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BULLETIN ON AGING AND HEALTH

How Intellectual Property Rights Affect Innovation

Technological progress in health care is a double-edged sword, providing considerable benefits to patients but also contributing very substantially to rising health care costs. The laws governing intellectual property rights, such as patents and copyrights, are one lever the government has at its disposal to influence the rate of technological progress. The traditional motivation for intellectual property is to provide incentives for research on new technologies. However, new products often require several steps of invention and research, implying that intellectual property on an existing technology may affect incentives for research on subsequent applications of and improvements on the initial discovery. Relatively little is known about this question of how intellectual property rights affect cumulative innovation.

In “**Intellectual Property Rights and Innovation: Evidence from the Human Genome**” (NBER Working Paper 16213), researcher Heidi Williams explores this relationship by analyzing the sequencing of the human genome.

In the late 1990s and early 2000s, there were two major efforts to sequence the human genome, one by the public Human Genome Project and the other by the private firm Celera. The two groups took different approaches to DNA sequencing, and as a result some genes were sequenced first by the public effort and others were sequenced first by Celera. If a gene was sequenced first by Celera, Celera’s intellectual property placed restrictions on how research-

ers at other institutions could use the gene sequence data, and required some institutions to pay substantial fees in order to access the data. Once a gene was sequenced by the public effort, it was placed in the public domain—with the stated goal of encouraging research and development. By the end of 2003, all genes were in the public domain.

Williams explores whether genes first sequenced by Celera experienced a different level of subsequent innovation than did genes first sequenced by the public effort. Innovation is measured here both in terms of published scientific research and the development of gene-based diagnostic tests.

To examine this question, Williams constructs a unique gene-level data set including the roughly 28,000 known genes on the human genome. For each gene, she records whether the gene was held with Celera’s intellectual property for a period of time; this occurred in 6 percent of genes. She then measures the number of published scientific papers related to all genotype-phenotype links for each gene (that is, links between a gene and an observable trait, such as the Huntington gene and Huntington’s disease). Next, she identifies whether there is any commercially available genetic test for each genotype-phenotype link. Finally, all data is aggregated to the gene level.

Three strategies are used to test how Celera’s intellectual property affected subsequent innovation. The first compares innovation on genes ever held by Celera to that on genes originally sequenced by

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the public effort. The second traces what happens once the intellectual property protection is removed on genes held by Celera; this approach may help to address the concern that Celera genes could have differed from non-Celera genes (for example, in terms of inherent commercial potential). The third limits the sample to Celera genes, and examines variation in the length of time a gene was held with Celera’s intellectual property.

Turning to the results, Williams finds that Celera genes had 35 percent fewer publications over the period 2001 to 2009 than non-Celera genes. Celera genes were also 1.5 percentage points less likely to be used in a diagnostic test by 2009; since only 3 percent of genes are so used, this is a large effect. Results from the second and third empirical approaches are largely similar. Interestingly, the lower

levels of innovation on Celera genes persist more than five years after all genes had moved into the public domain.

In short, less scientific knowledge was generated on Celera genes both during and after the time they were held with Celera's intellectual property. One explanation that is consistent with these results is that there are increasing returns to research and development—that is, once scientific knowledge has accumulated in a given area, future discoveries related to that knowledge may be made at lower cost relative to discoveries in other

areas where less is known.

Williams notes that her study does not evaluate the overall welfare effects of Celera's entry into the effort to sequence the human genome. Celera's ability to obtain intellectual property likely encouraged the firm to undertake its sequencing effort. To the extent that Celera's entry accelerated the public sequencing effort, Celera's intellectual property could thus have increased total innovation, even if there was reduced innovation on Celera genes. Rather, the results suggest "an alternative institutional mechanism may have

had social benefits relative to Celera's chosen form of intellectual property." For example, the public sector could have paid Celera some fee to buy out Celera's property rights and place Celera genes immediately in the public domain. Most broadly, the results suggest "open access to scientific materials may encourage cumulative innovation."

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Do Reminders Increase Saving?

Over the past ten to fifteen years, a substantial body of research has documented the fact that individuals' saving, borrowing, and consumption behavior is often at odds with the predictions of standard economic models. For example, voluntary commitment devices and default options, which should not affect saving in a fully rational, forward-looking model, have been shown to have large impacts on savings decisions. To explain these findings, economists have developed models in which individuals have time inconsistent preferences (display a different degree of patience depending on whether they are making a short-run or long-run decision) and self-control problems.

In "Getting to the Top of Mind: How Reminders Increase Saving" (NBER Working Paper 16205), researchers **Dean Karlan, Margaret McConnell, Sendhil Mullainathan,** and **Jonathan Zinman** explore another potential reason for this discrepancy—limited attention.

