

INSIDE THIS ISSUE

- Automation Can Be a Response to an Aging Workforce
- High-Speed Rail Expansion and German Worker Mobility
- Exploring Wide Productivity Variances among EU Firms
- Corporate Money in Politics: A Philanthropic Channel
- Postdoctoral Fellowships and Career Choice in Science

When It Comes to Entrepreneurs, Youth Isn't Everything

Star innovators such as Bill Gates, who was 19 when he started Microsoft, Steve Jobs, 21 when he started Apple, and Mark Zuckerberg, 19 when he launched Facebook, have reinforced the long-standing impression that young people are the wellspring of entrepreneurship. Systematic data on firm founders, however, suggest that this impression is false.

In **Age and High-Growth Entrepreneurship** (NBER Working Paper No. 24489), [Pierre Azoulay](#), [Benjamin Jones](#), [J. Daniel Kim](#), and [Javier Miranda](#) provide evidence that, on average, successful entrepreneurs are middle-aged.

They analyzed administrative data from the U.S. Census Bureau on more than 2.7 million business founders whose companies subsequently hired at least one employee. The mean age of founders was 42. When looking at the highest-growth startups in the economy, the mean age at founding rose still higher — to 45.

The study explores not just the age of founders, but the factors that are correlated

with firm success. Founders with prior work experience closer to the specific industry of the start-up, and founders with longer experience in that indus-

try, have substantially greater success rates. “For the 1 in 1,000 highest-growth firms, founders with three or more years of experience in the 2-digit industry see upper tail success at twice the rate” of founders with no

experience in the 2-digit industry, the researchers report.

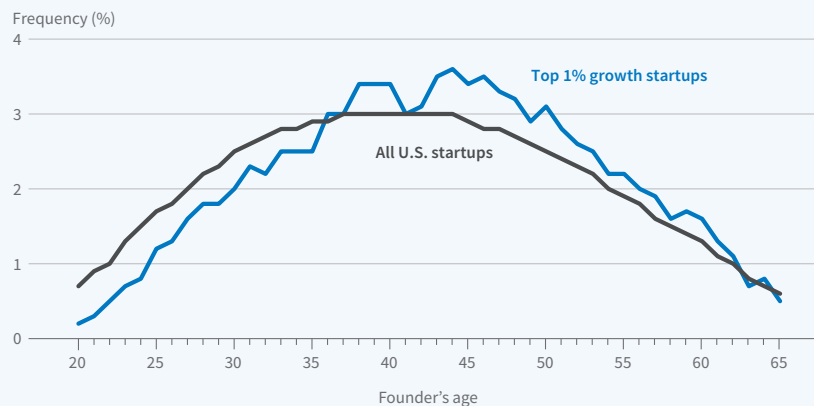
The study takes two approaches to examining growth-oriented startups.

While it is a widely held belief that youth and entrepreneurship go hand in hand, research finds that more successful entrepreneurs launch their enterprises in their 40s than in their 20s.

try, have substantially greater success rates. “For the 1 in 1,000 highest-growth firms, founders with three or more years of experience in the 2-digit industry see upper tail success at twice the rate” of founders with no

The first considers technology orientation, which can suggest the potential for high growth. The second considers the actual outcome for the firm, based on the three-, five-, or seven-year time window after founding.

Age Distribution of Startup Entrepreneurs



“All U.S. startups” includes data from 2007–14
“Top 1% growth startups” includes data from 2007–09
Source: Researchers’ calculations using data from W-2 records, K-1 forms, and the Longitudinal Business Database

Using third-party venture capital databases, the researchers determine whether a given company has received venture capital financing. They argue that such funding is suggestive of substantial growth potential. They also use employment growth and sales growth as defining characteristics of a high-growth new venture.

“... [C]omputing-oriented ventures as

well as wireless telecom ventures appear to have the youngest founders,” they write. “Yet even here the mean founder ages range from 38.5 to 40.8 ...”

