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## Welfare Implications of Falling Natural Gas Prices

Advances in horizontal drilling and hydraulic fracturing have allowed U.S. natural gas producers to profitably extract gas from shale formations previously considered uneconomic. From 2007 to 2013, production grew by more than 25 percent, leading to a sharp drop in prices. From 2000 to 2010, the average price of natural gas in the United States was \$6.81 per thousand cubic feet in 2013 dollars. Since 2011, it has averaged \$3.65 per thousand cubic feet.

In **Welfare and Distributional Implications of Shale Gas** (NBER Working Paper No. 21115), [Catherine Hausman](#) and [Ryan Kellogg](#) use new estimates of natural gas supply and demand elasticities to estimate the broad welfare and distributional effects of the natural gas supply boom. They find that it generated net economic benefits, not including environmental impacts, of \$48 billion in 2013, which consists of a gain of \$74 billion per year in consumer surplus benefits and a reduction of \$26 billion per year in producer surplus benefits. As prices fall, this “consumer surplus” rises. A similar effect operates in the reverse direction for producers, though it is counteracted by the supply expansion itself. Some producers are able to extract natural gas for less than the prevailing market price, and they receive “producer surplus” as a result. When prices fall, the magnitude

of this surplus declines. Natural gas producers with wells that were operating before the

states such as Arkansas and Pennsylvania that experienced large increases in new shale pro-

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Researchers estimate that falling U.S. natural gas prices between 2007 and 2013 generated consumer benefits of \$74 billion in 2013 and reduced producer welfare by \$26 billion annually.

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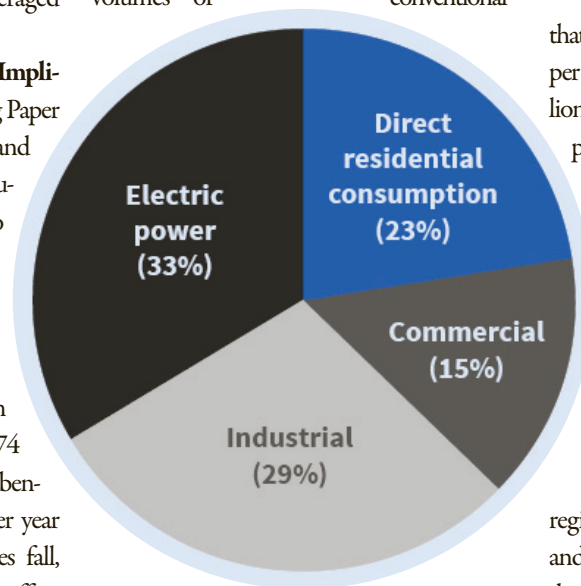
shale gas boom received lower revenues from their existing wells; therefore, states with large volumes of conventional

production but had little conventional production saw increases in producer benefits.

The consumer surplus estimates suggest that lower prices created benefits of \$17 billion per year to residential natural gas users, \$11 billion per year to commercial users, \$22 billion per year to industrial users, and \$25 billion per year to electric power utilities. Benefits to commercial and industrial purchasers and to utilities ultimately accrue to those who purchase their products as well as to their employees and shareholders. The gains to these entities are therefore included in the \$74 billion consumer surplus estimate.

Residents of the West South Central region — Arkansas, Louisiana, Oklahoma, and Texas — benefited most from the price decline because their industrial and electric power sectors use large amounts of natural gas. The estimated benefit in the region was \$432 per person per year. Benefits in New England were \$190 per person per year.

The results also suggest that low-cost natural gas stimulated manufacturing activity.



**CONSUMER BENEFITS OF LOWER NATURAL GAS PRICES**  
Most savings come from reduced electric, industrial, and commercial costs  
Source: Authors' estimates using Energy Information Administration data

natural gas production experienced declines in annual benefits to producers. Meanwhile,

The authors use data from the 2002, 2007, and 2012 Economic Censuses to compare the pre-boom period, 2002 to 2007, with the boom period, 2007 to 2012. They compare industries above and below the 90th percentile in their intensity of natural gas use, labeling the first group “highly dependent” on natural gas and the second group “less dependent.” They find that industries that are highly dependent on natural gas contracted less during the post-2008

economic downturn, and increased rather than decreased employees’ compensation, arguably—though not conclusively—as a result of the favorable shock to natural gas prices that coincided with the economy-wide recession.

