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## INSIDE THIS ISSUE

- What Charging Habits of Owners Reveal about Electric Vehicle Use
- Local Tax Incentives for Job Creation: California's Experience
- Wage and Promotion Impacts of Older Workers Delaying Retirement
- Explaining the Historical Rise of US Research Universities
- The Impact of California's Gender Quotas for Corporate Boards

## The Impact of Competitive Bidding in the Medicare Program

In 2020, the Medicare program provided health coverage for 62 million elderly and disabled Americans at a cost of more than \$800 billion. Annual expenditures are projected to reach about \$1.6 trillion by 2028. Medicare fee-for-service plans cover 60 percent of Medicare beneficiaries. When patients in these fee-for-service plans receive care, Medicare reimburses providers directly at administratively determined reimbursement rates set by complex regulations.

Spurred by concerns that Medicare's administered prices for durable medical equipment were sometimes higher than market rates, in July 2010, Medicare piloted a competitive bidding program for selected high-cost, high-volume, durable medical equipment products in nine competitive bidding areas. Competitive pricing took effect in the first quarter of 2011.

At the time, Medicare spending on durable medical equipment was \$11.3 billion. More than 11 million Medicare beneficiaries had one or more claims for one of the hundreds of items like oxygen concentrators, wheelchairs, CPAP devices, walkers, and infusion pumps that comprise the durable medical equipment category. In 2013, the competitive bidding program was expanded to

include 100 additional competitive bidding areas as well as more items. In **Getting the Price Right? The Impact of Competitive Bidding in the Medicare Program** (NBER Working Paper 28457), [Hui Ding](#), [Mark Duggan](#), and [Amanda Starc](#) determine that

Replacing administratively set pricing with a bidding mechanism reduced spending on 12 durable medical devices by 41.8 percent, and reduced average quantities purchased by 9.3 percent.

replacing administered pricing even with "a highly imperfect bidding mechanism" reduced spending on 12 durable medical devices by 41.8 percent. This was mostly due to falling prices; quantities purchased fell 9.3 percent.

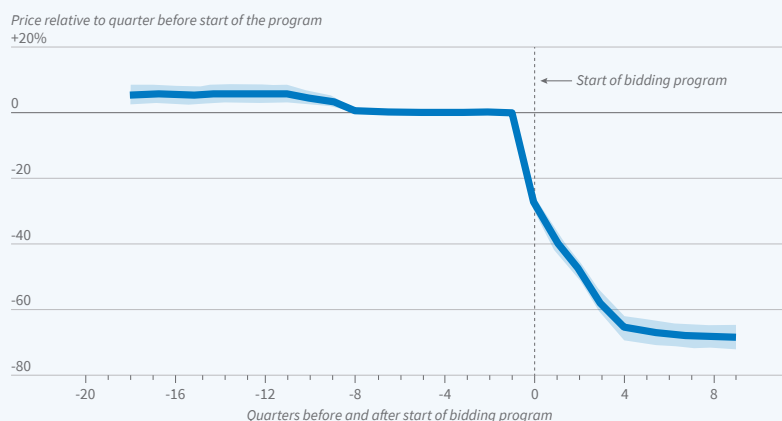
The results are based on claims data from

a nationwide sample of 20 percent of Medicare fee-for-service beneficiaries. The sample includes claims from the first quarter of 2009 through the fourth quarter of 2015. The analysis exploits the staggered introduction of competitive bidding across time and geographic locations.

To understand the drivers of reduced spending, the researchers perform a detailed examination of spending on continuous positive airway pressure (CPAP) devices used to treat sleep apnea. After competitive bidding was introduced, average Medicare spending on CPAP devices fell by 47.2 percent. Prices fell by 45 percent and quantity fell by 4.3 percent at the onset of competitive bidding.

