electrifying the Trucking Industry"

- **Gautam Gowrisankaran**, Columbia University and NBER; **Ashley Langer**, University of Arizona and NBER; and **Konan Hara**, University of Arizona, "Regulating Power Plant Emissions: Environmental Justice, Enforcement, and Regulator Priorities"

- **Irene Jacqz**, Iowa State University, and **Sarah Johnston**, University of Wisconsin-Madison, "Staggered Electric Vehicle Adoption, Air Pollution Disparities, and Subsidy Policy"

Summaries of some of these papers are available at
www.nber.org/conferences/distributional-consequences-new-energy-technologies-spring-2022

COVID-19 and Health Outcomes

A conference on COVID-19 and Health Outcomes took place June 24 online. NBER affiliates Marcella Alsan of Harvard University, Maria Polyakova of Stanford University, and Kosali I. Simon of Indiana University organized the meeting, which was supported by the National Institute on Aging. These researchers' papers were presented and discussed:

- **Brian McGarry**, University of Rochester; **Ashvin Gandhi**, University of California, Los Angeles; and **Michael L. Barnett**, Harvard University, "Does SARS-CoV-2 Surveillance Testing Prevent COVID-19 Transmission? Evidence from the US Nursing Home Industry"

- **Sherry A. Glied**, New York University and NBER, and **Renata Howland** and **Ingrid Ellen**, New York University, "Demons of Density: Do Higher-Density Environments Put People at Greater Risk of Contagious Disease?"

- **Joshua D. Gottlieb**, University of Chicago and NBER, and **Avi Zenilman**, Yale University, "When Nurses Travel: Labor Supply Responses to Peak Demand for Nurses"

- **Erkmen G. Aslim**, Grand Valley State University; **Wei Fu** and **Chia-Lun Liu**, University of Pennsylvania; and **Erdal Tekin**, American University and NBER, "Vaccination Policy, Delayed Care, and Health Expenditures" (NBER Working Paper 30139)

- **Christopher J. Ruhm**, University of Virginia and NBER, "The Evolution of Excess Deaths in the United States during the First Two Years of the COVID-19 Pandemic"

- **Kosali I. Simon**; **Sumedha Gupta** and **Coady Wing**, Indiana University; and **Kate Bundorf**, Duke University and NBER, "Social Isolation and Delayed Alzheimer's Disease and Related Dementias Diagnosis during the COVID-19 Era"

Summaries of some of these papers are available at www.nber.org/conferences/covid-19-and-health-outcomes-spring-2022

Big Data and High-Performance Computing for Financial Economics

A conference on Big Data and High-Performance Computing for Financial Economics took place July 16 in Cambridge and online. Research Associates Toni Whited of the University of Michigan and Mao Ye of Cornell Johnson Graduate School of Management organized the meeting, which was supported by the National Science Foundation. These researchers' papers were presented and discussed:

- **Marco Di Maggio**, Harvard University and NBER; **Dimuthu Ratnadiwakara**, Louisiana State University; and **Don Carmicheal**, Upstart, "Invisible Primes: Fintech Lending with Alternative Data" (NBER Working Paper 29840)

- **Rui Da** and **Dacheng Xiu**, University of Chicago, and **Stefan Nagel**, University of Chicago and NBER, "The Statistical Limit of Arbitrage"

- **Ron Kaniel**, University of Rochester; **Zihan Lin** and **Markus Pelger**, Stanford University; and **Stijn Van Nieuwerburgh**, Columbia University and NBER, "Machine-Learning the Skill of Mutual Fund Managers" (NBER Working Paper 29723)

- **Ran Chang**, Shanghai Jiao Tong University, and **Zhi Da**, University of Notre Dame, "The Dark Side of the Cloud"

- **Cheng Luo**, Farallon Capital Management; **Enrichetta Ravina**, Federal Reserve Bank of Chicago; **Marco C. Sammon**, Harvard University; and **Luis M. Viceira**, Harvard University and NBER, "Retail Investors' Contrarian Behavior around News, Attention, and the Momentum Effect"