The study also explores geographical heterogeneity, and separately considers California, Massachusetts, and New York. These three states account for the majority of high-growth startup activity in the U.S. Even in these states, success-

ful entrepreneurs are still middle-aged. The youngest entrepreneurs in this part of the analysis, whose mean age was 38.7, were founders of venture capital-supported companies in New York.

When the set of 2.7 million founders was reduced to the 1,900 associated with companies that were both located in entrepreneurial hubs and received venture backing, the mean age

of founders was 39.5.

The researchers conclude with a comment about current practices in the venture financing industry. “To the extent that venture capital targets younger founders, early-stage finance appears biased against the founders with the highest likelihood of successful exits or top 1 in 1,000 growth outcomes.”

— Alex Verkhivker

Automation Can Be a Response to an Aging Workforce

Some worry that rapid technological progress, specifically in automation and robotics, may lead to workers being replaced by machines in many industries, and that this will generate societal disruptions not seen since the onset of the Industrial Revolution. The authors of **Demographics and Automation** (NBER Working Paper No. 24421) offer a different narrative. [Daron Acemoglu](#) and [Pascual Restrepo](#) show that changing demographics are one factor that relates to the adoption of new technologies. An aging workforce leads to automation, particularly through robotics, as employees react to a scarcity of middle-aged workers. New automation and robotic technologies are deployed more rapidly in countries where young and middle-aged workers are comparatively scarce.

The researchers study the demographic differentials within industries and between countries in an effort to explain the large country-to-country differences in the adoption of new automation and

robotic technologies. The number of industrial robots per thousand workers in the U.S. manufacturing sector, for instance, stood at 9.1 in 2014; the numbers were significantly higher in Japan

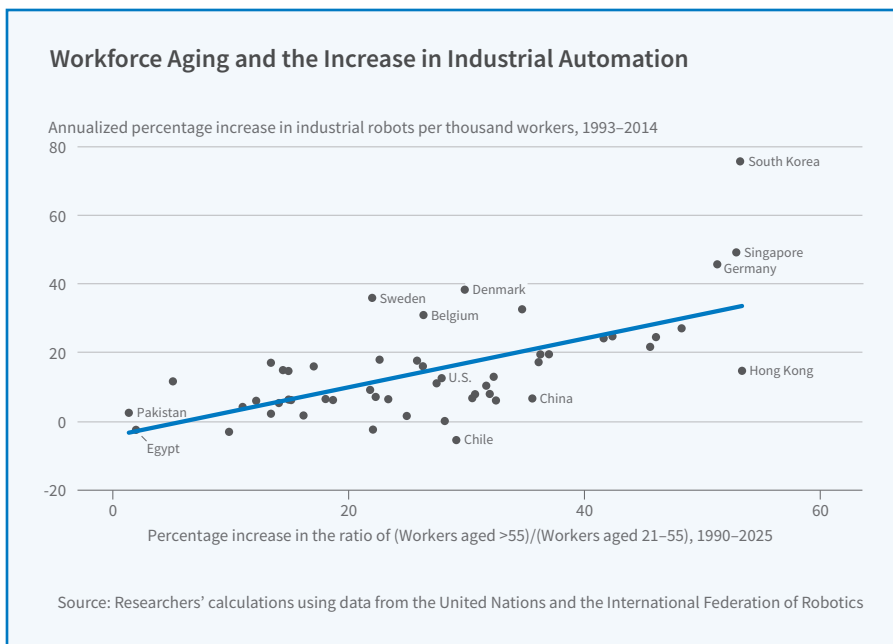
and Germany (17.0), both of which have older populations. Using data from a variety of sources, including the International Federation of Robotics, the researchers zero in on the age distribution of the working popula-

New technology can sometimes replace workers in jobs for which there are no longer enough humans.

tion as a potential driver of robotic innovation. They define middle-aged workers as those between the ages of 26 and 55, and older workers as those over the age of 55. They find that countries that are

undergoing more rapid aging, meaning that they are experiencing a greater proportional decrease in the number of middle-aged workers relative to older workers, invest significantly more in robotics. They are more likely to develop new technologies and manufacture robots, and to deploy these robots in production.

