

The Digest

February 2025

In This Issue

Household Heat Pump Adoption and Energy Use

Universal Pre-K Access and Parental Earnings

The Environmental Benefits of OPEC's Collusive Behavior

Can Policy Interventions Reduce Evictions?

Tariffs and US Labor Productivity: Evidence from the Gilded Age

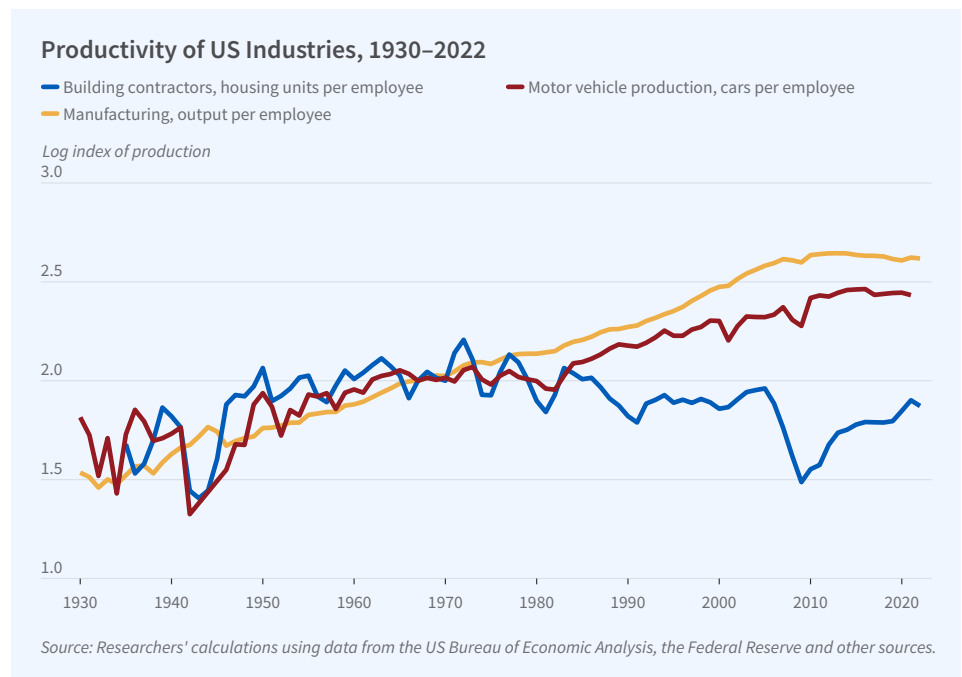
Stagnation of US Construction Productivity

Local land use and state and federal environmental regulations proliferated in the early 1970s. About this time, US residential construction productivity began to decline; today, it is close to the level of the 1930s. In contrast, manufacturing productivity has risen for many decades. In the auto industry, for example, it has risen from 4.8 cars per employee per year in 1939 to around 25 per employee per year by 2020.

In [Why Has Construction Productivity Stagnated? The Role of Land-Use Regulation](#) (NBER Working Paper 33188), [Leonardo D'Amico](#), [Edward L. Glaeser](#), [Joseph Gyourko](#), [William R. Kerr](#), and [Giacomo A. M. Ponzetto](#) investigate the relationship between restrictive land use regulations and the residential construction productivity decline. They find that more restrictive regulation favors smaller projects, artificially limiting the size of the firms that build homes. Smaller firms invest less in technology. A back-of-the-envelope calculation shows that if half of the link between productivity and firm size is causal, homebuilding would be approximately 60 percent more productive if the size distribution of US homebuilding firms matched that of firms in the manufacturing sector.

Developers in the US generally partner with landowners and agree on a building project. They then propose that project to the various governmental authorities overseeing compliance with land use regulations. If all regulators approve, houses are built and sold by the developer. As regulatory burdens grow, approved projects tend to become smaller and their profitability declines. Building houses in highly regulated areas is unattractive to developers, and with fewer developers building, house prices rise. Smaller developers also have fewer incentives to invest in technology, further exacerbating the effect on prices. As area affordability declines, some residents leave.

The researchers estimate the relationship between productivity and firm size using the Census of Construction Industries (part of the Economic Census)



Land use regulations are a key explanation for stagnant productivity in the residential construction sector.

and microdata from the Census Bureau's Longitudinal Business Database. Both revenues and units built per employee increase as firm size increases. Firms with 20 to 99 employees produce 45 percent more units per employee than the smallest firms. Firms with more than 500 employees produce more than four times as many units per employee.