- **Bhagath Cheela** and **André DeHon**, University of Pennsylvania; **Jesús Fernández-Villaverde**, University of Pennsylvania and NBER; and **Alessandro Peri**, University of Colorado Boulder, "Programming FPGAs for Economics: An Introduction to Electrical Engineering Economics" (NBER Working Paper 29936)

- **Thomas Ernst**, University of Maryland, and **Chester S. Spatt**, Carnegie Mellon University and NBER, "Payment for Order Flow and Asset Choice" (NBER Working Paper 29883)

- **Utku A. Acikalin**, TOBB University of Economics and Technology; **Tolga Caskurlu**, University of Amsterdam; **Gerard Hoberg**, University of Southern California; and **Gordon M. Phillips**, Dartmouth College and NBER, "Intellectual Property Protection Lost and Competition: An Examination Using Machine Learning"

Summaries of some of these papers are available at
www.nber.org/conferences/big-data-and-high-performance-computing-financial-economics

Wage Dynamics in the 21st Century

A conference on Wage Dynamics in the 21st Century took place in Cambridge and online September 16–17. Research Associates Erik Hurst of the University of Chicago and Lisa B. Kahn of the University of Rochester organized the meeting, which was supported by the Smith Richardson Foundation. These researchers' papers were presented and discussed:

- **Eliza Forsythe**, University of Illinois at Urbana-Champaign, "The Effect of Minimum Wage Policies on the Wage and Occupational Structure of Establishments"

- **Mark Bils**, University of Rochester and NBER; **Marianna Kudlyak**, Federal Reserve Bank of San Francisco; and **Paulo C. Lins**, University of Rochester, "The Quality-Adjusted Cyclical Price of Labor"

- **Stephane Bonhomme**, University of Chicago; **Kerstin Holzheu**, Sciences Po; **Thibaut Lamadon** and **Magne Mogstad**, University of Chicago and NBER; Elena Manresa, New York University; and Bradley Setzler, Pennsylvania State University and NBER, "How Much Should We Trust Estimates of Firm Effects and Worker Sorting?" (NBER Working Paper 27368)

- **Elizabeth Weber Handwerker**, US Bureau of Labor Statistics, "Outsourcing, Occupationally Homogeneous Employers, and Growing Wage Inequality in the United States"

- **Daron Acemoglu**, Massachusetts Institute of Technology and NBER, and **Pascual Restrepo**, Boston University and NBER, "Tasks, Automation, and the Rise in US Wage Inequality" (NBER Working Paper 28920)

- **Isaac Sorkin**, Stanford University and NBER, and **Melanie Wallskog**, Duke University, "The Slow Diffusion of Earnings Inequality"

- **José María Barrero**, Instituto Tecnológico Autónomo de México; **Nicholas Bloom**, Stanford University and NBER; and **Steven J. Davis**, University of Chicago and NBER, "Long Social Distancing"

- **Austan Goolsbee** and **Chad Syverson**, University of Chicago and NBER, "Monopsony Power in Higher Education: A Tale of Two Tracks" (NBER Working Paper 26070)

- **John C. Haltiwanger**, University of Maryland and NBER; **Henry R. Hyatt**, US Census Bureau; and **James Spletzer**, US Census Bureau, retired, "Sources of Increasing Earnings Inequality: Reconciling Survey and Administrative Data"

- **Sadhika Bagga**, University of Texas at Austin, "Firm Market Power, Worker Mobility, and Wages in the US Labor Market"

Summaries of some of these papers are available at www.nber.org/conferences/wage-dynamics-21st-century-fall-2022

Tax Policy and the Economy

A conference on Tax Policy and the Economy met in Washington, DC, on September 22. Research Associate Robert A. Moffitt of Johns Hopkins University organized the meeting, which was supported by the Lynde and Harry Bradley Foundation. Dr. Cecilia Rouse, the Chair of the Council of Economic Advisers, delivered a luncheon address. These researchers' papers were presented and discussed:

- **David Altig**, Federal Reserve Bank of Atlanta; **Laurence J. Kotlikoff**, Boston University and NBER; and **Victor Yifan Ye**, Boston University, "How Much in Social Security Benefits Are Americans Leaving on the Table?"