Unless they purchase Medigap insurance, standard fee-for-service Medicare beneficiaries have a 20 percent copay for CPAP machines. Those covered by both Medicare and Medicaid have low or no copayment requirements. The researchers separate supply and demand responses by comparing how standard Medicare beneficiaries and dual eligi-

Medicare's Competitive Bidding Program and the Price of CPAP Machines



Light-blue areas represent 95% confidence intervals  
CPAP machines are typically used by patients who have breathing problems during sleep  
Source: Researchers' calculations using data from the Centers for Medicare & Medicaid Services

ble beneficiaries responded to lower CPAP prices. They find that demand for CPAP machines was downward sloping for standard Medicare beneficiaries, and that a \$1 reduction in out-of-pocket costs led to a 1.73 percent increase in the quantity demanded. Despite lower prices from competitive bidding, fewer CPAP devices were purchased for dual eligible beneficiaries. This quantity reduction suggests that suppliers responded to reduced CPAP reimbursement by reducing supply.

The researchers also construct a measure

of clinical appropriateness for CPAP treatment and find that the reduction in CPAP purchase quantity was significantly higher among patients without a formal sleep apnea diagnosis. This suggests that utilization declined most among those who derived less benefit from CPAP use. Calculations using incremental cost-effectiveness ratios from the United Kingdom's National Institute for Health and Care Excellence suggest that the savings from the reduction in Medicare spending exceeded the estimated welfare costs of reduced CPAP access.

The researchers conclude that the competitive bidding program reduced prices and spending. The results suggest that Medicare's future funding challenges could be partially addressed through use of market mechanisms for price setting. They caution that their analysis is not a complete welfare analysis and does not account for supplier profits or the long-term effects of the increased market concentration that accompanied the switch to competitive bidding.

—Linda Gorman

## What Charging Habits of Owners Reveal about Electric Vehicle Use

Estimates of the environmental benefits of electrification of the passenger vehicle fleet depend on the number of miles that each new electric car will displace from the gasoline-powered fleet. Using new data on the electricity use of electric vehicle (EV) owners in northern California from 2014 to 2017, [Fiona Burlig](#), [James B. Bushnell](#), [David S. Rapson](#), and [Catherine Wolfram](#) report in **Low Energy: Estimating Electric Vehicle Electricity Use** (NBER Working Paper 28451) that the average EV charges less than half of the amount that has been assumed in projections by state regulators. When combined with public data on nonresidential charging, these results imply that the average battery electric vehicle (BEV) drove about 6,700 miles per year and that plug-in hybrid electric vehicles (PHEVs) traveled only 1,700 miles per year with electricity.

The research matches California Department of Motor Vehicles registration records with Pacific Gas and Electric electricity consumption data for 2014 through 2017. The sample comprises 57,290 of the 423,297 EVs in California, which (both then and now) is home to around half of all EVs in the US.

The researchers estimate that regular charging of an electric vehicle increased a household's average electricity consumption by 2.9 kilowatt-hours (kWh) per day, or 0.121 kWh per hour. They find that elec-

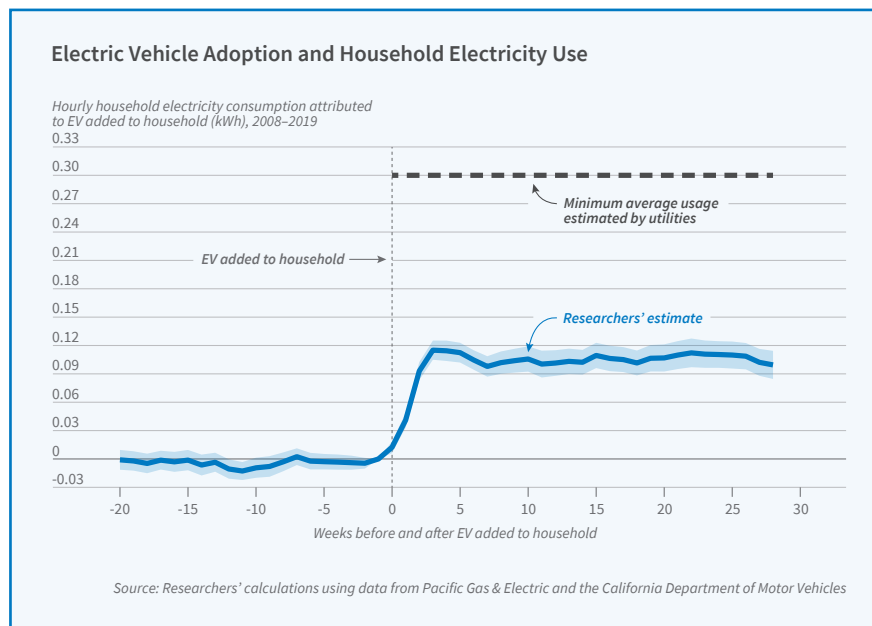
tricity consumption rose within a couple of weeks of an owner registering an EV, and that it largely remained constant for the next six months. Increased electricity consumption was concentrated between the hours of 10 pm and 6 am, suggesting drivers charge their EVs when they come home and leave them