The researchers also use CoreLogic microdata for 167 counties covering 51 percent of the US population from 1950 to 2018 to measure the scale of development projects. They find that in 1950–51, 37 percent of homes built were in the largest 1 percent of development projects. By 2018–19, the comparable statistic was only 24 percent. They show that this decline in big projects is hardly explained by increased love of variety by consumers, and rather seems driven by supply.

Controlling for house age, lot size, square footage, census tract, and year of sale, the homes from relatively large projects did not appreciate differentially over time.

To explore the relationship between regulation and home building firm size, the researchers use data from the Wharton Residential Land Use Regulatory Index. They find that Census Bureau core-based statistical areas with stricter land use regulations have smaller and less productive construction firms, and less residential and nonresidential construction activity.

Data on patent activity for the construction industry also suggest that as construction firms and projects become smaller, innovation declines. Patenting in construction and in sectors that mostly supply inputs to builders lagged the rest of the economy, especially since the 1970s.

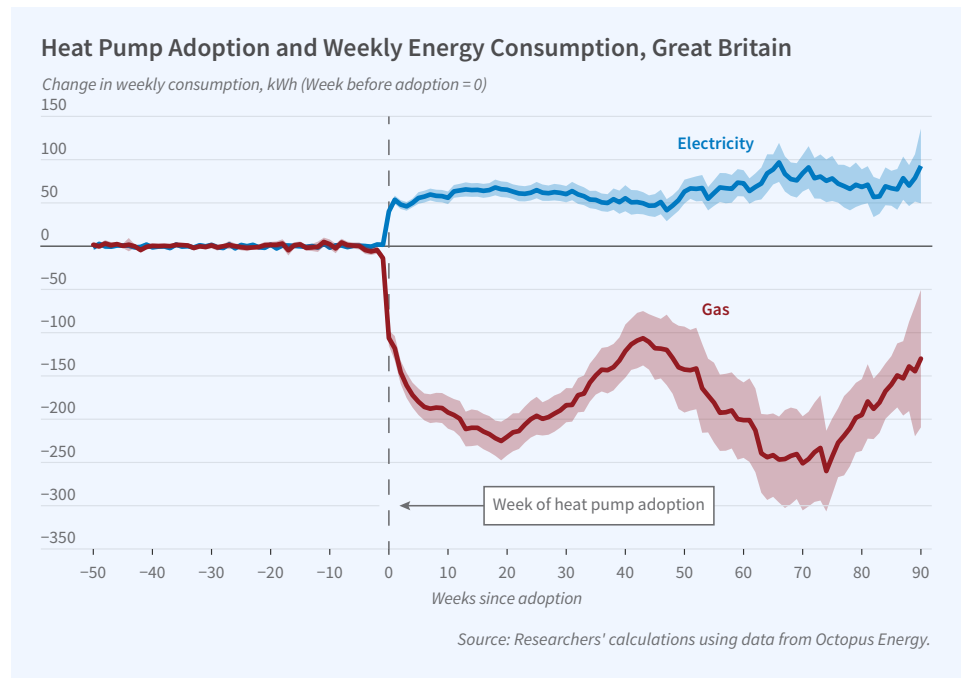
— Linda Gorman

Household Heat Pump Adoption and Energy Use

In [Decarbonizing Heat: The Impact of Heat Pumps and a Time-of-Use Heat Pump Tariff on Energy Demand](#) (NBER Working Paper 33036), researchers [Louise Bernard](#), [Andy Hackett](#), [Robert D. Metcalfe](#), and [Andrew Schein](#) study the impact of heat pumps, a low-carbon alternative to gas boilers, on household energy demand. They analyze data from Octopus Energy, a global energy supplier, focusing specifically on residential heat pump installations in the UK. Their data sample includes the universe of Octopus heat pump adopters between early 2022 and mid-2024. There are 1,321 heat pump adopters in the sample and the average heat pump size is 8 kW. Almost all of these customers took advantage of the UK's boiler upgrade scheme, a government subsidy that helps cover the cost of replacing fossil fuel heating systems with low-carbon technologies like heat pumps.