Population aging can explain almost 40 percent of the country-to-country variation in the adoption of industrial robots. The researchers estimate that a 10 percentage point increase in the ratio of the number of middle-aged to older workers is associated with 0.9 more robots per thousand workers. In their



sample of developed countries over the last two decades, the average number of robots per thousand workers was three.

The researchers estimate that demographic differences can explain 25 percent of the gap in the number of robots per worker between the United States and Germany. They also find

that the shift to automation is more pronounced in industries that traditionally rely more heavily on middle-aged workers.

While the implications of population aging for a nation's productivity are ambiguous, and depend on how technology responds to demographic

change, the implications for the relative productivities of specific industries are clear: "[B]ecause of the induced increase in automation, industries with the greatest opportunities for automation should increase their value added per worker relative to other industries."

—Jay Fitzgerald

High-Speed Rail Expansion and German Worker Mobility

Starting in the late 1990s, Germany expanded its high-speed rail network (HSR), connecting outlying locales to large urban areas. In **The Effect of Infrastructure on Worker Mobility: Evidence from High-Speed Rail Expansion in Germany** (NBER Working Paper No. 24507), [Daniel F. Heuermann](#) and [Johannes F. Schmieder](#) study how this large-scale infrastructure investment affected commuter behavior. They find that the expansion reduced travel times and increased commuting, as workers moved to jobs in smaller cities while keeping their places of residence in larger urban areas.

Until the late 1990s, the HSR system connected the largest cities of Germany. The connected cities were located in just three of the 16 German states. Areas between the large cities, through which the tracks ran, campaigned for stations, and in a second wave of expansion, the government added stops in many of these cities.

The researchers analyze the effects of this infrastructure improvement by comparing cities granted stops in the second wave of expansion with other small German cities that were not added to the rail network. They note that new rail stops were not placed due to economic conditions, such as connectedness to urban centers, but because of political factors. Moreover, unlike infrastruc-

Expansion of the network between larger and smaller cities reduced travel times by 13 minutes on average, and increased the number of commuters working in smaller cities while retaining homes in larger ones.

ture investments in roads and highways, the HSR system exclusively carries passengers. It does not transport goods, so it affects labor but not product markets.

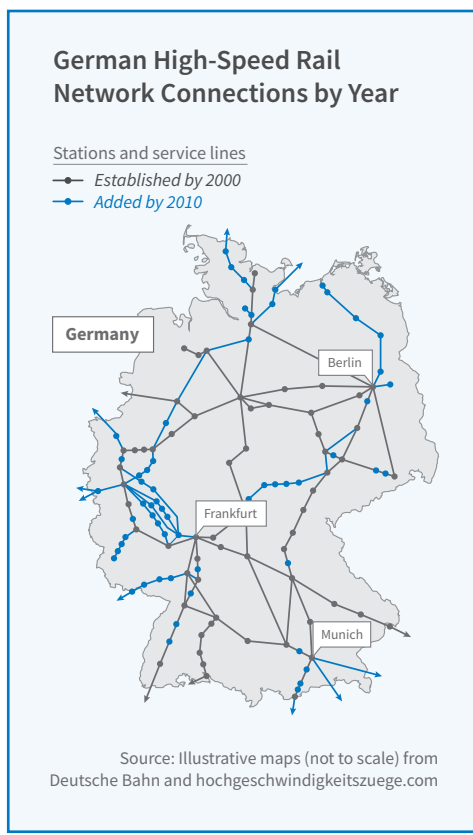
The researchers create a dataset that includes travel times, train schedules, and

administrative employment data, which contain the region of work and residence for each traveler.

