

The Digest

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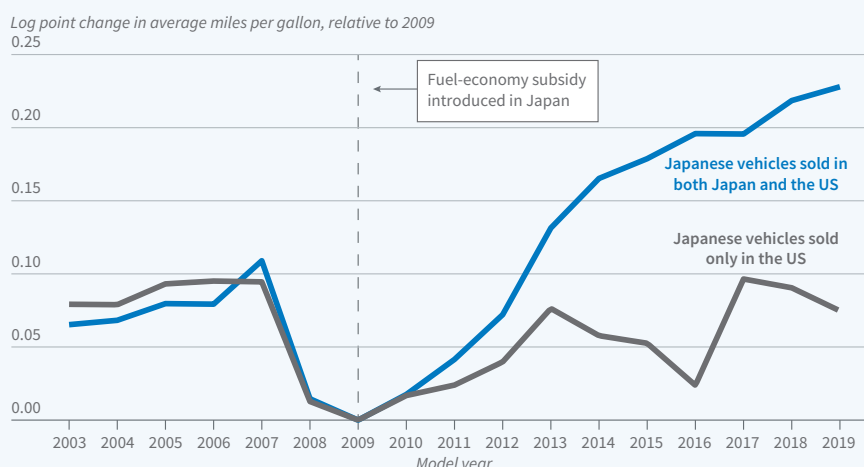
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How Japanese Fuel-Economy Subsidies Affected Cars Sold in America

Multinational firms often sell nearly identical products across global markets. This raises the question of what happens when a government regulates a product in one country: Does that change propagate to the same product sold elsewhere? In [Global Policy Spillovers: How Environmental Policies Propagate Through Product Attributes](#) (NBER Working Paper 35197), [Koichiro Ito](#), [James M. Sallee](#), and [Jonathan \(Andrew\) Smith](#) study “attribute propagation”—the mechanism by which a domestic policy induces broader changes in product attributes through multinational firms’ product design decisions. The researchers focus on a Japanese fuel-economy subsidy introduced in 2009, which provided consumers purchasing vehicles above a weight-based fuel economy target with subsidies ranging from approximately \$700 to \$1,500—roughly 5 to 10 percent of the average price of a new car. Because Japanese automakers sold many of the same car models in both Japan and the US, some US-market vehicles were potentially exposed to the subsidy’s influence while others—Japanese-brand models sold exclusively in the American market—were not.

The researchers compare fuel economy trends between these two groups of vehicles over the 2003–2019 period, drawing on vehicle specification records from Car Sensor (Japan) and WardsAuto (US) as well as monthly model-level sales figures and production data from MarkLines. They find that for vehicles sold in both Japan and

Effect of Japanese Fuel-Economy Subsidies on Vehicles Sold in the US



Starting in 2009, the Japanese government offered subsidies for purchasing new cars that exceeded fuel-economy targets.
Source: Researchers’ calculations using data from Car Sensor, WardsAuto, and MarkLines.

Japan’s 2009 fuel-economy subsidy improved the fuel efficiency of Japanese-brand vehicles sold in both Japan and the United States.

the US, the subsidy generated an 8.7 percent improvement in US fuel economy relative to vehicles sold by Japanese automakers exclusively in the US. They estimate that the direct effect in Japan was larger: a 25.2 percent improvement. They also find that US automakers, whose sales volumes in Japan were too small to make compliance with the subsidy worthwhile, showed no statistically significant change in the fuel economy of their US vehicles.

The researchers find a greater degree of attribute propagation when a given vehicle is produced in a single facility and shipped to multiple

markets, and on models with smaller preexisting fuel economy differences between the Japanese and US markets. The latter finding suggests that less-differentiated products are more likely to be jointly designed for multiple markets.

The researchers estimate that global CO₂ reductions as a result of the Japanese policy were 5.4 times the reductions associated with vehicles sold in the Japanese market. This is because the US vehicle market is substantially larger than the Japanese market, and because American drivers travel approximately 11,218 miles per vehicle annually compared to 3,206 in Japan.