The researchers leverage the staggered rollout of heat pump installations to estimate the causal effect of boiler-to-heat pump incentive programs on consumers' energy demand. Adoption of heat pumps alters the composition of energy demand: demand for gas drops by 90 percent and demand for electricity rises by 61 percent per year. Overall demand for energy declines by 40 percent. The net effect of these changes is a nearly 70 percent decline in households' CO₂ equivalent emissions throughout a heat pump's operational lifespan.

The study also presents favorable evidence for the efficacy of time-of-use tariffs in reducing electricity consumption during periods of peak



Consumers who replaced their gas boilers with heat pumps reduced their overall energy use by an average of 40 percent.

demand, when energy production is least carbon efficient. Octopus Energy's time-of-use tariff involves a 40 percent marginal price reduction during periods when a higher share of electricity being supplied to the grid is from renewable energy sources. It also includes a 60 percent increase in marginal prices during peak use periods (4:00 pm–7:00 pm). Analyzing a sample of 6,631 Octopus Energy users who adopted the tariff between late 2022 and mid-2024, the researchers estimate that these consumers reduced energy consumption by one-half during the period of peak consumption and doubled consumption during the windows of time in which energy use was subsidized. In sum, consumers

saved £318 by switching to the time-of-use tariff, and £240 of these savings were due to shifting demand away from peak periods.

The researchers estimate that for every £1 of net government expenditure, the UK boiler upgrade scheme generates £1.24 in social benefits. When they include possible learning-by-doing benefits from technological advances associated with greater heat pump use, the social benefit rises to £1.90. The welfare-enhancing properties of the subsidy are generated by the decarbonizing nature of this heat source and the reduction of air pollution associated with gas consumption.

— Laurel Britt

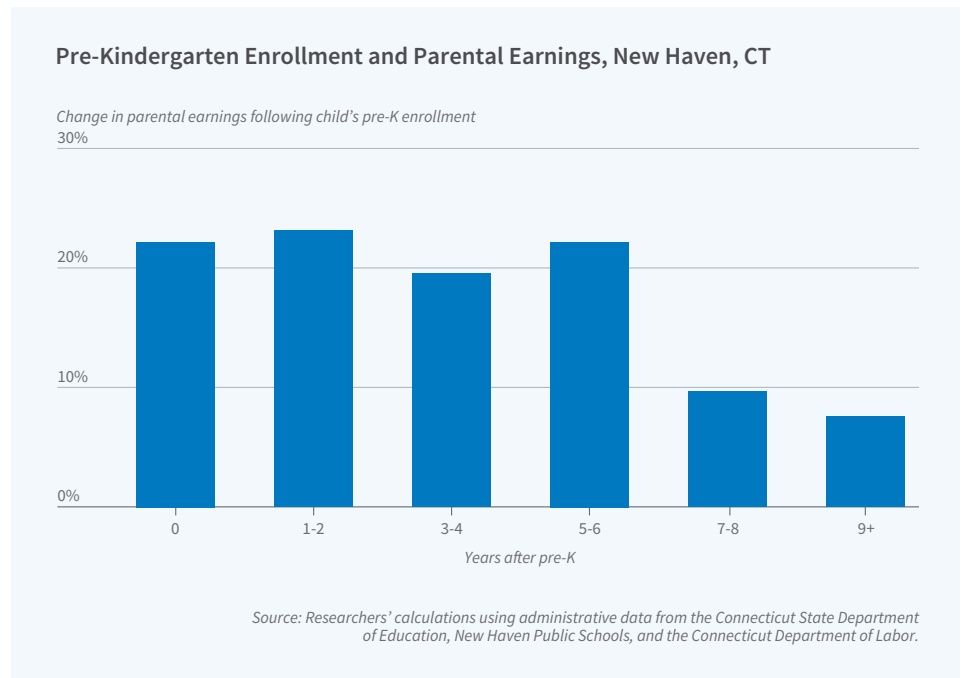
Universal Pre-K Access and Parental Earnings

In recent decades, cities, states, and the federal government have expanded funding for universal pre-kindergarten (UPK) programs. These programs are large and free. The policy logic underlying UPK expansion is that many parents may lack access to or underinvest in pre-kindergarten childcare and that the educational benefits for children and expanded labor market opportunities for parents combine to outweigh the costs of public provision.