For the average pair of cities in their study, the high-speed rail expansion reduced travel time by 13 minutes, or about 10 percent of the pre-expansion time. The number of commuters rose by 0.25 percent for each 1 percent decrease in travel time. Reductions in commuter time and the corresponding increase in passengers followed an inverted U-shaped pattern, with the largest impacts occurring on routes of 200 to 500 kilometers in length.

The researchers estimate that 840,000 people started to use rail transportation for commuting during their 1994–2010 sample period. Twelve percent of the increase in ridership was attributable to the 10 percent reduction in commuting time as a result of HSR expansion.

The researchers find that the number of commuters from small cities to large cities is 40 percent larger than the number commuting from large to small cities. The opposite pattern, however, commuting from large cities to small, was much more sensitive to the reduction in travel time from HSR expansion. This supports the view that workers



enjoy living in large urban areas and are not there solely for employment.

The study concludes that the gains from the investment in infrastruc-

ture accrued mainly to smaller cities. Commuters are twice as likely as non-commuters to be college graduates, which suggests that building HSR net-

works may be one way to engage relatively high-skilled workers in the economies of peripheral regions.

—Morgan Foy

Exploring Wide Productivity Variances among EU Firms

European companies vary widely in output per unit of capital and labor, which means that the European Union (EU) does not produce as much as it could if resources were allocated more efficiently, according to **Resource Misallocation in European Firms: The Role of Constraints, Firm Characteristics and Managerial Decisions** (NBER Working Paper No. 24444).

The cross-firm spread in labor and capital productivity in EU countries is about twice as large as that in the United States, [Yuriy Gorodnichenko](#), [Debora Revoltella](#), [Jan Svejnár](#), and [Christoph T. Weiss](#) calculate. Reducing the EU dispersion to US levels—a change that would likely require many significant policy reforms—could increase the EU’s GDP by more than 30 percent.

The researchers measure firm productivity by studying the marginal revenue product of an extra unit of capital and an extra unit of labor. They find that the cross-firm dispersion of the estimated marginal revenue product of capital (MRPK) has been increasing steadily since the 1990s. The dispersion of the marginal revenue product of labor (MRPL) has also risen, but not as much as the dispersion of MRPK.

To understand why firm productivity varies so widely, the researchers survey a random

sample of firms in each of the EU’s 28 nations and match the survey answers to an administrative database with firm-level information. This makes it possible to assess how well firm characteristics, as well as industry-level and country-level variables,

Nation- and industry-specific barriers keep resources from flowing to the most efficient firms in the European Union. Their complete elimination could boost EU GDP by almost one-third.

can explain firm-level productivity. The variables that help to explain the variation in firm productivity include firm demographics, measures of input quality, capacity utilization, and indicators of the dynamic adjustment of inputs. For example, an older firm with a dated capital stock may be less efficient than a newer firm with state-of-the-art technology and recently acquired capital. Higher capacity utilization is also

associated with higher productivity.