Fertilizer manufacturers are the most intensive users of natural gas in the U.S. economy. From 2002 to 2007, fertilizer manufacturing establishments decreased by 9.5 percent and fertilizer manufacturing employ-

ment decreased by 15.8 percent. Between 2007 and 2012, however, fertilizer manufacturers increased employment by 8.6 percent, establishments by 8.3 percent, employee compensation by 24.8 percent, and capital expenditures by 232.7 percent. The authors report that low U.S. natural gas prices are also a driving force behind plans to increase U.S. ethylene production sharply.

—Linda Gorman

## Demystifying the Chinese Housing Boom

China’s housing-price appreciation from 2003–13 has been enormous—stronger than during the recent U.S. housing bubble and more on the order of Japan’s property boom in the 1980s, according to **Demystifying the Chinese Housing Boom** (NBER Working Paper No. 21112). Would a drop in house prices wreak havoc on China’s financial markets and its economy more generally? A number of factors suggest that the risk of a price decline is modest and that the effects of a decline would be muted, according to researchers [Hanming Fang](#), [Quanlin Gu](#), [Wei Xiong](#), and [Li-An Zhou](#).

One key factor is that the rise in Chinese housing values has been accompanied by an equally strong rise in household income. Another is that even though those at the lower rungs of the income chain are buying homes that are worth eight, sometimes 10, times their annual disposable income, the Chinese have shown remarkable resilience in holding onto their property. One reason is that buyers in China typically put down more than 35 percent on a home, which reduces their mortgage payments and insulates the buyers and the banks that lend to them from a plunge in property values.

“[T]he housing market is unlikely to trigger an imminent financial crisis in China, even though it may crash with a sudden stop in the

Chinese economy and act as an amplifier of the initial shock,” the authors conclude.

By studying comprehensive mortgage

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Large down-payments and sharp recent increases in household income mean the housing frenzy in China is unlikely to trigger a national financial crisis.

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data from a major Chinese commercial bank, the authors constructed a set of housing price indices for 120 major cities in China. Since many Chinese buildings are new, there are not yet many resales of units. The researchers there-

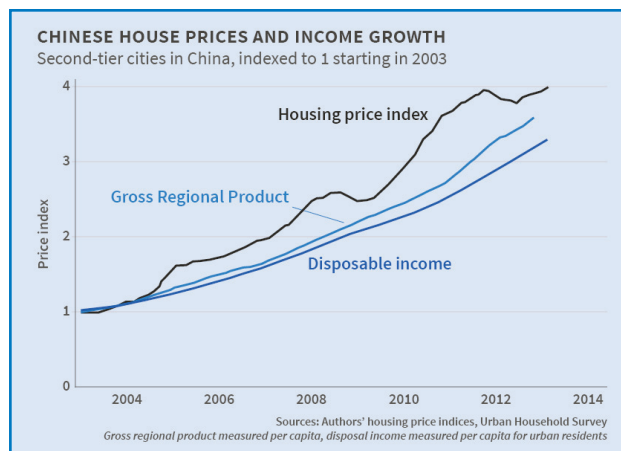
appreciation was 10.5 percent; in third-tier cities, 7.9 percent.

A key difference between the Chinese

house price run-up of the last decade, and the U.S. house price bubble of the early 2000s and the Japanese house price increase of the 1980s, is that Chinese incomes have grown sharply as prices have risen. The authors calculate that during the period studied household income grew at an average annual real rate of 9.0 percent in China, except in the first-tier cities, where the growth was closer to 6.6 percent a year.

“The enormous income growth rate across Chinese cities thus provides some assurance to the housing boom and, together with the aforementioned high mortgage down payment ratios, renders the housing market an unlikely trigger for an imminent financial crisis in China,” they write.

Still, there are risks. Chinese home-buyers, especially those whose incomes fall in the bottom 10 percent of homeowners, take on extreme financial burdens to buy homes. They pay up to 10 times their annual disposable income to buy a property. These house-



fore measured the price rise over time by comparing similar housing units within the same development. They found that in first-tier cities—Beijing, Shanghai, Guangzhou, and Shenzhen—housing prices rose by an annual average real rate of 13.1 percent between 2003 and 2013. In second-tier cities, annual real

holds—typically near the 25th percentile of the overall income distribution—have to save about three years of their household income to accumulate a down payment. Even with a generous down payment, say 40 percent, which reduces the monthly loan payment, and a relatively low 6 percent

mortgage interest rate, such households will still need to devote 45 percent of their disposable income to servicing the loan.