plugged in overnight. This hourly pattern has implications for the reduction in carbon dioxide emissions associated with vehicle electrification. In California, CO<sub>2</sub> emissions associated with electricity consumption are

At-home charging data from California suggest that electric vehicles have been driven many fewer miles per year than their gasoline-powered counterparts.

highest overnight, when the marginal electricity generator is likely to be gas-fired rather than solar or wind powered. The researchers' estimate of average daily per-vehicle EV charging consumption, 2.9 kWh, is far below the estimate of California's utilities of 7.2 to 8 kWh. The utility estimate was based on the small and likely unrepresentative sample of households with dedicated EV meters; by contrast, this new study uses data on tens of thousands of cars, which are broadly representative of California's EV fleet.

What explains low EV electricity consumption? One possibility is that EVs are being charged primarily away from home. This would run contrary to existing administrative data. By the researchers' estimates,



in order for EVs to be driven as much as their gasoline-powered counterparts, away-from-home charging kWh would have to be three times what is currently reported to state regulators. The researchers reason that this is unlikely because Low Carbon Fuel Standard credits, worth between \$0.20 and \$0.25 per kWh — well above the price of electricity — are paid to chargers who report.

Assuming the administrative data are correct, the researchers suggest several possible explanations for low EV electricity consumption. First, relatively early EV adopters may have different baseline driving behavior than the aver-

age car owner. The researchers observe that EV owners tended to use more electricity in their homes prior to EV purchases than households who did not buy an EV during the sample period, implying unobservable differences.

Second, drivers may perceive EVs as less convenient than gasoline-powered vehicles due to range anxiety or other attributes. Relatedly, EVs often make up just one piece of a household's vehicle portfolio. The researchers find a relatively weak relationship between kWh consumed and vehicle battery size, with the exception of Teslas, which both have a larger battery than other sample vehicles and use substan-

tially more electricity. Finally, it is possible that low EV usage is attributable to high electricity prices, and that households might use their EVs more if electricity cost less.

“If EVs are being driven as much as conventional cars, it speaks to their potential as a near-perfect substitute for vehicles burning fossil fuels,” the researchers write. “If, on the other hand, EVs are being driven substantially less than conventional cars, it raises important questions about the potential for the technology to replace a vast majority of trips currently using gasoline.”

—Brett M. Rhyme

## Local Tax Incentives for Job Creation: California's Experience

Many states and localities offer local subsidies to firms in an effort to create jobs. Whether such local development programs are a cost-effective way of raising employment is a controversial issue, and can result in significant swings in the nature and extent of such subsidies.