Governments and Global Credit Markets: Two Centuries of Evidence

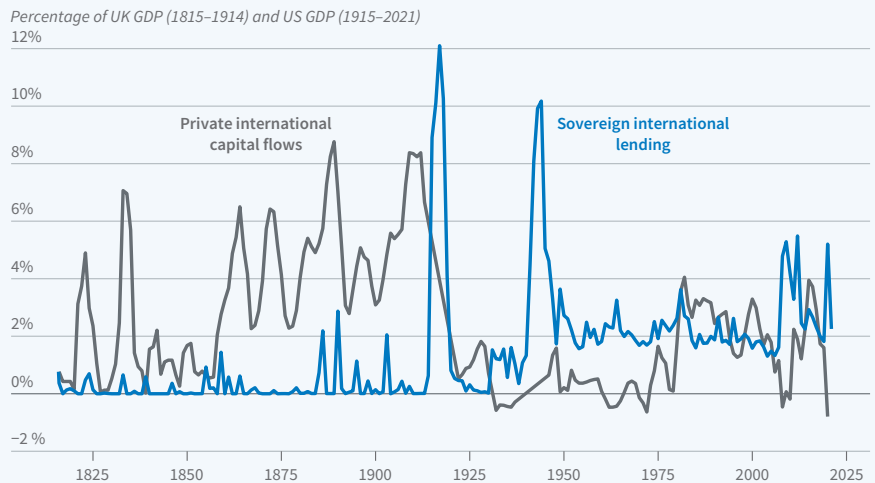
When private capital markets freeze during wars and financial crises, who keeps cross-border credit flowing? Often, it is governments themselves. In *States as Financiers: International Lending in War and Peace* (NBER Working Paper 35225), Sebastian Horn, Carmen M. Reinhart, and Christoph Trebesch construct and analyze the most comprehensive historical record of official cross-border lending assembled to date.

The researchers create three new datasets. The first, the International Official Lending Database, traces more than 1.2 million individual loans, grants, and guarantees extended by 134 bilateral creditor governments and 70 multilateral institutions to over 200 debtor countries from 1790 to 2024, totaling more than \$20 trillion in 2020 dollars. The second dataset covers outstanding external public debt decomposed by creditor type for up to 140 economies from 1910 to 2024. The third compiles instrument-level private capital flow data around 36 major global financial crises and 35 great power war episodes.

The researchers find that official international lending is far more substantial than commonly recognized. Aggregate official flows repeatedly matched or exceeded private cross-border flows. Scaled to the GDP of the leading creditor nation, which was the United Kingdom until 1914 and the United States thereafter, these flows surpassed 10 percent of GDP in 1916 and 1942. Between 1910 and 2020, official creditors accounted for between 30 and 60 percent of total external public debt worldwide. In the average developing country today, approximately 60 percent of external public debt is owed to bilateral and multilateral official creditors.

The data also show that private capital flows are procyclical, contracting during crises and wars, while official flows exhibit statistically significant positive correlations with financial crises, macroeconomic disasters, geopolitical risk, and interstate war.

Private International Capital Flows vs. Sovereign Lending, 1815–2021



Source: Researchers' calculations using data from multiple sources.

When private capital retreats during wars and financial crises, governments often step in with large-scale, heavily subsidized cross-border loans.

During great power wars, official flows to belligerent countries exceeded private flows by a factor of 10 or more on average. The probability of a crisis- or war-affected country receiving at least one official loan or grant rose from roughly 20 percent in the nineteenth century to essentially 100 percent in the post–World War II period, and the average bailout size nearly doubled from 65 percent of recipient-country imports in the nineteenth century to more than 100 percent in recent decades.

Official and private credit also differ sharply in pricing. Private external lenders charge average spreads of 177 basis points above the US risk-free rate, and those spreads rise with borrower credit risk. Official creditors lend at average spreads of –305 basis points, and their pricing is largely insensitive to borrower creditworthiness; lower-rated sovereigns borrow more cheaply from official creditors than higher-rated sovereigns. The same divergence extends to maturities: Higher-risk

borrowers face shorter maturities from private creditors but longer ones from official creditors.