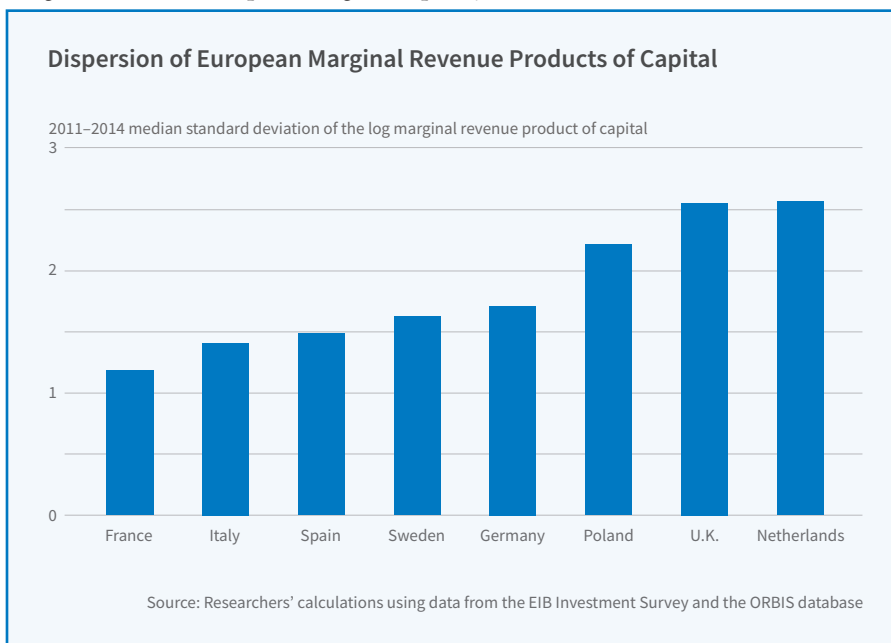
The researchers find that when they constrain the effects of these variables to be the same in all EU countries, firm-level characteristics can explain 11.2 percent of the variation in MRPK, and 27.1 percent of the varia-

tion in MRPL. When they allow the effect of firm-level variables to differ across countries, so that the effect of a rise in capacity utilization influences the predicted productivity of a German firm differently than an Italian firm, they can explain most of the variation in productivity. The researchers show that, in terms of labor allocation, firms are more segmented across countries than across industries, as seen in the fact that differences

in the levels of MRPL are higher across countries than across industries. The opposite is true for capital. This suggests that national regulations and language barriers could play an important part in the efficiency of resource allocation within the EU.

They also find that measures of each country’s business, institutional, and policy environment contribute to explaining the dispersion of firm productivity.

—Laurent Belsie



Corporate Money in Politics: A Philanthropic Channel

The channels through which corporations may support elected officials is a subject of long-standing and contentious debate in the United States. Firms' capacity to spend on behalf of elected officials of whom they approve increased markedly with the Supreme Court's Citizens United decision in 2010. While a large body of research has studied the determinants of corporate political contributions and has attempted to track their consequences, almost no attention has been paid to another channel through which corporations may interact with elected officials: corporate philanthropy.

Do corporations which support or have business with office holders make sizeable charitable donations either to charities located in those politicians' districts, or on whose boards the politicians serve?

This is the question examined by [Marianne Bertrand](#), [Matilde Bombardini](#), [Raymond Fisman](#), and [Francesco Trebbi](#) in **Tax-Exempt Lobbying: Corporate Philanthropy as a Tool for Political Influence** (NBER Working Paper No. 24451).

Using data on corporate charitable giving, lobbying, and congressional committee assignments, the researchers construct a measure that links corporate interests, which are declared in corporate lobbying disclosure forms, to relevant congressional committees, and then to the members of those committees.

Studying corporate foundations

associated with Fortune 500 and S&P 500 companies, they find that a foundation's grants to charitable organizations located in a congressional district

Nonprofit organizations with a member of Congress on their board are four times more likely than peer organizations to receive grants from corporate foundations.

are higher when the representative of that district holds a seat on a committee that deals with policy relevant to the firm associated with the foundation. This pattern surrounding corporate charitable giving and committee seats is echoed in corporate political action committee (PAC) spend-