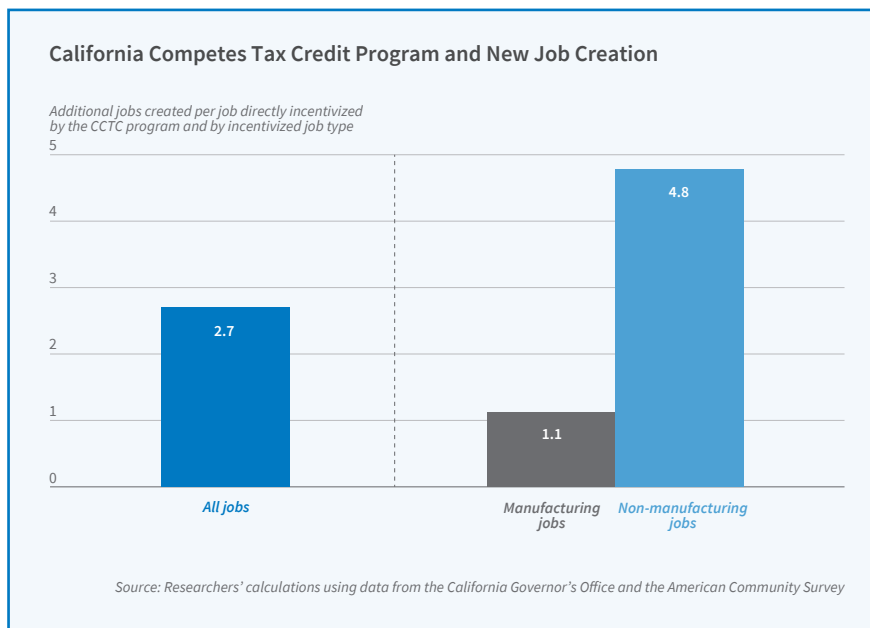
Consider California. The state scrapped its enterprise zone program in 2013 after research showed that — like many incentive programs of that type — it produced no net job growth. It was replaced in 2014 with the California Competes Tax Credit (CCTC), a program with several innovative features. It has explicit eligibility thresholds, but once those are met CCTC administrators have broad discretion to direct credits to companies they think have the greatest potential for creating new jobs. The program can also quickly recapture the incentives and pause further credits if hiring goals aren't met, because the companies are rigorously evaluated every year. The CCTC prioritizes companies located in impoverished areas. Applicants

Awarding tax credits based on a combination of formal and discretionary criteria, and strictly monitoring grantee compliance, generated new jobs both at firms receiving credits and at other firms.

who indicate that at least three-quarters of their new hires will work at least three-quarters of the time in a high-unemployment or high-poverty area get priority in the review process. The program also features preferential review for applicants who can certify that without a subsidy they would either relocate to a new state or close down their California operations.

**In Combining Rules and Discretion in Economic Development Policy: Evidence on the Impacts of the California Competes Tax Credit** (NBER Working Paper 28594), [Matthew Freedman](#), [David Neumark](#), and [Shantanu Khanna](#) find that in its first four years the CCTC was responsible for creating jobs for residents of both low-income and high-income areas and had important multiplier effects.

In the first 12 rounds of the CCTC's awards, between mid-2014 and mid-2018, an average of 284 firms applied for tax credits during each of three allocation rounds, and on average 82 of them were awarded tax credits in each round. The average award was some \$865,000 in credits; about a fifth of the awards were in excess of \$1 million. In all, the state handed out some \$1.23 billion in tax credits to businesses that pledged



to create 124,000 jobs, a cost of \$9,900 per incentivized position.

The researchers estimate that in addition to creating the jobs that were directly incentivized by the program, the CCTC had multiplier effects. For every new job subsidized in a particular census tract, they estimate that the tract gained an average 2.5 additional workers. Including these indirectly created jobs, the program's cost per job created drops to

approximately \$3,960 per position.

The estimated multiplier effects were not uniform. They were much stronger for non-manufacturing (4.8 jobs created indirectly) than for manufacturing (1.1 indirect jobs). The program appeared to create more jobs for workers living in more-affluent tracts and those with more highly educated workers. However, increases in employment were experienced by residents of both more- and less-affluent areas.

The researchers note that their calculations may understate or overstate the actual impact of the tax subsidies because the study only counts jobs created within a specific census tract. It misses spillover effects on adjacent communities. Similarly, if new jobs arose in the same tract as the subsidized jobs but were not related to the subsidy program, the study could be overstating the CCTC's impact.

—*Laurent Belsie*

## Wage and Promotion Impacts of Older Workers Delaying Retirement

The retirement decisions of older workers can influence the earnings growth rate and promotion rate of younger workers, especially in firms where promotion opportunities are more limited. These effects are the focus of **Career Spillovers in Internal Labor Markets** (NBER Working Paper 28605), by Nicola Bianchi, Giulia Bovini, Jin Li, Matteo Paradisi, and Michael L. Powell. The study examines the role of within-firm factors, such as the retirement decisions of coworkers, in contributing to career dynamics.