The authors develop a simple model to illustrate the potentially important role of attention. In their model, individuals have regular expenses that occur every period as well as lumpy expenses that occur only periodically, like school or car registration fees. Individuals may fail to pay attention to an upcoming lumpy expenditure, causing them to save less and borrow more than they would in a standard, forward-looking model.

The authors' model generates two testable predictions. First, savings reminders will cause individuals to pay more

attention to upcoming lumpy expenditures and thereby increase their saving. Second, reminders that draw attention to a particular goal or opportunity will be particularly effective because individuals are more likely to pay attention to a reminder that is more salient to them.

Importantly, models in which an individual suffers from time-inconsistency or self-control problems would not generate the same predictions. In those models, the decision to save little towards or borrow to meet a lumpy expenditure is made consciously and is in fact the best decision, given the individual's preferences. In these models, reminders will not affect saving.

Limited attention models may help to explain several well-known phenomena. First, the tendency of defaults to be "sticky" could occur because the individual stops paying attention once the default has been implemented. Second, "mental accounting" (such as having different accounts for different spending categories and constraining spending based on the funds in each account) could be related to attention, as labeling an account may increase the likelihood that individuals pay attention to that expenditure item. Finally, limited attention can generate behavior that looks like time-inconsistent preferences.

To test the main predictions of their model, the authors run three experiments with banks in the Philippines, Peru, and Bolivia. Each experiment involved a group of individuals who responded to a marketing offer to open a goal-ori-

ented savings account. These individuals were randomly assigned to either receive a savings reminder or not. Reminders were delivered by text message in the Philippines and Bolivia and by letter in Peru (due to low cell phone prevalence).

The authors' key finding is that clients who received reminders saved 6 percent more and were 3 percentage points more likely to reach their savings goal than those who did not receive reminders. Results were relatively similar across the three countries.

In the Peru experiment, the authors test whether reminders associated with the respondent's specific reason for saving (given at the time of opening the account) are more effective. The authors randomly assigned respondents to receive either a generic reminder or one that mentioned their specific reason for saving. Specific reminders increased saving by 16 percent relative to receiving no reminder, while generic reminders had no significant effect on saving.

To further explore the salience of reminders, the authors randomly assigned some respondents in the Peru experiment to receive one jigsaw piece of a photo of their goal each time they made a deposit, while others received either a photo of their goal or a pen at the time of sign up. The authors found no effect of the jigsaw treatment on saving, suggesting that the standard letter reminder was more effective.

Finally, the authors test whether reminders are more effective for respondents who exhibit time-inconsistent pref-

erences, which they elicit using standard questions. They find some support for the notion that reminders are more effective on time-inconsistent individuals.

In conclusion, the authors find that reminders are most effective “when they focus on a particular future goal set by the

client (e.g., a future expenditure to be purchased with a targeted savings amount), and on the means toward achieving that goal (making the next deposit).” They note “our results open up the possibility that phenomena attributed to unstable time preference may in fact be due to lim-

ited attention, but more work is needed to address this possibility rigorously.”

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The Effect of the Economic Crisis on American Households

Over the past several years, the American economy has experienced the most severe recession since the Great Depression of the 1930s. The unemployment rate has risen by more than 5 percentage points since the crisis began, while the stock market and housing market have tumbled – from late 2007 to late 2008, the S&P 500 Index fell by about 40% while the Case-Shiller home price index fell by about 20%.

These dramatic and nearly simultaneous shocks to labor, stock, and housing markets have undoubtedly affected American households. But quantifying how big the impacts have been and how households have responded to the crisis is difficult. Many of the data sets economists typically rely on to examine consumption and wealth are fielded only every two or three years, so researchers may have to wait several years until data collected during the recession is available. Moreover, the fact that many surveys do not follow the same households over time makes it difficult to track the recession’s impact.

In “**Effects of the Financial Crisis and Great Recession on American Households**” (NBER Working Paper 16407), researchers **Michael Hurd** and **Susann Rohwedder** take up this question using data from a series of surveys developed for this specific purpose and fielded in the American Life Panel (ALP).

The ALP is an ongoing survey of about 2,500 people run by RAND Labor and Population. The survey is conducted via the internet, with Web TV provided for those without internet access; results are weighted to be representative of the population. For assessing the effects of the financial crisis on American households respondents were first interviewed in November 2008, just after stock prices had fallen sharply and following a somewhat longer period of housing price

declines but before most of the rise in the unemployment rate. Respondents were re-interviewed in February and May 2009 and have been interviewed monthly since that time. The paper reports results covering the 17-months period from November 2008 through April 2010.