In [Parents' Earnings and the Returns to Universal Pre-Kindergarten](#) (NBER Working Paper 33038), [John Eric Humphries](#), [Christopher Neilson](#), [Xiaoyang Ye](#), and [Seth D. Zimmerman](#) study whether UPK raises parents' earnings. The researchers examine UPK in the New Haven Public Schools (NHPS), which have offered full-day public pre-kindergarten to three- and four-year-olds since the late 1990s. New Haven's pre-K students are selected through a lottery system, allowing the researchers to compare outcomes between students who are selected for the free, all-day program and those who are not. The researchers link 20 years of NHPS pre-K lottery enrollment information with data on parental earnings and student achievement.

Enrolling a child in the NHPS UPK program raises parents' average earnings by \$5,461 per year, or 21.7 percent, during the one- or two-year period when the child is of pre-kindergarten age. These gains coincide with increases in hours worked: UPK enrollment allows parents to work 12.8 more hours per week in the year following enrollment.

Parents' earnings remain higher for at least the next six years. These gains are not driven by increased



Access to pre-kindergarten programs increases average parental earnings by over \$5,400 per year.

labor supply alone. The effects on hours worked fall towards zero after the pre-kindergarten period and effects on labor force participation are modest both during and after pre-kindergarten. This suggests that the long-run labor market effects of UPK may be attributable to returns to experience or job continuity, as UPK allows parents to maintain their career paths, keep consistent work hours, and possibly work more effectively.

The researchers find that UPK enrollment does not raise the fraction of children in childcare, as nearly all students selected for UPK substitute away from another childcare option. There is, however, a large effect on hours of childcare. Children who “win” the UPK lottery receive an average of 11.3 more hours of childcare coverage per week. This is because NHPS UPK programs offered a 10-hour

day for most of the study period, supplementing a 6.5-hour academic day with before- and aftercare, similar to extended-day programs in other cities.

The researchers find little evidence that UPK affects children's academic performance or behavior in the medium run. They find no statistically significant effects on test scores, attendance, or grade retention between kindergarten and the eighth grade.

The study suggests high returns to public investment in free, all-day early childhood care since gains in parental earnings offset the program's cost. On average, each \$1 of net government costs yields \$10 in benefits to families. These findings suggest the return to UPK is higher than that of many other active labor market policies.

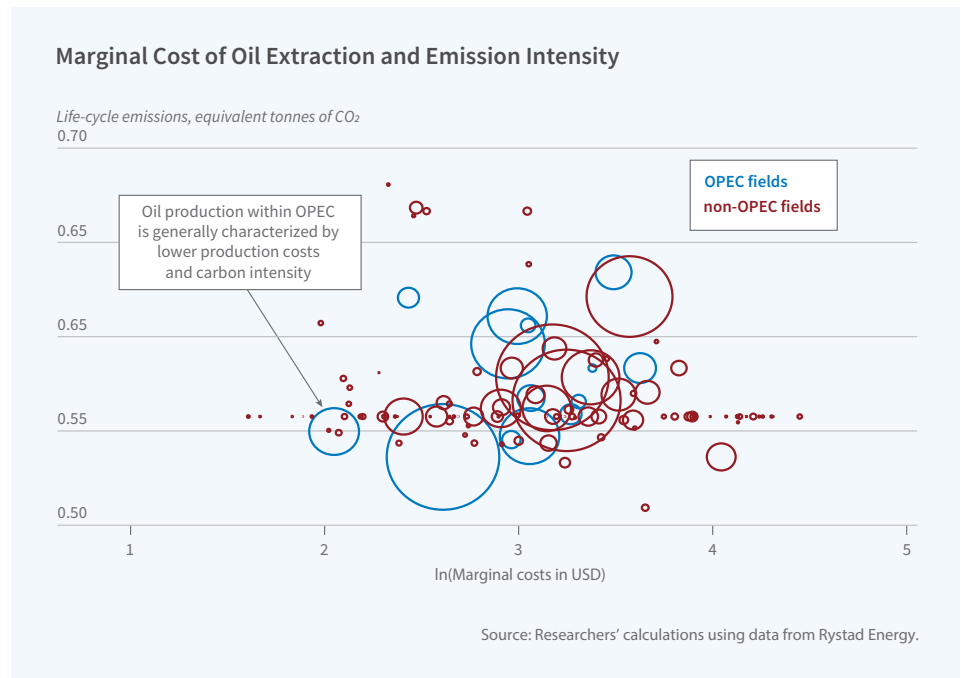
— Abigail Hiller

The Environmental Benefits of OPEC's Collusive Behavior

The global oil sector accounted for more than 40 percent of anthropogenic CO₂ emissions in 2021. The Organization of the Petroleum Exporting Countries' (OPEC) cartel power restricts oil supply, which in turn reduces the environmental externalities of fossil fuel use. OPEC's influence on prices also shifts production locations both across cartel members and between cartel members and nonmembers.

