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Measuring the Impact of Mobility Restrictions on Virus Transmission

Human mobility contributes to the transmission of infectious diseases that threaten global health. A principal response of many countries to the COVID-19 pandemic has been to impose restrictions on people's movements. However, such policies are controversial because they have a negative economic impact, and they also limit personal freedoms. To strike the right balance, it is essential to understand the effect of lockdowns on the spread of pandemics.

In **Human Mobility Restrictions and the Spread of the Novel Coronavirus (2019-nCoV) in China**, (NBER Working Paper 26906), Hanming Fang, Long Wang, and Yang Yang quantify the effectiveness of human mobility restrictions on efforts to control the spread of the disease and reduce health risks in Hubei province, the area of China in which the virus emerged.

The lockdown of 11 million people in the city of Wuhan on January 23, 2020, was at that point the largest quarantine in public health history. The researchers explore how the lockdown affected population movement and how population flows among Chinese cities affected virus

There would have been 65 percent more cases of COVID-19 in the 347 Chinese cities outside Hubei province had Wuhan not been locked down on January 23.

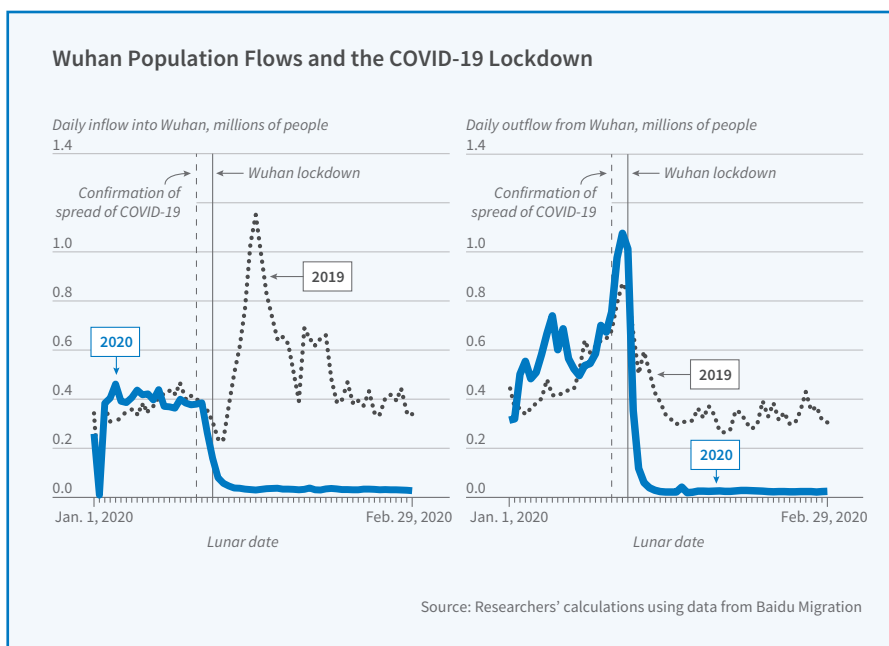infection rates in cities other than Wuhan. They estimate how many COVID-19 cases elsewhere in China were prevented by the Wuhan lockdown, and investigate whether social distancing policies in destination cities effectively reduced the spread of infection.

The researchers utilize datasets from Baidu Migration on population movement, as well as daily city-level data on the numbers of confirmed COVID-19 cases, recovered patients, and death tolls from the Chinese Center for Disease Control and Prevention. They focus on the sample period of January 1–February 29, 2020.

They employ difference-in-differences estimation strategies to disentangle the effect of the lockdown from three confounding effects. The first involves the fact that the virus broke out right before the Chinese Lunar New Year, on January 25.

Wuhan Population Flows and the COVID-19 Lockdown

Daily inflow into Wuhan, millions of people

Daily outflow from Wuhan, millions of people

Source: Researchers' calculations using data from Baidu Migration

This holiday, also known as "Spring Festival," is associated with the largest internal migration of the year in China. The second confounding effect, the "virus effect," is the precautionary activity of individuals in response to the COVID-19 outbreak, as even without a lockdown, they curtailed their public movements and tried to avoid virus exposure. Finally, for Wuhan and nearby cities, the researchers account for a possible "panic effect" which could have led to increased population outflow from the outbreak's epicenter and decreased inflow to it.