- **Mark Duggan**, Stanford University and NBER; **Audrey Guo**, Santa Clara University; and **Andrew Johnston**, University of California, Merced and NBER, "Unemployment Insurance Taxation and Labor Demand"

- **Jonathan Meer**, Texas A&M University and NBER, and **Joshua Witter**, Amazon, "Effects of the Earned Income Tax Credit for Childless Adults: A Regression Discontinuity Approach"

- **Edward L. Glaeser**, Harvard University and NBER; **Caitlin S. Gorback**, University of Texas at Austin; and **James M. Poterba**, Massachusetts Institute of Technology and NBER, "The Distributional Burden of Fuel Taxes and Transportation User Fees"

- **Katarzyna A. Bilicka**, Utah State University and NBER, and **Michael P. Devereux** and **Irem Guceri**, University of Oxford, "Tax Avoidance Networks and the Push for a 'Historic' Global Tax Reform"

Summaries of some of these papers are available at www.nber.org/conferences/tax-policy-and-economy-2022

Economics of Artificial Intelligence

A conference on the Economics of Artificial Intelligence took place in Toronto September 22–23. Research Associates Ajay K. Agrawal, Joshua S. Gans, and Avi Goldfarb of the University of Toronto and Catherine Tucker of the Massachusetts Institute of Technology organized the meeting, which was supported by the Alfred P. Sloan Foundation. These researchers' papers were presented and discussed:

- **Ganesh Iyer**, University of California, Berkeley, and **Tony Ke**, Chinese University of Hong Kong, "Competitive Algorithmic Targeting and Model Selection"

- **Himabindu Lakkaraju**, Stanford University, and **Chiara Farronato**, Harvard University and NBER, "When Algorithms Explain Themselves: AI Adoption and Accuracy of Experts' Decisions"

- **Daniel Rock**, **Prasanna Tambe**, and **Zhiwei Wang**, University of Pennsylvania, "Technological Complements to AI Growth"

- **Martino Banchio** and **Andrzej Skrzypacz**, Stanford University, "Artificial Intelligence and Auction Design"

- **Ashesh Rambachan**, Harvard University, "Identifying Prediction Mistakes in Observational Data"

- **Ron Yang**, Stanford University, "(Don't) Take Me Home: Home Bias and the Effect of Self-Driving Trucks on Interstate Trade"

- **Lindsey R. Raymond** and **Danielle Li**, Massachusetts Institute of Technology, and **Erik Brynjolfsson**, Stanford University and NBER, "Augmented Intelligence: The Effects of AI on Productivity and Work Practices"

- **Ariel Dora Stern**, Harvard University, "AI and Health Regulation"

- **David M. Cutler**, Harvard University and NBER; and **Nikhil Sahni**, **George Stein**, and **Rodney Zemmel**, McKinsey & Company, "AI to Reduce Administrative Costs in Health Care"

- **James J. Feigenbaum**, Boston University and NBER, and **Daniel P. Gross**, Duke University and NBER, "Organizational Frictions and Increasing Returns to Automation: Lessons from AT&T in the Twentieth Century" (NBER Working Paper 29580)

- **Tania Babina**, Columbia University; **Alex X. He**, University of Maryland; **Anastassia Fedyk**, University of California, Berkeley; and **James Hodson**, AI for Good, "Artificial Intelligence, Firm Growth, and Product Innovation"

- **Maria D. Fitzpatrick**, Cornell University and NBER, and **Katharine Sadowski** and **Christopher Wildeman**, Cornell University, "Does Access to an Algorithmic Decision-Making Tool Change Child Protective Service Caseworkers' Investigation Decisions?"

- **Ziad Obermeyer**, University of California, Berkeley and NBER, and **Sendhil Mullainathan**, University of Chicago and NBER, "Health Data Platforms"

- **David Dranove**, Northwestern University, and **Craig Garthwaite**, Northwestern University and NBER, "Artificial Intelligence, the Evolution of the Health Care Value Chain, and the Future of the Physician"

Summaries of some of these papers are available at www.nber.org/conferences/economics-artificial-intelligence-conference-fall-2022

Program Meeting

Economic Fluctuations and Growth

Members of the NBER's Economic Fluctuations and Growth Program met July 16 in Cambridge and online. Program Directors Mark Gertler of New York University and Peter J. Klenow of Stanford University organized the meeting. These researchers' papers were presented and discussed:

- **Jane Olmstead-Rumsey**, Federal Reserve Bank of Minneapolis, "Market Concentration and the Productivity Slowdown"

- **Christian K. Wolf**, Massachusetts Institute of Technology and NBER, and **Alisdair McKay**, Federal Reserve Bank of Minneapolis, "What Can Time-Series Regressions Tell Us about Policy Counterfactuals?"