In [Two Wrongs Can Sometimes Make a Right: The Environmental Benefits of Market Power in Oil](#) (NBER Working Paper 33115), researchers [John Asker](#), [Allan Collard-Wexler](#), [Charlotte De Cannière](#), [Jan De Loecker](#), and [Christopher R. Knittel](#) use data from Rystad Energy and engineering estimates of the carbon intensities of oil production in different locations to examine how OPEC's market power has affected carbon emissions since 1970.

The researchers identify two competing ways market power can affect carbon emissions: the volume effect and the composition effect. The volume effect is the result of OPEC members restricting their production capacity to drive up global oil prices, which reduces overall consumption and thus total emissions. Over 80 percent of oil-related CO₂ emissions come from final consumption, not production. The countervailing composition effect is related to the other 20 percent. OPEC quantity restraint shifts production to non-OPEC producers who, on average, employ more energy-intensive oil extraction



Collusion by OPEC member nations has constrained global oil production, driving up prices and preventing an estimated \$4 trillion in emissions-related externalities since 1970.

methods. OPEC countries like Saudi Arabia, Qatar, and the United Arab Emirates emit approximately 0.54 tons of CO₂ per barrel of oil during extraction and refining, compared to 0.57 tons in Canada and 0.63 tons in the US. Production costs and carbon intensity are positively related because lower-cost fields generally require less energy for extraction and refining.

The researchers compare the actual history of oil, which reflects OPEC's market power, to a counterfactual scenario with a competitive oil market. They estimate that OPEC's market power reduced CO₂ emissions by 67.7 billion tons between 1970 and 2021. That is the

equivalent of four years of current oil consumption or 1.7 years of total global CO₂ emissions. Using a social cost of carbon of about \$60 per ton of CO₂, this translates to about \$4 trillion in avoided environmental damages.

Using the DICE climate model, the authors calculate the OPEC-related reduction in emissions helped to avoid a 0.028°C temperature increase in 2021. The reduction also represents about 18 percent of the remaining carbon budget needed to have a 50 percent chance of meeting the 2015 Paris Agreement's 1.5°C target.

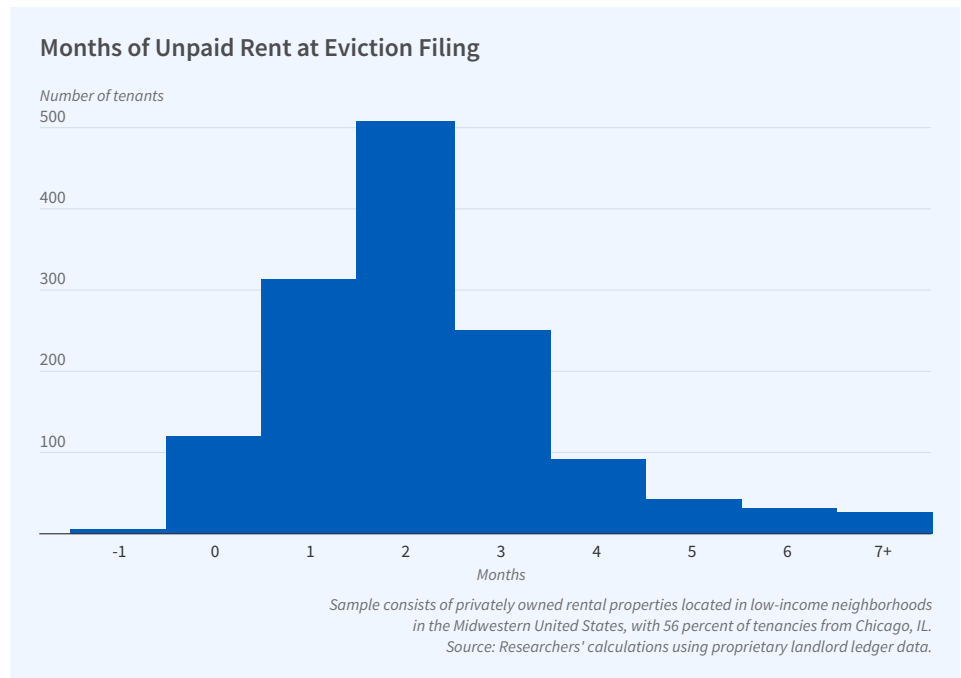
— Leonardo Vasquez

Can Policy Interventions Reduce Evictions?