After controlling for these three effects, the researchers conclude that the Wuhan lockdown reduced inflow into the city by 77 percent, outflow by 56 percent, and within-Wuhan movement by 54 percent. They find that the lockdown significantly contributed to reduction in the total cases of infection outside of Wuhan, even with the social distancing measures later imposed by other cities.

The study estimates that there would have been 65 percent more COVID-19 cases in the 347 Chinese cities outside Hubei province, and 53 percent more in 16 Hubei province cities other than Wuhan, had Wuhan not been locked down on January 23.

Imposing enhanced social distancing policies in 63 cities outside Hubei province effectively reduced the impact of population inflows from the epicenter cities in Hubei province on the spread of the virus in destination cities elsewhere.

The results demonstrate the role human mobility restrictions can play in containing the spread of contagious disease, and suggest that their imposition can help reduce the peak number of cases and allow stressed medical systems a chance to better cope with the flow of new cases.

—Lauri Scherer

Social and Economic Impacts of the 1918 Influenza Epidemic

An estimated 40 million people, or 2.1 percent of the global population, died in the Great Influenza Pandemic of 1918–20. If a similar pandemic occurred today, it would result in 150 million deaths worldwide. In **The Coronavirus and the Great Influenza Pandemic: Lessons from the "Spanish Flu" for the Coronavirus's Potential Effects on Mortality and Economic Activity** (NBER Working Paper 26866), Robert J. Barro, José F. Ursúa, and Joanna Weng study the cross-country differences in the death rate associated with the virus outbreak, and the associated impacts on economic activity.

The flu spread in three waves: the first in the spring of 1918, the second and most deadly from September 1918 to January 1919, and the third from February 1919 through the end of the year. The first two waves were intensified by the final years of World War I; the authors work to distinguish the effect of the flu on the death rate from the effect of the war. The flu was particularly deadly for young adults without pre-existing conditions, which increased its economic impact relative to a disease that mostly affects the very young and the very old.

India lost 16.7 million people. Five hundred and fifty thousand died in the US. Spain's death rate was low, but the disease was called "Spanish flu" because the press there was first to report it.

The researchers analyze mortality data from more than 40 countries, accounting for 92 percent of the world's population in 1918 and an even larger share of its GDP. The mortality rate varied from 0.3 percent in Australia, which imposed a quarantine in 1918, to 5.8 percent in Ken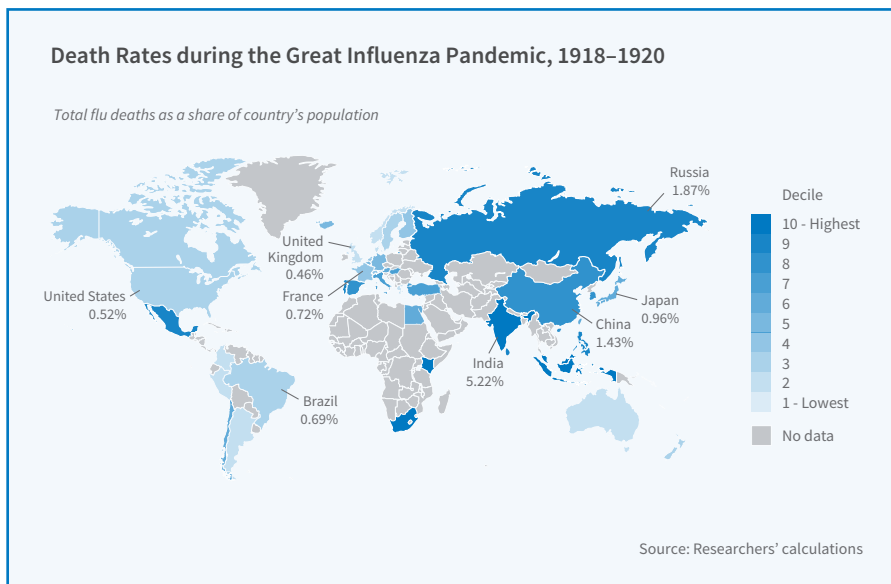ya and 5.2 percent in India, which lost 16.7 million people over the three years of the pandemic. The flu killed 550,000 in the United States, or 0.5 percent of the population. In Spain, 300,000 died for a death rate of 1.4 percent, around average. There is no consensus as to where the flu originated; it became associated with Spain because the press there was first to report it.