As to the drivers of official bilateral lending, the researchers estimate that a 1 percent increase in bilateral trade exposure is associated with approximately a 0.4 percent increase in official financial flows. This relationship is relatively stable across the pre- and post–World War II periods. Allied country pairs receive more than twice the volume of bilateral loans and grants as non-allied pairs. The dominant drivers shift by shock type: During wars, military alliances are the primary predictor of lending, with official flows to wartime allies running roughly 175 percent above those to non-allies. During financial crises, trade linkages become the more important driver while the alliance interaction is not statistically significant. These results are consistent with creditor governments acting to protect domestic banks and exporters during financial stress and supporting military partners during conflict.

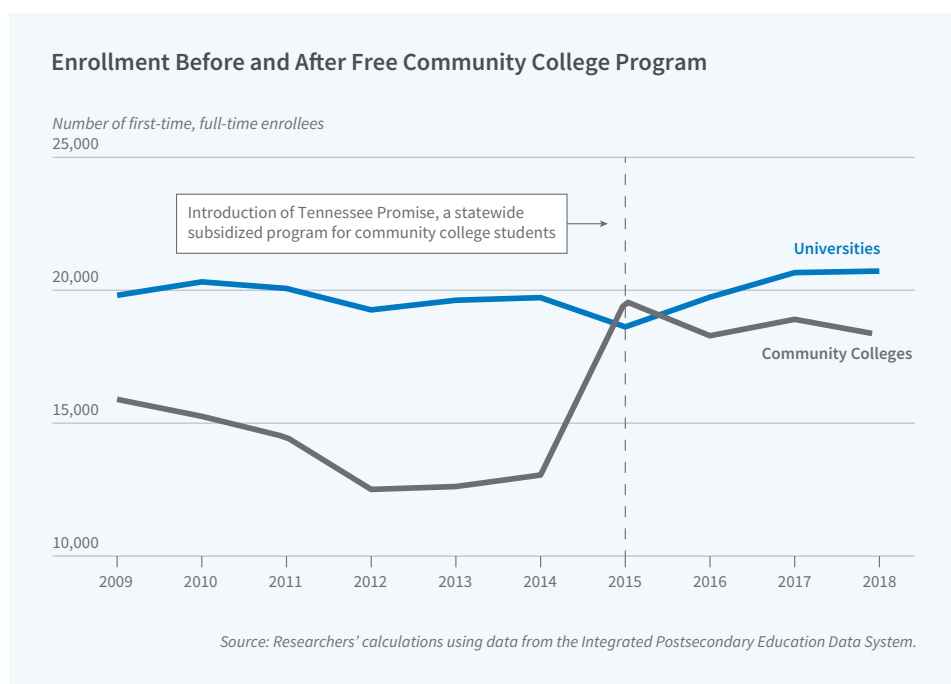
Christoph Trebesch acknowledges support from the European Union (ERC, Great.Power.Finance, 101087838).

The Long-Term Effects of Tuition-Free Community College

Over the past decade, “free college” programs have expanded rapidly across the United States, with more than 20 states adopting some form of tuition-free postsecondary aid. In *A Promise Worth Keeping? Impacts of Free Community College on Degrees and Earnings* (NBER Working Paper 35226), Paige Schnoor, Jonathon Attridge, Celeste K. Carruthers, and Jilleah G. Welch study Tennessee Promise, the first statewide tuition-free community college program in the US. Launched for the high school graduating class of 2015, Tennessee Promise covered any gap between a school’s tuition and mandatory fees and a student’s existing grant aid. The program grew from a single-county pilot in 2009 to full statewide eligibility by 2015. Its average cost was less than \$1,000 per participant per year.

The researchers draw on two complementary data sources. For institutional-level outcomes, they use 2000–2023 data from the Integrated Postsecondary Education Data System and exploit variation in Promise exposure across Tennessee institutions over time. They use colleges and universities in other states as a comparison group and Tennessee schools as the treatment group. For individual-level outcomes—enrollment, degree attainment, earnings, and household formation—they use 2000–2024 American Community Survey microdata.