The authors first quantify the share of American households who have experienced financial distress, which they define as being unemployed (respondent or spouse), being more than two months behind on mortgage payments, or having a home valued at less than the mortgage. They find that back in November 2008, shortly after the onset of the financial crisis, roughly 13 percent of households were in distress and that this fraction increased rapidly by June 2009 to about 17 percent where it has remained. The cumulative measure shows that nearly 40 percent of households have experienced financial distress at least some time during the 17-months period.

Spending changes provide one measure of the recession’s impact on households’ well-being. At the first survey, nearly three-quarters of respondents said they had reduced spending due to the economic crisis; at the next survey, 30 percent said they had reduced spending further since the first survey. Among those reporting a decrease in spending, many cited the need to reduce debt (80 percent), a reduction in income (70 percent), a change in employment status (45 percent), or a decrease in the value of their home (45 percent) or stock holdings (35 percent) as reasons for the decline.

It is difficult to quantify changes in spending, especially retrospectively. Because reductions in spending turned out to be the most wide-spread response to the economic crisis, the authors instituted a monthly survey schedule and included detailed questions about the

amounts that households spent across 25 categories. Even though this effort missed the initial reductions in spending, it documents further declines of 5 to 10 percent that occurred between April 2009 and March 2010.

Changes in specific categories of spending may shed some light on how households achieved the reductions in spending and the resulting impact on well-being. Food spending fell by a similar percent as overall spending; most of the decline occurred in spending on food purchased away from home, as households substituted “food in” for “food out.” Spending on prescription drugs and health care services dropped more sharply than total spending; to the extent that these expenditures are protective against future health declines, these cuts may have long-term negative impacts on health.

Some households responded to the crisis by borrowing more. While the number of households with credit cards fell by 3 percent over the sample period, perhaps reflecting a tightening of access to credit, among those households with credit card debt the amount of debt carried over from month-to-month rose by 25 percent. This added debt could translate into additional interest payments of nearly \$1,000 per year.

Another way for individuals to respond to a fall in stock or housing assets is to retire later. However, the share of respondents who indicated that they intend to work past age 62 actually declined by 3 percentage points during the sample period. To put this in perspective, labor force participation of men ages 60 to 64 increased by 3 percentage points between 2003 and 2008. The decline in expected work past age 62 suggests an increase in pessimism among workers about their labor market prospects at older ages.

The ALP illuminates both how households have been affected by falling stock and housing markets and how expectations about these markets may be changing. By early 2009, households who had at least some retirement savings reported that those savings had dropped in value by about 30% on average. One in six households responded by reallocating existing retirement account balances away from stocks, nearly three times as many as shifted balances towards stocks. In terms of expectations, in November 2008 respondents estimated the chances of a positive gain in the stock market over the next ten years to be 60 percent on average, although historically the odds of this are over 90 percent. These long-term expectations became even more pessimistic as the economic crisis went on, reaching their low point in April 2010. Respondents were similarly pessimistic about the chances that house prices would increase over the next five years, estimating the chances to be 56.4 per-

cent in November 2008, and lower yet in April 2010 (51.3 percent), even though national housing prices have never failed to rise over a five-year period since the index began.

A somewhat different way to measure the recession's impact is to explore the effect on health and subjective measures of satisfaction. While only 7 percent of survey respondents report being dissatisfied or very dissatisfied with their lives in mid-2009, this fraction increased to 10 percent by April 2010. One-third expressed dissatisfaction with their income situation, showing little trends through the period of study while the fraction dissatisfied with their overall economic situation declined from 45 percent to 34 percent from November 2008 to April 2010. Some measures of self-assessed well-being show little trend (about 28 percent report feeling worn out, 25 percent feeling happy, 17 percent reporting depression problems), however the fraction with difficulties sleeping was

highest at the onset of the crisis (34 percent) and dropped to about 24 percent by the end of the study period (April 2010). The fraction with fair or poor self-rated health dropped only a little from 16 to 14 percent over the same period.

The authors conclude by pointing out that the recession officially ended in June 2009. They note that according to their data, "the economic situation of the typical household is no longer worsening, which is consistent with the end of the recession defined as negative change. However, when defined in terms of levels rather than rates of change, from the point of view of the typical household, the Great Recession is not over."

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NBER Profile: John Cawley

John Cawley is a Research Associate of the NBER's programs in health care and health economics. He is an Associate Professor and the Director of Graduate Studies in the Department of Policy Analysis and Management at Cornell University.