There is little reliable data on how many people were infected by the virus. The most common estimate, one third of the population, is based on a 1919 study of 11 US cities; it may not be representative of

Death Rates during the Great Influenza Pandemic, 1918–1920

Total flu deaths as a share of country's population

Russia 1.87%
United Kingdom 0.46%
France 0.72%
United States 0.52%
Japan 0.96%
China 1.43%
India 5.22%
Brazil 0.69%

Decile
10 - Highest
9
8
7
6
5
4
3
2
1 - Lowest
No data

Source: Researchers' calculations

the US population, let alone the global population.

The researchers estimate that in the typical country, the pandemic reduced real per capita GDP by 6 percent and private consumption by 8 percent, declines comparable to those seen in the Great Recession of 2008–2009. In the United States, the flu's toll was much lower: a 1.5 percent decline in GDP and a 2.1 percent drop in consumption.

The decline in economic activity combined with elevated inflation resulted in large declines in the real returns on stocks and short-term government bonds. For example, countries experiencing the average death rate of 2 percent saw real stock returns drop by 26 percentage points. The estimated drop in the United States was much smaller, 7 percentage points.

The researchers note that "the probability that COVID-19 reaches anything close to the Great Influenza Pandemic seems remote, given advances in public health care and measures that are being taken to mitigate propagation." They note, however, that some of the mitigation efforts that are currently underway, particularly those affecting commerce and travel, are likely to amplify the virus's impact on economic activity.

In a related study, **Non-Pharmaceutical Interventions and Mortality in US Cities during the Great Influenza Pandemic, 1918–19** (NBER Working Paper 27049),

Robert Barro analyzes data on the mitigation policies pursued by US cities as they confronted the flu epidemic. There were substantial cross-sectional differences in the policies that were adopted. Relative to the average number of flu deaths per week over the course of the epidemic, the number of flu deaths at the peak was lower in cities that pursued more aggressive policies, such as school closing and prohibition of public gatherings. However, the estimated effect of these policies on the total number of deaths was modest and statistically indistinguishable from zero. One potential explanation of this finding is that the interventions had a mean duration of only around one month.

— *Steve Maas*

Fear of Failure, Bank Panics, and the Great Depression

Between 1929 and 1932, the money supply and bank lending in the United States declined by more than 30 percent. In **Contagion of Fear** (NBER Working Paper 26859), Kris James Mitchener and Gary Richardson attribute much of this decline to the changing behavior of bank depositors. In 1930, after the collapse of Caldwell and Company, the largest bank-holding company in the South, runs on banks became widespread. The calling card of a panic, according to contemporaries, was the suspension of numerous banks in close proximity in a short period, such as within ten miles and 30 days. These panics deprived banks of deposits, which forced them to adjust their balance sheets and reduce lending to businesses and households. These declines in deposits and increases in reserves account for almost all of the decline in