The researchers exploit a 2011 Italian pension reform—the Fornero reform—that unexpectedly tightened eligibility criteria for public pensions, leading to sudden and widespread retirement delays by many retirement-age workers. Using administrative data on Italian private-sector workers provided by the Italian Social Security Institute (INPS), they compare the wage growth and internal promotions of younger workers before and after the reform, and relate these outcomes to the age composition of their firm's workforce.

They find that a one-year increase in the average retirement age of workers at a firm who are near retirement age leads to a 2.5 percent per year decrease in the wage growth rate of younger coworkers.

When the retirement delay affects a worker in a higher-level position, it also reduces the number of categorical promotions, which they define as workers moving from blue-collar to white-collar jobs or

affect the number of promotions to managerial jobs: a one-year retirement delay among managers reduces the number of younger workers promoted to manager by nearly 50 percent.

A one-year increase in the average retirement age of workers who are close to retirement reduces the wage growth of younger coworkers by 2.5 percent per year.

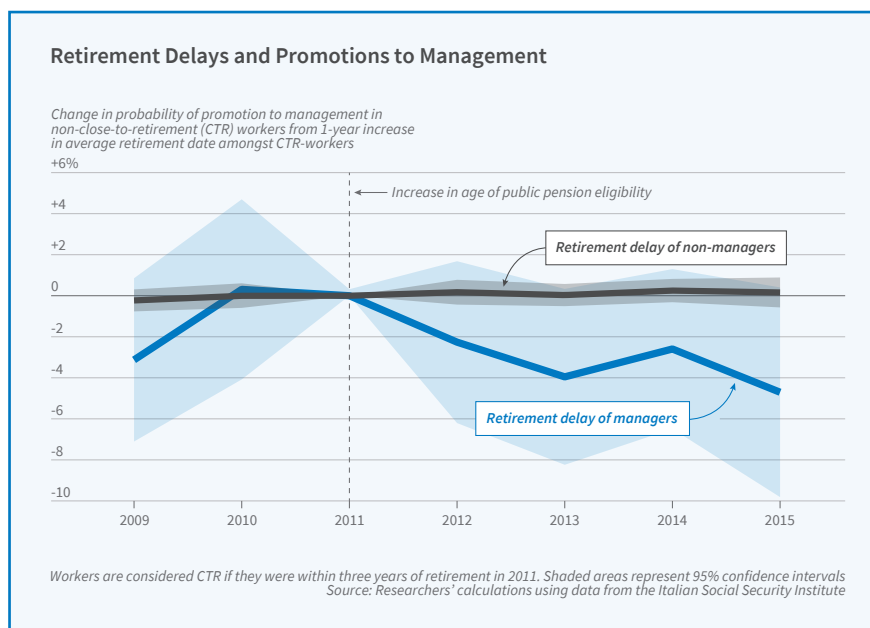
from either blue- or white-collar to managerial jobs. A one-year increase in the retirement age of a white-collar worker reduces the promotion rate to white-collar jobs by about 21 percent.

Delays in blue-collar workers' retirements do not affect the number of promotions to white-collar positions. Similarly, only retirement delays among managers

These wage and promotion rate effects are most pronounced at firms with limited workforce flexibility, such as those with a larger share of workers close to retirement, firms that are shrinking, and firms with few highly paid positions. Retirement delays have a larger impact—more than four times larger than the average effect—on the wages of coworkers who are 55 years old or older. The researchers note that this may reflect firms' use of seniority as a criterion for promotion.

The researchers did not find any evidence that younger workers respond to delayed retirement of their older coworkers by quitting. They did find, however, that a one-year increase in retirement age increases layoffs by about 10 percent, and reduces hiring by 2 percent.

—*Dylan Parry*



# Explaining the Historical Rise of US Research Universities

The United States had about 900 colleges before the Civil War. By 1875, educational attainment exceeded that in any European nation, but the country had no top-tier research universities. Yet over the next half century, US research universities not only emerged, but achieved global dominance. In 1920, for example, there were more mentions of US universities than German universities—long the global research leaders—in the biographies of Nobel Prize winners.