Households can make that work as long as income continues its rapid growth, but there are signs that China's economy is slowing. The authors caution that if China's growth

rate does decline, and especially if the economy experiences a sudden stop with a dramatic decline in growth, then house prices could decline. Even if this did not destabilize the financial system, they warn, the decline could amplify the initial shock to economic activity.

—Laurent Belsie

## Thinking, Fast and Slow: Efforts to Reduce Youthful Crime in Chicago

Disparities in youth outcomes in the United States are striking. For example, among 15-to-24 year olds, the male homicide rate in 2013 was 18 times higher for blacks than for whites. Black males lose more years of potential life before age 65 to homicide than to heart disease, America's leading overall killer. A large body of research emphasizes that, beyond institutional factors, choices and behavior contribute to these outcomes. Those choices include decisions around dropping out of high school, involvement with drugs or gangs, and how to respond to confrontations that could escalate to serious violence.

In **Thinking, Fast and Slow? Some Field Experiments to Reduce Crime and Dropout in Chicago** (NBER Working Paper No. 21178), authors Sara B. Heller, Anuj K. Shah, Jonathan Guryan, Jens Ludwig, Sendhil Mullainathan, and Harold A. Pollack explain these behavioral differences using the psychology of automaticity. Because it is mentally

costly to think through every situation in detail, all of us have automatic responses to some of the situations we encounter. These responses—automaticity—are tuned to situations we commonly face.

The authors present results from three large-scale, randomized experimental studies carried out in Chicago with economically disadvantaged male youth. All three experiments show sizable behavioral responses to fairly short-duration, auto-

maticity-reducing interventions that get youths to slow down and behave less automatically in high-stakes situations.

Interventions that get youths to slow down and behave less automatically in high-stakes situations show positive results in three experiments.

The first intervention (called *Becoming a Man*, or BAM, developed by Chicago-area nonprofit Youth Guidance) involved 2,740 males in the 7th through 10th grades in 18 public schools on the south and west sides of

graduation rates of between 7 and 22 percent.

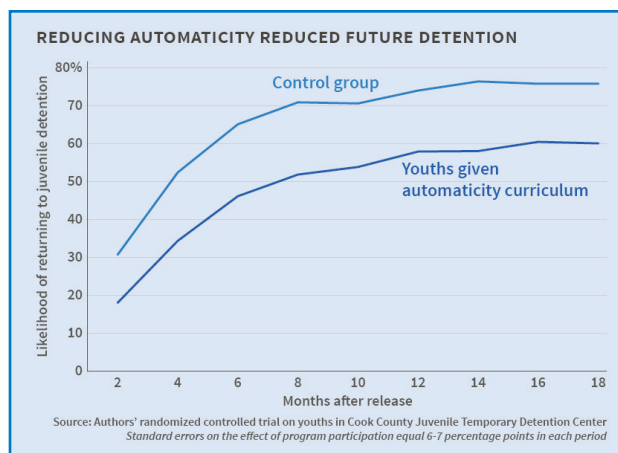
A second study of BAM randomly assigned 2,064 male 9th and 10th graders

within nine Chicago public high schools to the treatment or to a control condition. The authors found that arrests of youth in the treatment group were 31 percent lower than arrests in the control group.

The third intervention was delivered by trained detention staff to high-risk juveniles housed in the Cook County Juvenile Temporary Detention Center. The curriculum in this program, while different from the first two interventions, also focused on reducing automaticity. Some 5,728 males were randomly assigned to units inside the facility that did or did not implement the program. The authors found that those who received programming

were about 16 percent less likely to be returned to the detention center than those who did not.