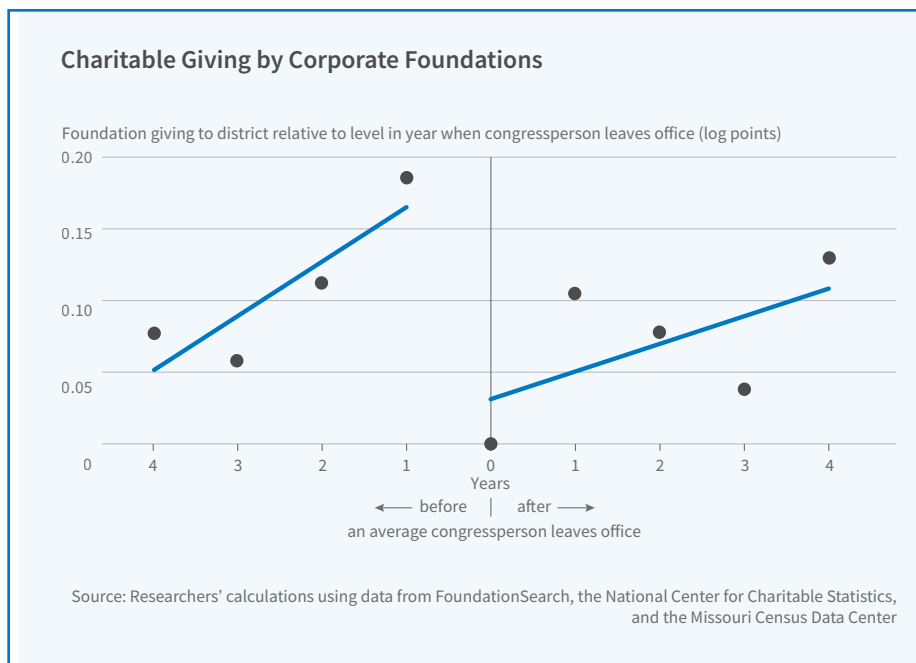
the congressperson serves. Corporate foundations are more likely to support a nonprofit with a member of Congress on its board if that member sits on a

committee relevant to the corporation. In general, nonprofit organizations with a politician on their board are over four times more likely to receive grants from corporate foundations than are their comparable peer foundations.

The researchers develop a model to assess the fraction of corporate charity that may be politically motivated, and estimate that about 7 percent of the \$18 billion in total corporate charitable contributions made in 2014, or about \$1.3 billion, was allocated in ways that might have had political motivation. They note that this is 280 percent higher than annual PAC contributions made to candidates in the 2013–14 cycle, and about 40 percent of total annual lobbying expenditures in 2014.

The research suggests that campaign donations and lobbying may not be the only channels through which corporations seek to influence elected officials. They see their findings “as highlighting the need to go beyond easily observable channels in order to gain a broader appreciation of the full role of corporate influence in politics.”

— Dwyer Gunn



ing. When legislators leave Congress, there is a drop in corporate donations into their districts, as seasoned and influential members of Congress are replaced by freshmen, a pattern that also appears for PAC contributions.

Similar patterns are observed in corporate giving to nonprofits in which members of Congress have a personal interest, such as those on whose board

Postdoctoral Fellowships and Career Choice in Science

What works in supporting the pipeline of scientific talent development? The National Institutes of Health (NIH) has been asking that question for decades, and has funded undergraduate and graduate fellowships, research grants, and other programs designed to train and encourage promising young scientific researchers.

In **The Impact of Postdoctoral Fellowships on a Future Independent Career in Federally Funded Biomedical Research** (NBER Working Paper No. 24508), [Misty L. Heggeness](#), [Donna K. Ginther](#), [Maria I. Larenas](#), and [Frances D. Carter-Johnson](#) explore the effects of the NIH's Ruth L. Kirschstein National Research Service Award (NRSA). This is a training program that supports undergraduate, graduate, and postdoctoral fellowships. The researchers focus on its post-graduate component, and conclude that this program has raised the number of scientists carrying out NIH-funded biomedical research.

In 2008, the NRSA spent about \$751 million supporting research for 16,370 researchers, of whom 1,487, or about 9 percent, received so-called "F32" postdoctoral fellowships. Competition for the awards can be fierce.

Over the years, a number of studies have been conducted to measure the impact of the NRSA training programs.