Analysis of new data from the early 1930s suggests that depositors' fears led to runs on banks that were clustered in time and space. These panics significantly reduced lending and monetary aggregates.
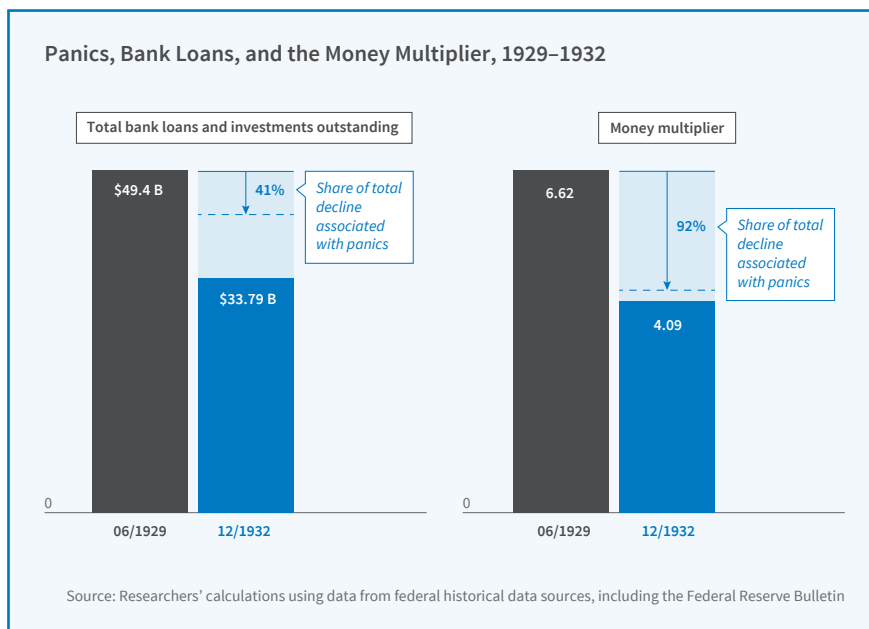
the money supply during the Great Depression.

The researchers assemble a new set of data on bank balance sheets, loans, deposits, and reserves as well as currency in circulation at the

Federal Reserve district level, most of which was originally published in the *Federal Reserve Bulletin*. The data allow them to calculate the money supply in each Fed district at call dates, roughly quarterly. They compare this new data to microdata on bank failures gathered from the archives of the Fed.

The data demonstrate that the average number of weekly bank suspensions doubled after Caldwell's failure in the fall of 1930, rising from 15.1 to 39.1. Panic-induced bank closures peaked in the last quarter of 1930 and in the last two quarters of 1931. Among the bank suspensions that occurred during panics, about 55 percent were associated with large

Panics, Bank Loans, and the Money Multiplier, 1929–1932

Total bank loans and investments outstanding

$49.4 B
41% — Share of total decline associated with panics
$33.79 B

Money multiplier

6.62
92% — Share of total decline associated with panics
4.09

0   06/1929   12/1932

0   06/1929   12/1932

Source: Researchers' calculations using data from federal historical data sources, including the Federal Reserve Bulletin

regional or national events, while the remainder were due to local conditions.

The researchers find that when banks failed during periods that were not classified as panics, there was usually a "flight to quality," with deposits flowing to Federal Reserve member banks; these banks were likely seen as more stable than non-member banks. During panics, however, the reverse was true, and deposits flowed out of the banking system, even from Fed member banks. These outflows were associated with reduced lending, although the magnitude of the effect varied by place. For each dollar that flowed out of a Federal Reserve System member bank in New York or Chicago, the two central reserve cities, business loans declined by an estimated 35 cents. By comparison, a dollar flowing out of a member bank in another city on average reduced lending by 54 cents. At non-member banks, a one-dollar deposit outflow was associated with a 51-cent decline in loans.

Combining microeconomic data on individual bank suspensions with these econometric estimates allows the researchers to calculate the aggregate impact of panics on economy-wide lending. Their findings indicate that banking panics reduced lending in banks that remained in operation by $6.4 billion, nearly twice the $3.3 billion in loans and investments trapped in failed banks. Keeping the money supply constant at the pre-Depression level would have required a 60 percent expansion in the monetary base. This expansion would have been feasible, given resources available to the Fed at the time, and would not have seemed unreasonable in the decades after the Depression. It was, for example, only one-third as large as the 200 percent expansion in the monetary base that policymakers enacted following the failure of Lehman Brothers in 2008. The researchers note that their findings underscore the importance of bank balance sheets in both downturns and recoveries.

— Linda Gorman

After Working with Female Peers, Federal Judges Hire More Women

Labor-market discrimination can be harmful to those who are discriminated against as well as to society at large, since discrimination can lead to inefficient allocation of workers to potential jobs. There is an active debate over the extent of such discrimination, and how to address it.