In *Why Does the US Have the Best Research Universities? Incentives, Resources, and Virtuous Circles* (NBER Working Paper 28279), [W. Bentley MacLeod](#) and [Miguel Urquiola](#) explain how American higher education in the late nineteenth century was remodeled when a relatively free market encountered changing student demand. New universities specializing in advanced instruction and research attracted both funding and students. Today, the most selective US research universities spend about \$150,000 per student, six times the national average.

In the first century after American independence, US students generally preferred colleges that were close to home, and schools

were differentiated by religious affiliation. The curricula emphasized Latin, Greek, logic, rhetoric, mathematics, physical sciences, and ethics and politics. Open enrollment meant that anyone who could afford the tuition could attend, and colleges grew by adding more students. There were few professors, and they were paid relatively little. Some professors conducted research, but it was neither emphasized nor rewarded.

Attempts at reform only succeeded decisively when private donors created Cornell University in 1865 and Johns Hopkins University in 1876. Both schools

attracted students by expanding curricula, offering specialized instruction, and focusing on graduate education. MIT, Stanford, the University of Chicago, the University of California, Berkeley, and various land-grant state universities were other early

entrants. Well-established institutions, such as Harvard and Columbia, responded to the competition by creating their own specialized departments and professional schools. In Europe, where higher education was largely funded by governments, the entry

not need to protect their jobs by avoiding hiring more talented colleagues. As the US supply of graduate specialists grew, professors founded associations like the American Chemical Society (1877) and the American Historical Association (1884). They began publishing specialty journals that reviewed the quality of research before publication.

Growing numbers of students with open enrollment meant that less-prepared students began attending college, threatening colleges' ability to cater to the elites who had been their traditional customers. In 1919, Columbia implemented selective admissions. It

Schools competed for talent by offering higher salaries, reduced teaching loads, sabbaticals, and, beginning at Princeton in the 1920s, tenure. The researchers suggest that tenure increased institutional research productivity in part because tenured faculty do

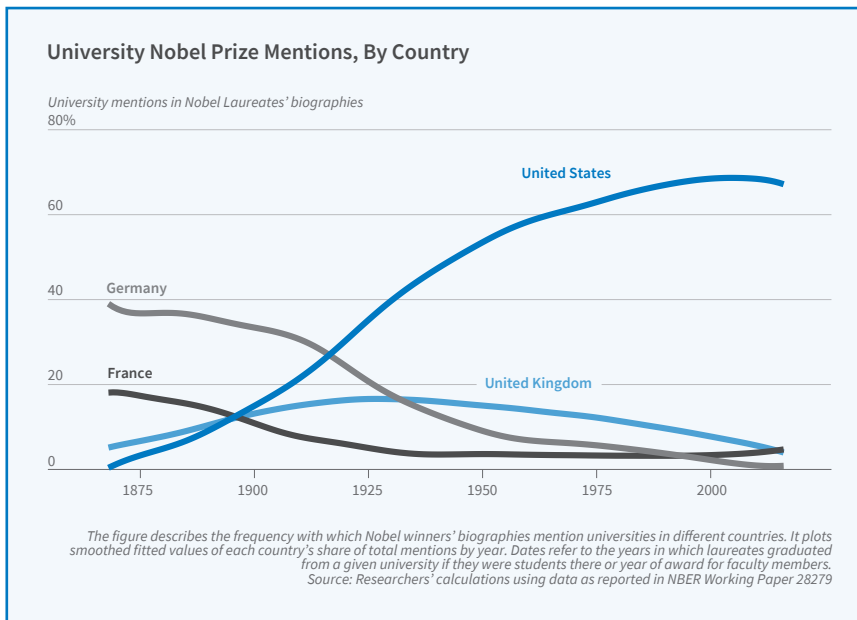
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capped its class size, required personal data on application forms, and denied admission without explanation. This, along with the use of standardized tests like the SAT in 1926, gradually created academically stronger student bodies. Early adopters of selective admissions developed supportive alumni networks that donated to them, further advancing research and specialized instruction. These institutions were well positioned to garner an outsized portion of the large increase in federal research funding that began in the 1960s.