The sizable impacts the authors observe from all three interventions stand in stark contrast to the poor record of many efforts to improve the long-term life outcomes of disadvantaged youths. As with all randomized experiments, there is the question of whether these impacts generalize to other samples and settings. The interventions considered in this study would not be costly to expand. The



the city. Some youths were offered an automaticity-reducing program once a week during school or an after-school sports intervention developed by Chicago nonprofit World Sport Chicago. The authors find that participation in the programming reduced arrests over the program year for violent crimes by 44 percent, and non-violent, non-property, non-drug crimes by 36 percent. Participation also increased engagement with school, which the authors estimate could translate into gains in

authors estimate that the cost of the intervention for each participant in the first two studies was between \$1,178 and \$2,000. In the third case, the per-participant cost was about \$60 per juvenile detainee. The results suggest that expanding these programs may be more cost-

effective than other crime-prevention strategies that target younger individuals.

The authors also present results from various survey measures suggesting the results do not appear to be due to changes in mechanisms like emotional intelligence or self-con-

trol. On the other hand results from some decision-making exercises the authors carried out seem to support reduced automaticity as a key mechanism. The results overall suggest that automaticity can be an important explanation for disparities in outcomes.

—Les Picker

## ‘Consumer-Directed’ Health Plans Appear to Lower Spending

**I**n Do ‘Consumer-Directed’ Health Plans Bend the Cost Curve Over Time? (NBER Working Paper No. 21031), [Amelia M. Haviland](#), [Matthew D. Eisenberg](#), [Ateev Mehrotra](#), [Peter J. Huckfeldt](#), and [Neeraj Sood](#) found that total annual health spending fell by 6.6, 4.3, and 3.4 percent in the three years after the firms studied began offering their employees health plans in which high deductibles were paired with tax-advantaged personal medical accounts to incentivize patients to reduce health-care spending.

Total annual health spending was defined as the amount paid by the employer, the insurer, and the employee. Most of the spending reduction occurred in outpatient care and pharmaceutical spending. It was not accompanied by increases in emergency department or inpatient spending. The reduction in care utilization is consistent with insured individuals being price-sensitized when faced with relatively high prices at the point of service in consumer-directed health plans.

Consumer-directed plans account for an estimated 20 percent of the insurance coverage provided by U.S. employer plans. The authors compared total annual health spending from 2003 to 2007 in 26 firms offering consumer-directed preferred provider plans to 5 million employees with that of 28 control firms offering traditional preferred-provider plans to 8 million employees.

Firms offering consumer-directed plans were recruited from clients of Towers

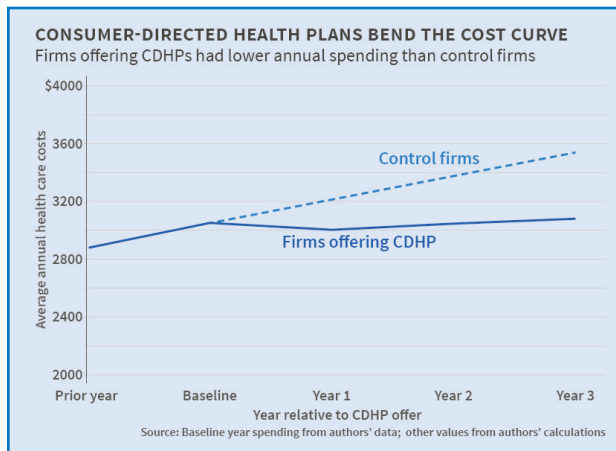
Watson. Firms offering traditional plans were recruited from among employers contributing to MarketScan, a dataset maintained then

by Thomson Reuters and now by Truven Health Analytics. They were selected to match approximately the geographic region, size, and industry distribution of the firms

Total annual health spending on 5 million employees in firms offering consumer-directed plans was compared to spending on 8 million employees in firms offering traditional plans.

to ensure that each firm’s sample employee composition characteristics in each succeeding year roughly matched those of the sample in the initial year.

Consumer-directed health plans are expected to reduce spending because they combine employee-specific accounts that are funded on a pre-tax basis with standard health coverage that has a higher deductible and a lower premium than traditional plans. Either the employer or the employee can contribute to the employee account and balances roll over from year to year. In this sample, average consumer-directed deductibles were roughly \$1,400. Average



with consumer-directed plans. Data for all firms included employee age, gender, marital status, and number of children, along with individual enrollment and claims data, information on individual accounts, employer contributions, and plan deductibles.