The findings suggest that access to Tennessee Promise raised postsecondary enrollment among 18-to-19-year-old high school graduates by 5.4 percentage points, or almost 10 percent of their baseline rate, with somewhat larger effects for nonwhite students and those living outside



Tennessee Promise, a statewide tuition-free community college program, significantly increased college enrollment and associate degree attainment among eligible students.

metropolitan areas. At the institutional level, Promise exposure was associated with a statistically significant 15 percent increase in associate’s degrees conferred at two-year institutions and a 24 percent increase in transfer-out students, while two-year graduation rates fell by roughly 21 percent of the comparison mean, a finding consistent with the enrollment of more academically marginal students.

A concern with aid programs focused on two-year programs is that some students who would have attended four-year institutions will instead enroll in community colleges, ultimately reducing bachelor’s degree completion. The researchers find evidence consistent with initial diversion into two-year pathways, including an 8 percent increase in transfer students at four-year institutions.

However, Promise-eligible individuals were approximately 2.7 percentage points more likely to hold a bachelor’s degree by age 24. Women drove this effect: Promise-eligible women were 4.1 percentage points more likely to hold at least a bachelor’s degree by ages 23–24.

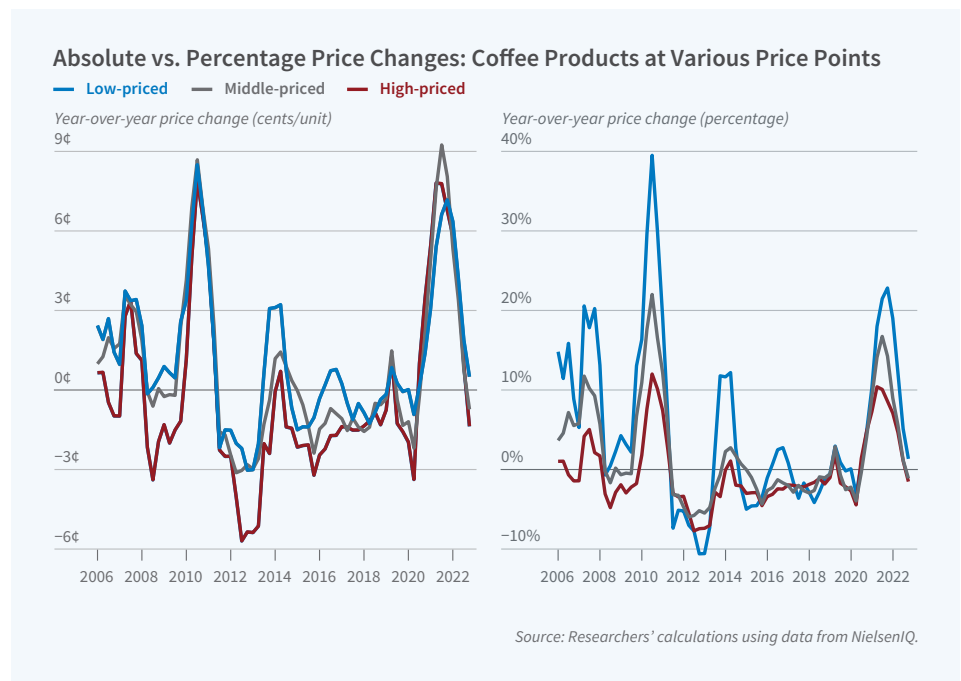
Beyond education, the researchers find that Promise increased wage and salary income by about 7 percent over ages 21–24, though they urge caution given that only 5.4 percent of eligible cohorts showed measurable enrollment increases. The researchers do not find any evidence of an increase in labor force participation, but they do find delays in family formation: Eligible individuals were approximately 27 percent less likely to be married before age 21 and 17 percent less likely to have a child in the household by age 22.

The researchers acknowledge that an early phase of this project was supported by the Gates Foundation and the Tennessee Higher Education Commission.