In a typical year, about 5 percent of tenants have an eviction case filed against them. In [Nonpayment and Eviction in the Rental Housing Market](#) (NBER Working Paper 33155), [John Eric Humphries](#), [Scott T. Nelson](#), [Dam Linh Nguyen](#), [Winnie van Dijk](#), and [Daniel C. Waldinger](#) analyze lease-level landlord records to determine what leads to an eviction decision and how various policies might affect the eviction rate. They examine the payment and eviction histories of nearly 6,000 tenants between 2015 and 2019, which they describe as reflecting professionally managed rental properties in low-income neighborhoods of US urban areas.

In their data sample, nonpayment and eviction were common – more than 30 percent of tenants were at least two months behind on rent at the end of their tenancies, and nearly one in four tenants were evicted. However, landlords often tolerated some nonpayment and typically waited until a tenant had missed multiple payments to file for eviction. This suggests that landlords wait for uncertainty to resolve about whether the tenant would catch up. Indeed, almost half of the tenants in the sample fell behind on their rent at some point, but 39 percent of this group — or about 20 percent of the tenants analyzed — eventually resumed paying and repaid all the overdue rent.

Based on these patterns, the researchers estimate a dynamic discrete choice model of a landlord's decision to evict their tenant. Landlords behave as though it costs them between two and three months of rent to initiate an eviction proceeding. The authors also estimate that while many tenants recover from default, *evicted* tenants are less likely to. Only 15 percent of evicted tenants would have paid at



Rental assistance and legal aid delay or prevent some evictions, but have modest overall effects.

least 10 of the next 12 months of rent if the landlord had not evicted them.

The researchers model three types of interventions for averting eviction: taxing landlords for filing an eviction, delaying the eviction process through legal means, and providing short-term rental assistance. They calibrate each of these interventions to generate what they estimate would be a 5 percent reduction in the eviction rate.

The three policies differ substantially in the types of evictions prevented and the costs to landlords and taxpayers. A simulated eviction tax would result in tenants whose evictions are delayed or prevented staying a median of seven additional months in their rental units. The researchers calculate that of those whose evictions are delayed or prevented, 22 percent would have been able to pay at least 10 of their next 12 months of rent had they

not been evicted. In contrast, in a simulation where legal aid slows the eviction process, the median tenant whose eviction is delayed would stay four additional months, and only 12 percent of these tenants would have paid at least 10 of the next 12 months had they stayed. The legal aid option is particularly costly to landlords because it benefits the tenants least likely to pay. The third option, short-term rental assistance, results in outcomes for both landlords and tenants that fall between those for the tax and legal aid.

The researchers conclude that general policies with moderate costs to landlords and taxpayers “are unlikely to prevent the majority of evictions,” but they point out that policies precisely targeted to renters with a high likelihood of resuming payment in the future might be cost-effective.

— Steve Maas

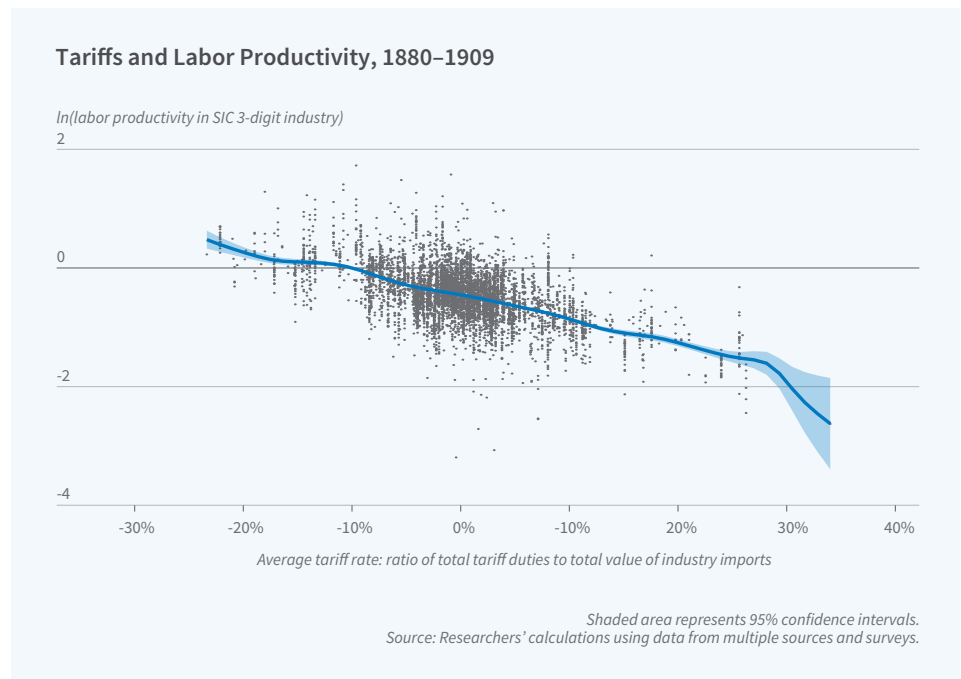
Tariffs and US Labor Productivity: Evidence from the Gilded Age