—Linda Gorman



of new universities was discouraged. While US schools created nationwide faculty and student sorting systems in their competition for research talent, some European countries, including Germany, focused their resources on preserving equality across schools. Many European faculty salaries were determined by rank and seniority rather than the internal "up-or-out" evaluation based on research quality that came to prevail in the US.

Instructors qualified to teach new, specialized curricula were in short supply in the US, and they were difficult to identify.

# The Impact of California's Gender Quotas for Corporate Boards

In 2018, California enacted a new law that required all publicly held corporations headquartered there—12 percent of all US firms—to have at least one woman director by the end of 2019. By the end of 2021, the statute requires boards with five members to include at least two women, and at least three women on boards with six or more directors.

In **Gender Quotas and Support for Women in Board Elections** (NBER Working Paper 28463), Marina Gertsberg, Johanna Mollerstrom, and Michaela Pagel study the early effects of this legislation on the composition of boards, the support for men and women who are nominated to corporate boards, and the share prices of California-based companies. They study Securities and Exchange Commission data on 585 firms of all sizes from January 2016 to July 2020—a two-year bracket around the law's enactment.

The legislation had an immediate impact on the gender composition of boards. The average share of women on boards of California companies was 12.9 percent in 2016, 15.8 percent in 2018, and 23.2 percent in 2020. The increase in the two years after enactment was more than twice as large as the increase in

the two years preceding the legislation.

The researchers examine shareholder support for director candidates before and after the new law took effect. Throughout their

Shareholder support for new female board nominees decreased to that of new male nominees after board gender quotas were mandated, but share prices declined only for firms that failed to replace the least-supported directors.

sample period, women who were standing for board election, both new directors and incumbents, received more support than their male counterparts. Under the assumption that stronger board candidates are likely to secure higher levels of shareholder support, this suggests that the board nomination process held women to a higher standard than men before

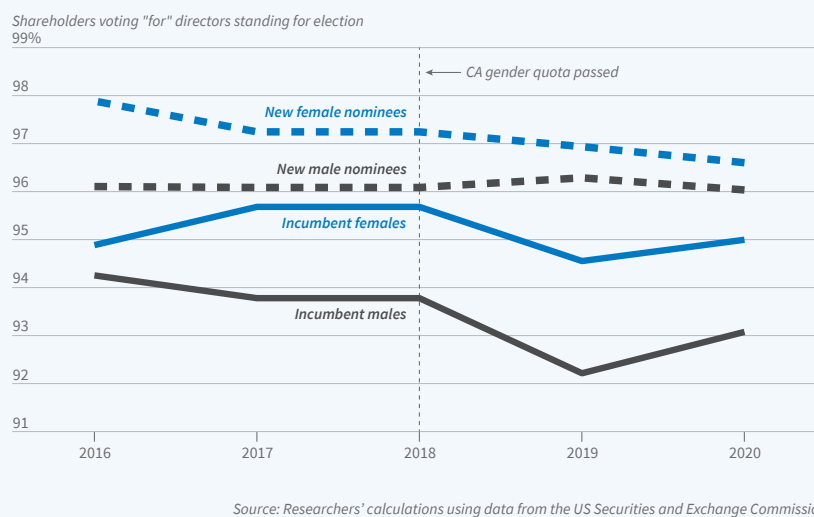
the legislation took effect. After 2018, shareholder support for new female nominees declined toward the level of support for new male nominees. However, incumbent female

directors standing for reelection saw almost no change in support, while there was a sharp decline in the level of support for incumbent men who were standing for reelection.

To explore how quotas on board composition affect firm value, the researchers compare the stock market returns of California-based companies around the enactment of the new legislation with the returns of similar non-California firms. California firms, particularly those that were least in compliance with the quota at the time of the legal change, lost value. The loss of value was concentrated at firms that did not replace their lowest quality male board members. The researchers conclude that market concerns about entrenched board dynamics, and not a shortage of qualified women directors, drove the negative stock price reaction.

—Brett M. Rhyme

California's Female Corporate Board Quota and New Directors, 2000–2020



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