This kind of comparison assumes that both sets of firms face the same health expenditure growth trend. One challenge is that the larger firms in the study are dynamic entities with multiple locations. The health, and health spending habits, of their employ-

ees can change as their overall employee profile changes. The authors addressed this by constructing individual weights designed

traditional coverage deductibles were slightly more than \$100. Median employer contributions to employee accounts were \$500 a year. Funds in the employee account can be used to pay for out-of-pocket expenses that are part of the health insurance plan but that are not covered, for example for deductible payments. If an employee’s account is empty, he is responsible for paying his deductible amount.

In theory, the incentive to control spending varies with consumer-directed account design. Health Reimbursement Accounts,

which made up almost 60 percent of the consumer-directed accounts in the first offer year and 75 percent in the third, are owned by employers. Unused funds accumulate from year to year but revert to the employer when an employee changes firms or retires. Funds

in Health Savings Accounts are owned by the employees. They follow their owners from job to job, across insurers, and into retirement.

The authors conclude that employers offering consumer-directed health plans spend less, but stress that further research is

needed to determine optimal benefit design, as the extent to which reductions are due to patients foregoing needed care is unknown. They caution that their results are limited to large employers and families with at least one full-time worker.

—Linda Gorman

## How Fast Are Semiconductor Prices Falling?

After falling rapidly through the mid-2000s, the price of computer chips has declined very slowly in recent years according to the Producer Price Index (PPI). The slowdown is especially puzzling given the continuing rapid advances in semiconductor technology.

In **How Fast Are Semiconductor Prices Falling?** (NBER Working Paper No. 21074), David M. Byrne, Stephen D. Oliner, and Daniel E. Sichel address this puzzle. The researchers focus on microprocessor units (MPUs), which account for about half of the semiconductors produced in the United States, and on pricing by Intel, the largest manufacturer of these chips. They determine that the matched-model procedure used to calculate the PPI for MPUs is not appropriate under the pricing regime that Intel adopted in the mid-2000s. That was when Intel began keeping the list prices of existing chips largely unchanged. Prior to 2003, the price of a particular Intel MPU model tended to drop fairly rapidly in the year or two following its introduction, especially once newer and faster models became available. By 2006, however, the posted price of a specific model tended to remain constant even after faster chips became available.

This change in Intel's behavior could account for the disconnect between continuing improvements in MPU performance and the reported slow-down in price declines. While it may work well in many settings, the authors argue that the matched-model methodology that underlies the PPI generated

biased estimates in the case of MPUs after the mid-2000s. In particular, when a chip's posted list price declines little if at all over its life cycle, the corresponding matched-model index will fall very slowly even if newly-introduced

Microprocessor unit (MPU) prices are declining faster than the Producer Price Index suggests, according to research into pricing practices over the last decade.

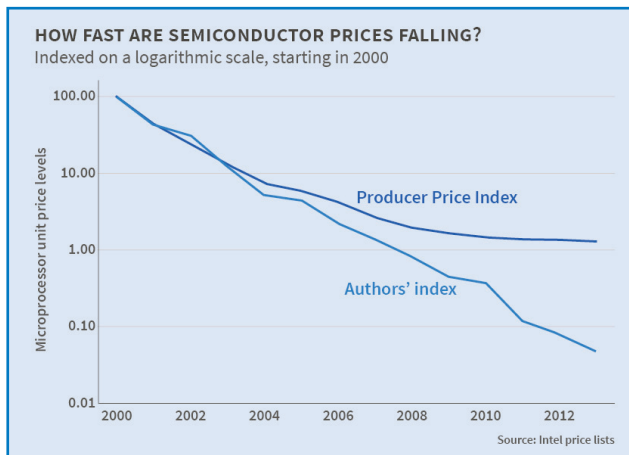
chips enter the market at greatly reduced, quality-adjusted prices. The authors suggest that hedonic indexes, such as one they develop that incorporates an end-user measure of performance to control for quality changes, provide a more accurate measure of price change

The authors find that quality-adjusted MPU prices continued to fall rapidly after the mid-2000s, contrary to the picture from the PPI. Their results have important implications for understanding the rate of

improvements in semiconductors, the pace of overall innovation, and, potentially, the U.S. economy more generally. They conclude that concerns that the semiconductor sector has begun to fade as an engine of growth appear to be unwarranted, and that in fact rapid advances have continued.