US tariff policy reduced labor productivity in the American manufacturing sector during the late nineteenth and early twentieth centuries, as [Alexander Klein](#) and [Christopher M. Meissner](#) report in [Did Tariffs Make American Manufacturing Great? New Evidence from the Gilded Age](#) (NBER Working Paper 33100).

The researchers find that at the industry level, higher tariffs were associated with reduced labor productivity, greater total output, more establishments, and more workers. They also find that higher tariffs were associated with lower output per establishment, suggesting that higher tariffs led to the entry of smaller, less productive firms.

The effects of tariffs varied significantly across industry subcategories. The negative effects were larger than in the manufacturing sector as a whole in industries such as advanced chemicals like rubber, oil, and dyes, and textiles and apparel. A small set of two dozen industries that were at the vanguard of the “second industrial revolution” exhibit some positive effect of tariffs on labor productivity, but there is still some uncertainty given the large standard errors on these coefficients. Moreover, the importance of these sectors in overall production was small, so the effect of a high tariff regime on overall labor productivity in manufacturing would likely also have been small.

To conduct their analysis, the researchers developed a novel database of product-level tariffs.



Tariffs on imported manufactured goods between 1870 and 1909 were associated with reduced labor productivity in domestic industries.

They digitized tariff information from the *Foreign Commerce and Navigation of the United States* for various fiscal years between 1869 and 1900. Product names from the data source were standardized, and products were assigned unique SITC codes to enable analysis at the industry level. Then, they matched the industry-level tariff data to industry-state-level manufacturing information drawn from the US Census of Manufactures for 1870, 1880, 1890, 1900, and 1909.

To avoid confounding cause and effect, the researchers focus on specific tariffs — tariffs specified as a fixed levy per unit of imports. The

ratio of the revenue from a specific tariff to the tariff-inclusive price of an imported good, a measure of the tariff rate in percentage terms, varies when the price of the foreign good changes. Foreign price changes can therefore be used as a source of exogenous tariff variation that is not related to potentially endogenous changes in tariff policy, which might be affected by industry conditions and lobbying efforts. These methods reveal some evidence consistent with the idea that industries comprised of politically influential firms were more successful in lobbying for tariff increases.

— Emma Salomon

The National Bureau of Economic Research is a private nonprofit research organization founded in 1920 and devoted to conducting and disseminating nonpartisan economic research. Its officers are:

James M. Poterba—President & CEO
Peter Blair Henry—Chair
Karen G. Mills—Vice Chair
Robert Mednick—Treasurer

The Digest summarizes selected Working Papers recently produced as part of the NBER's

program of research. Working Papers are intended to make preliminary research results available to encourage discussion and suggestions for revision. Neither the Working Papers nor The Digest have been subject to peer review or review by the NBER Board of Directors.

The Digest is free and may be reproduced with appropriate attribution to the NBER. Please provide the NBER's Communications team (ktasley@nber.org) with copies of anything reproduced.

Requests for print Digest subscriptions, changes of address, and cancellations may be sent to Digest, NBER, 1050 Massachusetts Avenue, Cambridge, MA 02138-5398 (please include the current mailing label), or emailed to subs@nber.org. Print copies of the Digest are only mailed to subscribers in the US and Canada; electronic subscriptions may be managed at my.nber.org/email_preferences.