When Input Prices Rise, Cheaper Varieties See Higher Inflation

Observers of the 2021–2023 inflation noticed that cheaper products exhibited much higher inflation rates. What explains these differences in inflation, and what are the effects on households across the income spectrum? In [Cheapflation Cycles](#) (NBER Working Paper 35235), [Kunal Sangani](#) finds that the way firms pass through cost changes creates systematic differences in inflation between cheap and expensive product varieties, leading to differences in inflation experienced by consumers in different income strata. The study draws primarily on NielsenIQ retail scanner data covering food-at-home sales across more than 30,000 retail stores from 2006 to 2023, alongside NielsenIQ Homescan Consumer Panel data tracking purchases by about 60,000 US households each year.

Sangani finds that firms selling low-price and high-price varieties alike tend to pass input cost increases through to consumers on an absolute, dollars-and-cents basis. Because the same absolute price increase is a larger share of a lower initial price, however, cheaper varieties within a category experience higher inflation in percentage terms when input costs rise. For example, in the case of coffee, Sangani finds that increases in agricultural coffee prices are passed through cent-for-cent uniformly across product varieties. That implies that logarithmic pass-through is substantially higher for cheaper varieties, though—0.57 log points for the lowest unit-price quintile versus 0.18 log points for the highest. Since lower-income households disproportionately purchase cheaper varieties—for example, coffee products purchased by the lowest-income quintile are on average 24 percent less expensive than those bought by the top quintile—this pricing behavior translates



Many firms pass through cost increases as similar absolute price increases across product varieties, resulting in higher inflation for the lowest-priced varieties.

directly into higher inflation rates for lower-income consumers.

Extending the analysis to the full food-at-home basket shows that this pass-through behavior can explain surges in “cheapflation” seen during the Great Recession and 2021–2023 inflation. Over the period from 2006 to 2023, within-category inflation differences driven by pass-through in levels account for 57 percent of the variance in the inflation gap between the top and bottom income quintiles. Adding differences in household spending shares across product categories explains another 13 percent.

The Bureau of Labor Statistics constructs consumer price indices using 273 entry-level item (ELI) categories, with inflation rates pooled across varieties within each category. This aggregation masks the differential

sensitivity of cheaper varieties within each category. This, in turn, understates the higher cost sensitivity and volatility of food-at-home inflation for low-income households.

The variance of food-at-home inflation rates is 21 percent higher for the lowest-income quintile than the highest in the disaggregated scanner data, versus just 6.3 percent higher in ELI-aggregated data—an understatement of roughly 70 percent. Over 2021–2023, the disaggregated data show 2.4 percentage points more food-at-home price growth for the lowest-income quintile relative to the highest, compared to only 0.3 percentage points in income-specific price indices constructed from official statistics. Sangani shows that the same patterns may extend to other categories beyond food at home.

AI Tools and Scientific Innovation

Determining a protein's structure—the three-dimensional shape that determines how it functions and how drugs might interact with it to influence disease pathways—has historically required months or even years of costly laboratory experiments. In July 2021, virtually overnight, Google DeepMind's AlphaFold2 algorithm generated predicted structures for hundreds of thousands of proteins and made them freely available in a public database. This represented one of the most discrete and well-defined AI shocks to any scientific field to date.