- **David W. Berger**, Duke University and NBER; **Kyle F. Herkenhoff**, University of Minnesota and NBER; and **Simon Mongey**, University of Chicago and NBER, "Minimum Wages, Efficiency, and Welfare" (NBER Working Paper 29662)

- **Alessandra Peter**, New York University, and **Gideon Bornstein**, University of Pennsylvania, "Nonlinear Pricing and Misallocation"

- **Benjamin Jones**, Northwestern University and NBER, and **Xiaojie Liu**, Northwestern University, "A Framework for Economic Growth with Capital-Embodied Technical Change"

- **Adrien Auclert**, Stanford University and NBER; **Rodolfo D. Rigato**, Harvard University; **Matthew Rognlie**, Northwestern University and NBER; and **Ludwig Straub**, Harvard University and NBER, "New Pricing Models, Same Old Phillips Curves?" (NBER Working Paper 30264)

Summaries of these papers are available at www.nber.org/conferences/economic-fluctuations-and-growth-program-meeting-summer-2022

NBER Books

Measuring Distribution and Mobility of Income and Wealth

Raj Chetty, John N. Friedman, Janet C. Gornick, Barry Johnson, and Arthur Kennickell, editors
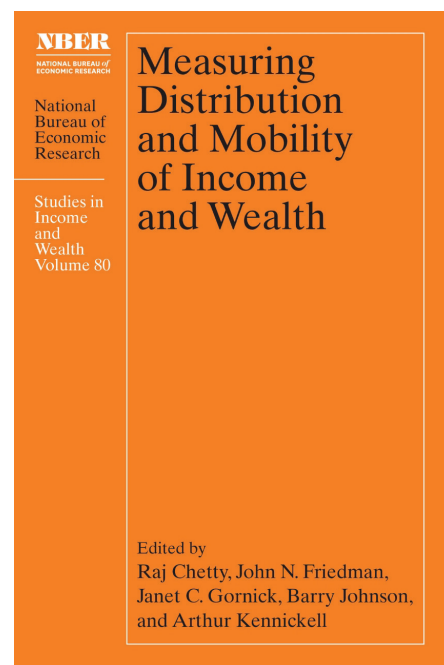https://press.uchicago.edu/ucp/books/book/chicago/M/bo181479073.html

Economic research is increasingly focused on inequality in the distribution of personal resources and outcomes. One aspect of inequality is mobility: are individuals locked into their respective places in this distribution? To what extent do circumstances change, either over the life-cycle or across generations? Research not only measures inequality and mobility, but also analyzes the historical, economic, and social determinants of these outcomes, and the effect of public policies.

This volume explores the latest developments in the analysis of income and wealth distribution and mobility.

The collection of 23 studies is divided into five sections. The first examines observed patterns of income inequality and shifts in the distribution of earnings and in other factors that contribute to it. The next examines wealth inequality and includes a substantial discussion of the difficulties of defining and measuring wealth. The third section presents new evidence on the intergenerational transmission of inequality and the mechanisms that underlie it. The next section considers the impact of various policy interventions that are directed at reducing inequality. The final section addresses the challenges of combining household-level data, potentially from multiple sources such as surveys and administrative records, and aggregate data to study inequality, and explores ways to make survey data more comparable with national income accounts data.

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NATIONAL BUREAU of ECONOMIC RESEARCH

National Bureau of Economic Research

Studies in Income and Wealth Volume 80

Measuring Distribution and Mobility of Income and Wealth

Edited by
Raj Chetty, John N. Friedman,
Janet C. Gornick, Barry Johnson,
and Arthur Kennickell

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