However, the researchers note, their results raise a new puzzle. In recent years, the price index for computing equipment in the National Income and Product Accounts has fallen quite slowly by historical standards. If MPU prices have in fact continued to decline rapidly, why has this not been reflected in the price of computers? They suggest that the official price indexes for computers may be inaccurate, in part because of the challenge of identifying the relevant and likely changing characteristics that determine quality. The authors suggest that end-user performance measures like the one they develop to study MPUs could also help to improve the estimation of computer price indexes.

—Matt Nesvisky



since the mid-2000s. Their hedonic index of MPU prices tracks the PPI closely through 2004. However, from 2004 to 2008 their preferred index fell faster than the PPI, and this disparity grew after 2008. Between 2008 and 2013, for example, their preferred index fell at an average annual rate of 43 percent, while the PPI declined at only an 8 percent annual rate.

## Are Larger Cities Losing Their Edge?

Nearly a century ago, the eminent economist Alfred Marshall hypothesized that ideas were more likely to germinate into useful inventions in large cities than in smaller ones. Innovators working in close proximity to other creative minds, he argued, had a greater opportunity to learn of the latest advances and to engage in brainstorming.

In *Cities and Ideas* (NBER Working Paper No. 20921), Mikko Packalen and Jay Bhattacharya test this conjecture. They study U.S. patents granted between 1836 and 2010, and calculate the population density per square mile where the inventor resided. This enables them to distinguish patents that were developed in urban areas from those that were developed elsewhere. They also identify the key concepts that each patent refers to, which in turn reflect the scientific or engineering foundation on which the patent is based. For each concept, they search the entire patent database to determine the date on which this concept was first mentioned. This makes it possible to classify patents based on the age of their scientific background. A patent for which the key concept first appears in the patent database just one year before the patent was filed is based on “younger” innovations than a patent for which the key concept has been

referenced in patents for several decades.

The authors find that, on average, patents that were filed by inventors in densely

The tendency for patents filed by inventors in densely populated areas to rely on newer scientific breakthroughs has waned in

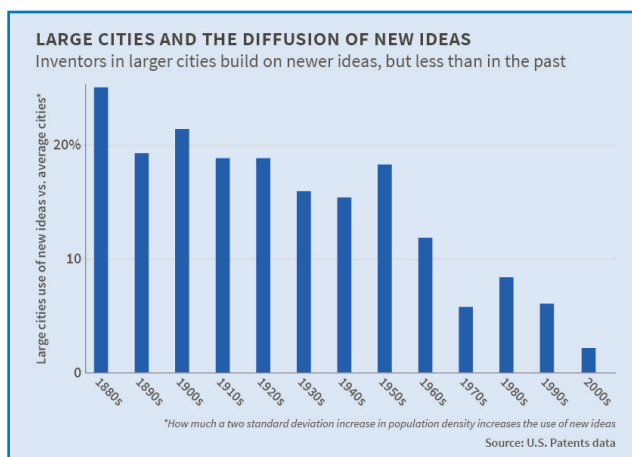
Inventors in densely populated areas relied on newer scientific breakthroughs more than their more-isolated peers until the middle of the 20th century, after which the disparity steadily narrowed.

populated areas relied on newer science than patents filed by their more-isolated peers

recent decades. There was a decline between the 1950s and the 1970s, and, after an uptick in the 1980s, a decline again in the 1990s and 2000s. “Taken together,” the authors write, “our results suggest that in the late 20th century agglomeration has become less important to innovation both in absolute terms and relative to other factors—like collaboration—that predict the use of newer ideas.”

The authors hypothesize that the recent decline in the difference in use of newer breakthroughs between more- and less-densely populated areas may be due to the spread of new communication technologies that have made new ideas available more readily to all. For example, with the emergence of the Internet, virtual communities may be erasing the advantage of physical proximity, and those in less-urban areas may be able to participate as effectively as those in larger cities in debating the merits and application of new ideas.

— Steve Maas



until the middle of the 20th century. In 1900, for example, a two standard deviation increase in the population density of an inventor’s home town was associated with a 20 percent increase in the probability that the patent would be one that relied on the latest scientific advances. The study defines a patent as using “latest advances” if the age of the patent’s key concept falls in the youngest 5 percent of the concept age distribution.

populated areas may be due to the spread of new communication technologies that have made new ideas available more readily to all. For example, with the emergence of the Internet, virtual communities may be erasing the advantage of physical proximity, and those in less-urban areas may be able to participate as effectively as those in larger cities in debating the merits and application of new ideas.

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