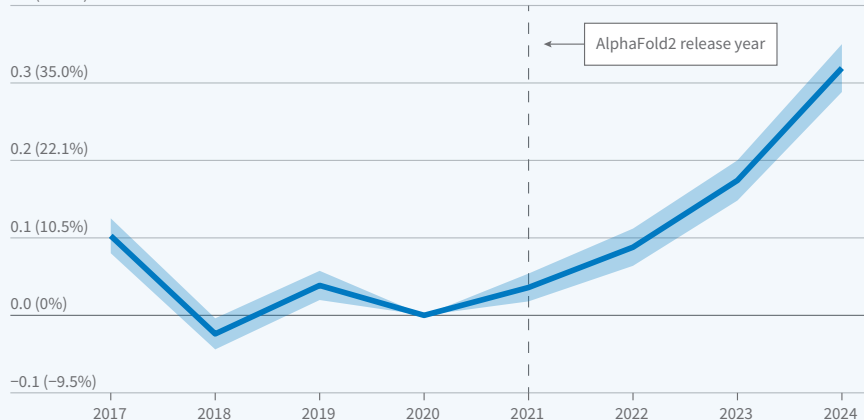
In [How Artificial Intelligence Shapes Science: Evidence from AlphaFold](#) (NBER Working Paper 35143), [Ryan R. Hill](#) and [Carolyn Stein](#) study how AlphaFold2's release affected both the narrow field of experimental structural biology and the downstream scientific and pharmaceutical research that depends on protein structures. They draw on data spanning the period 2017–2024 from several sources: the Protein Data Bank (PDB), which records experimental protein structures; the AlphaFold Protein Structure Database; UniProt's manually curated Swiss-Prot subset linking roughly 570,000 proteins to a categorized scientific literature; and ChEMBL, which records early-stage pharmaceutical bioactivity experiments.

Despite the algorithm's ability to predict protein structures at near-experimental accuracy and negligible cost, the rate of experimental structure deposits in the PDB did not decline after July 2021. Publication rates in top general-interest journals similarly remained stable, and there is little evidence that experimentalists shifted toward proteins that AlphaFold predicts less accurately—a pattern that would be expected if the AI were substituting for experimental work in easier cases.

Instead, the researchers document a complementarity effect: AlphaFold

Relative Publication Rates: Unsolved versus Solved Proteins

Poisson coefficient difference in publication rates of previously unsolved and previously solved proteins, relative to 2020
0.4 (49.2%)



Solved proteins had an experimentally determined structure prior to June 2021.
Source: Researchers' calculations using data from UniProt and Swiss-Prot.

The release of Google DeepMind's AlphaFold2 expanded scientific research on previously unstudied proteins.

predictions are being used as starting-point templates in the dominant computational method for converting x-ray crystallography data into three-dimensional structures. Among proteins with no experimentally solved structural neighbor, the probability of using starting points rose by 21 percentage points post-AlphaFold. Over 50 percent of such structures were using AlphaFold-derived templates by the end of the sample period.

The researchers next consider the impact of AlphaFold on related areas of protein science research, where new structure predictions might unlock insights where experimental structure determination had previously been a bottleneck. Because only about 8 percent of Swiss-Prot proteins had an experimentally solved structure before AlphaFold, the researchers compare research activity on previously unsolved proteins to that on previously solved proteins. They find that the volume of non-structure publications about previously unsolved proteins increased by between 16

and 25 percent relative to those about solved proteins after AlphaFold was released, and by more than 35 percent by 2024. By 2024, papers about previously unsolved proteins cite core AlphaFold references at an approximately 50 percent higher rate than papers about solved proteins.