In **Professional Interactions and Hiring Decisions: Evidence from the Federal Judiciary** (NBER Working Paper 26726), Marco Battaglini, Jorgen M. Harris, and Eleonora Patacchini study how one oft-discussed remedy for labor market discrimination — increased professional exposure to members of an out-group, in this case women — affects hiring practices.

US appellate court judges are randomly assigned to hear cases, typically alongside two colleagues who also are randomly assigned. As a result, the number of female colleagues with whom a given judge will hear cases is essentially random. The researchers use this source of variation to analyze how increased exposure to female colleagues affects judges' future decisions in the hiring of law clerks. Clerks' jobs are prestigious positions typically filled by graduates of top law schools. Judges enjoy almost complete control over the hiring of their law clerks.

Male judges who hear more cases alongside female judges are 4.3 percentage points more likely to hire a female law clerk subsequently.

The researchers hypothesize that judges may increase their hiring of female law clerks after working with female judi-

Working with Female Colleagues and Hiring Female Clerks

Probability of hiring at least one female clerk
100%

Male judges / Female judges

■ *Actual data*   ■ *After doubling of interactions with senior female colleagues*

Thin gray lines represent 95% confidence intervals
Source: Researchers' calculations using data from the *Judicial Yellow Book* and leagle.com

cial colleagues because they have a more positive view of women's professional capabilities. Using data from the Judicial Yellow Book and a database of federal court cases, the researchers find that judges who hear more cases alongside female colleagues are 4 percentage points more likely to hire at least one female law clerk in the following year. They also examine whether exposure differentially affects judges who vary in meaningful ways — by gender, age, experience level, political affiliation, status, quality, and current law clerk staff composition. The effects of exposure to female judicial colleagues are larger for men, for judges whose current roster of law clerks is majority male, and for less-experienced judges. For example, male judges who hear more cases alongside female judges are 4.3 percentage points more likely to hire a female law clerk subsequently, while female judges who hear more cases alongside female judges are 1.6 percentage points more likely to hire a female law clerk subsequently.

The researchers note that most of the judges in the sample are older and began
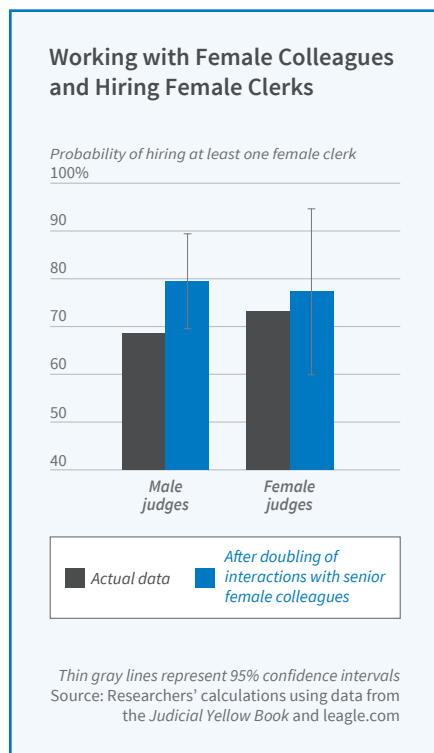
their careers when women were less prevalent in the legal profession. "Federal judges make hiring decisions in a labor market where women are significantly more numerous and successful than they were when the judges first entered the legal profession and the judiciary," they write.

The researchers note that their findings have important implications for the labor market and for companies seeking to diversify their ranks. "[I]ncreases in the diversity of the upper rungs of a profession can shift attitudes in a way that creates opportunities at the entry level of the profession," they conclude. "[I]ncreasing the diversity in the leadership of a profession… may have benefits beyond their immediate beneficiaries."

— *Dwyer Gunn*

Who Pays and Who Benefits from Public Infrastructure Projects

Transit infrastructure is a critical asset in most cities, but it is expensive to build. To finance expenditures of this magnitude, local governments must either be able to identify revenue streams that will cover the cost, or argue that there are going to be substantial non-revenue benefits from the project.