A perennial question is whether fellowship programs raise the likelihood of a career in science, or whether they simply

regular how fellowship receipt affects the number of NIH research grants that a researcher receives over the course of his

The National Research Service Award program increased the number of postdoctoral researchers who subsequently received an NIH grant.

keep Ph.D. recipients in the research field for a few years before they pursue other opportunities. The new study focuses specifically on the F32 program and how it affects the careers of fellowship recipients. The researchers consider in partic-

ular how fellowship receipt affects the

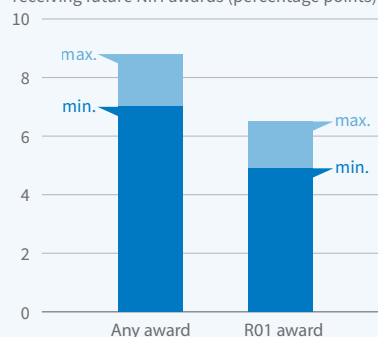
The study draws on data from the NIH, the National Science Foundation, and other sources. It focuses on 14,276 F32 fellowship applicants over the period from 1996 to 2008, and on NIH grant applications through 2015. The researchers tracked NIH grants to all of the F32 fellowship applicants through their post-fellowship careers. They compared the grant experiences of researchers who received fellowships to those of researchers with very similar characteristics, going by their fellowship applications, but who did not win a fellowship.

The study finds that receiving an NRSA fellowship increases the likelihood that a researcher will continue to be involved in NIH-funded research later in his or her career by between 6.3 and 8.2 percentage points. The probability that a researcher will subsequently receive an NIH-funded "R01" grant award, an indication of an independent research career, rises by between 4.6 and 6.1 percentage points.

—Jay Fitzgerald

National Institutes of Health Postdoctoral Fellowships and Subsequent Research Funding

Fellowship winners' change in probability of receiving future NIH awards (percentage points)



An R01 award is highly prestigious and indicative of a successful independent research career
Source: Researchers' calculations using data from the National Institutes of Health

NBER

The National Bureau of Economic Research is a private nonprofit research organization founded in 1920 and devoted to objective quantitative analysis of the American economy. Its officers are:

James M. Poterba—President & Chief Executive Officer
Karen N. Horn—Chair
John Lipsky—Vice Chair

The **NBER Digest** summarizes selected Working Papers recently produced as part of the Bureau's program of research. Working Papers are intended to make preliminary research results available to economists in the hope of encouraging discussion and suggestions for revision. The **Digest** is issued for similar informational purposes and to stimulate discussion of Working Papers before their final publication. Neither the Working Papers nor the **Digest** has been reviewed by the Board of Directors of the NBER.

The **Digest** is not copyrighted and may be reproduced freely with appropriate attribution of source. Please provide the NBER's Public Information Department with copies of anything reproduced.

Individual copies of the NBER Working Papers summarized here (and others) are available online free of charge to affiliates of subscribing organizations, such as universities and colleges, and to employees of NBER corporate associates. For others, there is a charge of \$5 per downloaded paper or \$10 per hard copy paper. Outside of the United States, add \$10 per hard copy order for postage and handling. To order, email the NBER Subscriptions Department at subs@nber.org or call (617) 588-1405; please have the Working Paper number(s) ready.

A full subscription to the NBER Working Papers entitles the subscriber to all new papers, recently more than 1,100 per

year. The online standard rate for a full digital subscription is \$2,400; the online academic rate is \$1,115. Subscriptions are free for corporate associates. The standard rate for hard-copy subscribers is \$10,000 per year and the academic rate is \$8,000. Higher rates apply for international hard-copy orders.

Partial Working Paper subscriptions, delineated by program, are also available. For further information, see our website, or write: National Bureau of Economic Research, 1050 Massachusetts Avenue, Cambridge, MA 02138-5398.

Requests for **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 U.S. and Canada; those in other nations may request electronic subscriptions at www.nber.org/drsunsubscribe/.