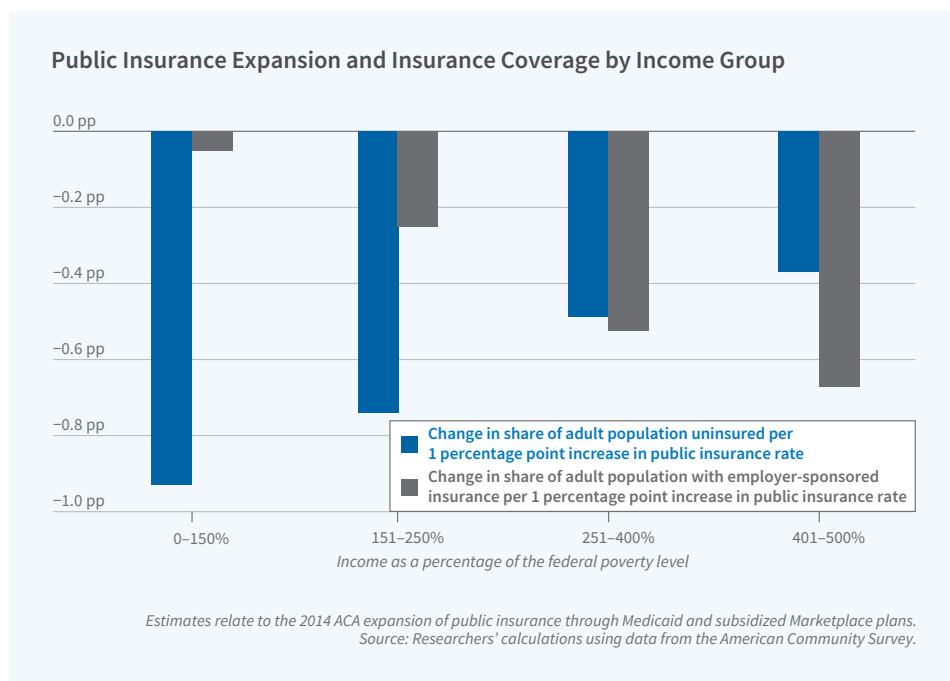
Despite the evident changes in research activity, the researchers do not find any shift in early-stage pharmaceutical R&D. ChEMBL bioactivity data—which record small-molecule binding experiments against protein targets—show no statistically significant increase in activity targeting previously unsolved proteins. This is consistent with a bottleneck model in which basic biological validation of a protein's disease relevance must accumulate before drug discovery investment occurs. The researchers suggest that pharmaceutical applications of AlphaFold's structural information may materialize in the future as the foundation of basic research matures.

Crowd-Out of Employer-Provided Health Insurance by the Affordable Care Act

The Affordable Care Act (ACA) reshaped how Americans obtain health insurance by expanding Medicaid eligibility and creating Marketplace exchanges for subsidized private plans. In [How Efficient Was the Affordable Care Act at Reducing Uninsured Rates?](#) (NBER Working Paper 35263), [Anuj Gangopadhyaya](#) and [Robert Kaestner](#) exploit variation in the timing of ACA implementation and Medicaid expansion across states to assess the impact of access to publicly supported coverage on the fraction of the population that is uninsured and that has employer-sponsored insurance (ESI). The researchers use data from the 2008–2024 American Community Survey, restricting their sample to adults ages 19–64. They focus on four possible insurance coverage categories: uninsured, ESI, Medicaid participants, and individuals purchasing insurance through Marketplace exchanges. They also group individuals into four income categories.

For adults with incomes at or below 150 percent of the federal poverty line (FPL), a 1-percentage-point increase in public coverage, namely Medicaid coverage or insurance purchased through a Marketplace, leads to a 0.93-percentage-point decline in the uninsured rate, with little corresponding decline in ESI. For this income group, nearly all gains in public coverage came from individuals who were previously uninsured.

At higher incomes, however, a larger fraction of those who took up public coverage under the ACA previously had ESI. For those with incomes between 151 and 250 percent of the FPL, a 1-percentage-point increase in public coverage was associated



Most low-income adults who took up insurance under the Affordable Care Act were previously uninsured, but among higher-income adults a substantial share of new public coverage replaced employer-sponsored insurance.

with a 0.7-percentage-point decline in the uninsured rate and a 0.3-percentage-point decline in ESI. For the 251–400 percent of FPL group, the figures were roughly a 0.5-percentage-point reduction in the share without insurance and a 0.5-percentage-point drop in ESI. For the highest income group, those with incomes between 401 and 500 percent of the FPL, the decline in the share without insurance was about 0.3 percentage points and the decline in ESI was about 0.6 percentage points. For higher-income groups, there was more “crowd-out”: A larger share of new public coverage substituted for existing employer coverage.

Crowd-out effects were largest among subgroups with higher pre-ACA ESI rates. For parents with incomes between 250 and 500 percent of the FPL, for example, roughly three people took up publicly supported coverage for every one newly insured person. Crowd-out effects were also more pronounced among married adults relative to single persons, and were larger for older adults (ages 45–64) than their younger counterparts. The researchers emphasize that for measuring crowd-out, it is important to consider all adults who receive ACA-related insurance, not just those who were newly eligible for Medicaid.

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