In **Taking the Q Train: Value Capture of Public Infrastructure Projects** (NBER Working Paper 26789), Arpit Gupta, Stijn Van Nieuwerburgh, and Constantine Kontokosta show that in the case of New York City's Second Avenue subway extension, the increase in city revenues recouped only a fraction of the project's costs, even though the benefits to firms and households were well in excess of these costs.

The Second Avenue subway extension, served by the Q train, was the most substantial investment in public subway infrastructure in the United States in the past several decades. It was completed in 2017. The public return on the project could be defined narrowly as the project's user fees net of operational expenditures, and broadly to include the incremental property, sales, and labor income tax revenues. Even the broader revenue stream captures only some of the benefits of the project, since it ignores the value of reduced air and noise pollution, less traffic, and the jobs created by the project. Most of these benefits are challenging to measure or to include in a cost-benefit calculation.

The researchers find that the project reduced commuting time, as expected. They estimate the commuting-time benefits of the subway extension using mobile

> The Second Avenue subway extension cost $4.5 billion and generated more than $7 billion in property appreciation, but public revenue rose by only a fraction of the benefits.

phone location data. They document substantial reductions. Commutes shortened by three minutes for all nearby residents, and by 14 minutes for residents who took the subway.

To gauge the total private benefits of the project, the researchers note

The Manhattan Q Line Extension

96 St
4
5
6
86 St
Q
72 St
63 St
F
N R W

Existing subway   Q line extension

Intended for illustrative purposes only

that real estate values in the vicinity of public transportation hubs capitalize the present value of all future benefits that accrue to households and businesses from transportation gains. They find that residential and commercial real estate asset values in the area defined as the Second Avenue Corridor (properties between 1st and 3rd Avenues) rose by approximately 10 percent, or about $7 billion, after the subway was extended, relative to other properties on the Upper East Side.

While the rise in real estate values exceeded the $4.5 billion cost of the project, suggesting that this project would pass a standard cost-benefit test, the city collected relatively little of this benefit. It was projected to receive only about $2.1 billion in future property taxes as a result of the extension-induced increase in property values; the other $2.4 billion in costs would be defrayed by taxpayers who did not benefit from the project. Thus more than two-thirds of the value created by this project accrued to private property owners. The researchers note that cities would find it easier to cover the cost of infrastructure projects if they were able to levy targeted property taxes on the properties whose owners benefited most from them.

— *Lauri Scherer*
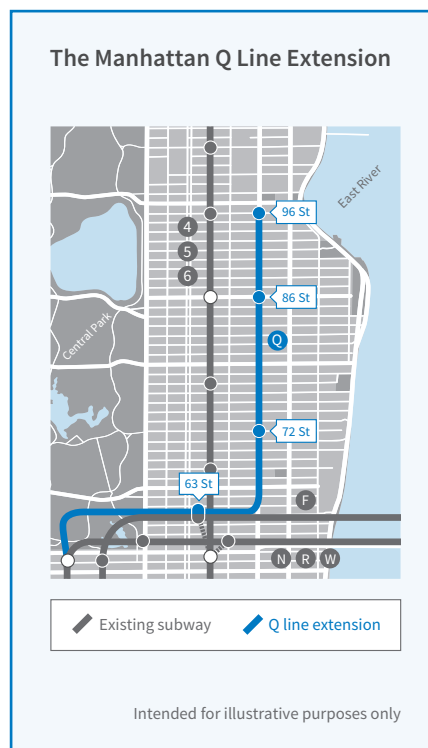
Copyright and Creativity: Italian Opera during the Napoleonic Age

Copyright laws introduced in two Italian states following Napoleon's late 18th-century military victories increased the number and quality of new operas, according to Michela Giorcelli and Petra Moser. Their study, **Copyright and Creativity: Evidence from Italian Opera during the Napoleonic Age** (NBER Working Paper 26885), illuminates the positive impact that copyright can play in promoting creativity.

The researchers focus on Lombardy and Venetia, two states that adopted copyright laws in 1801, after they came under French rule. The 1801 law granted composers in these states exclusive rights to their works for life, and an additional 10 years after their deaths to their heirs. With this law composers were not only compensated for writing an opera, but also received additional pay for each repeat performance of their work.

The study compares the number of new operas created in Lombardy and Venetia once copyright was introduced to the quantity created in six other Italian states where copyright was not introduced until the mid-1820s. The analysis draws on the detailed historical records of 2,598 operas premiered in these eight states by more than 700 Italian-born composers between 1770 and 1900.

Before 1801, composers created new operas at a similar rate in states with and without copyright, 1.6 and 1.4 per state-year espectively. After the introduction of copyright, the number of new operas by composers in Lombardy and Venetia increased threefold, to 4.6 per state-year by 1820, while operatic output in other states only increased by 50 percent. Indicators for the level of demand for new operas across the eight states, such as GDP per capita, population, the number of theaters, and the level of urbanization, were similar in states with and without copyright, suggesting that preexisting differences in demand cannot explain the marked difference in creative output across states.

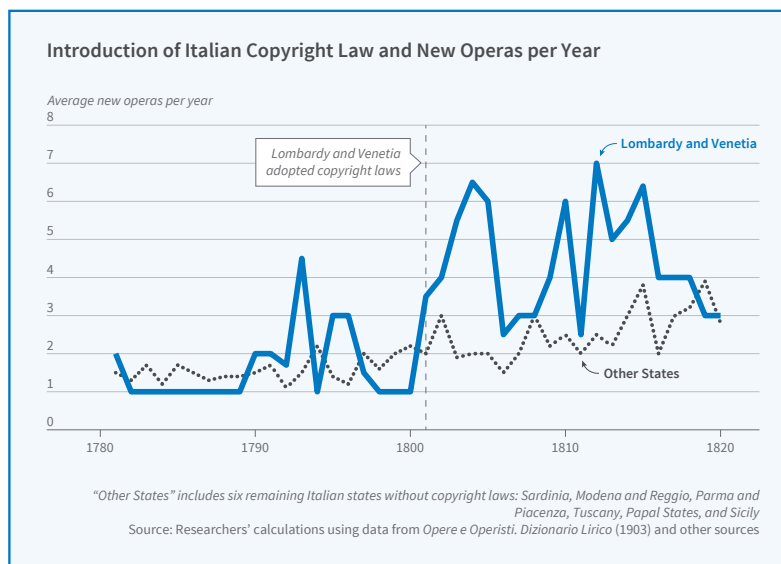The researchers do not find any evidence for a composer "brain drain," whereby productive composers moved from other Italian states to states with copyright. Instead they find that copyright motivated productive Italian-born émigrés to Austria and France to return to Italy.

Copyright also improved the quality of operas, measured by their historical popularity and durability. First, the researchers track

> When copyright law increased the financial returns to composition in Italian states conquered by France, both the quantity and quality of new operas rose.

operas that were popular in their time through to a standard reference of "notable" performances. They find that operas from Lombardy and Venetia were more likely to be immediate hits, and to be performed again after their premiere. Second, the researchers use operas that were performed at least once at New York's Metropolitan Opera between 1900 and 2014 as a measure of an opera's popularity and durability. Third, they collect operas sold as complete recordings on Amazon today to identify the most durable works. All of these measures indicate that composers in states with copyright produced more popular and durable operas than those in states without copyright.

Importantly, however, these results only apply to the original adoption of copyright. The researchers show that copyright extensions beyond the life of the composers create no benefits in terms of more and better operas.

— *Jennifer Roche*

Introduction of Italian Copyright Law and New Operas per Year

Average new operas per year

Lombardy and Venetia adopted copyright laws

Lombardy and Venetia

Other States

"Other States" includes six remaining Italian states without copyright laws: Sardinia, Modena and Reggio, Parma and Piacenza, Tuscany, Papal States, and Sicily
Source: Researchers' calculations using data from *Opere e Operisti. Dizionario Lirico* (1903) and other sources