John's research focuses on the economics of obesity. He has studied possible economic causes of obesity (such as income and food advertising), possible economic consequences of obesity (such as lower wages and higher medical care costs), and has evaluated methods of preventing and treating obesity (such as higher physical education requirements in schools and financial rewards for weight loss). To promote understanding of the different ways that social science disciplines study risky behaviors, he edited the *Handbook of the Social Science of Obesity*, which is forthcoming from Oxford University Press.

Dr. Cawley is the Co-Editor-in-Chief of *Economics and Human Biology*. He was a member of the Institute of Medicine Committee "Prevention of Obesity in Children and Youth," and has served on advisory boards and expert panels related to obesity for the Centers for Disease Control, the U.S. Food and Drug Administration, and the U.S. Federal Communications Commission.

John won the John D. Thompson Prize for Young Investigators (awarded by the Association of University Programs in Health Administration) and is a coauthor of the article that won the Charles C. Shepard Science Award in Prevention (awarded by the Centers for Disease Control and Prevention). His research has been supported by organizations including the National Institutes

of Health, the U.S. Department of Agriculture, and the Robert Wood Johnson Foundation. His work has been published in journals including the *American Economic Review*, *Review of Economics and Statistics*, *Journal of Economic Perspectives*, and *Journal of Health Economics*, and has been featured in media outlets such as the New York Times, the Wall Street Journal, and Scientific American.

Professor Cawley holds a Ph.D. in Economics from the University of Chicago and an A.B. in Economics from Harvard University. Prior to joining the faculty at Cornell, he was a Robert Wood Johnson Foundation Scholar in Health Policy Research at the University of Michigan. At Cornell, he teaches courses in health economics and microeconomics.

John lives in Ithaca, NY with his wife and colleague Rachel Dunifon and their two sons Jimmy and Will.



Abstracts of Selected Recent NBER Working Papers

16164

Martin Gaynor, Rodrigo Moreno-Serra, Carol Propper

Death by Market Power: Reform, Competition and Patient Outcomes in the National Health Service

The effect of competition on the quality of health care remains a contested issue. Most empirical estimates rely on inference from non experimental data. In contrast, this paper exploits a pro-competitive policy reform to provide estimates of the impact of competition on hospital outcomes. The English government introduced a policy in 2006 to promote competition between hospitals. Patients were given choice of location for hospital care and provided information on the quality and timeliness of care. Prices, previously negotiated between buyer and seller, were set centrally under a DRG type system. Using this policy to implement a difference-in-differences research design we estimate the impact of the introduction of competition on not only clinical outcomes but also productivity and expenditure. Our data set is large, containing information on approximately 68,000 discharges per year per hospital from 162 hospitals. We find that the effect of competition is to save lives without raising costs. Patients discharged from hospitals located in markets where competition was more feasible were less likely to die, had shorter length of stay and were treated at the same cost.

16171

Marcella Alsan, David Cutler

The ABCDs of Health: Explaining the Reduction in AIDS in Uganda

Uganda was widely viewed as a public health success for curtailing its AIDS epidemic in the early 1990s. To understand the reasons for the dramatic decline, we build a simulation model of HIV transmission using newly discovered data on HIV status and sexual behavior from the relevant time period. We then model the impact of abstinence, fidelity, condom use and selective mortality on the prevalence of HIV among various subgroups. Among young women, who experienced the greatest decline in HIV prevalence, the most

important component was delaying sexual debut, accounting for 57 percent of the drop in HIV prevalence. Condom use by high risk males and to a lesser extent death (of older males) also played a significant role, accounting for 30 and 16 percent respectively. However, for older women, the trend is reversed, with death being more important than abstinence or condom usage. All told, we explain 86 percent of the reduction in AIDS in Uganda.

16179

Carrie Hoverman Colla, William Dow, Arinkrajit Dube

How Do Employers React to a Pay-or-Play Mandate? Early Evidence from San Francisco

In 2006 San Francisco adopted major health reform, becoming the first city to implement a pay-or-play employer health spending mandate. It also created Healthy San Francisco, a “public option” to promote affordable universal access to care. Using the 2008 Bay Area Employer Health Benefits Survey, we find that most employers (75%) had to increase health spending to comply with the law, yet most (64%) are supportive of the law. There is substantial employer demand for the public option, with 21% of firms using Healthy San Francisco for at least some employees, yet there is little evidence of firms dropping existing insurance offerings in the first year after implementation.

16251

Darius Lakdawalla, Wesley Yin
Insurers' Negotiating Leverage and the External Effects of Medicare Part D

Public financing of private health insurance may generate external effects beyond the subsidized population, by influencing the size and bargaining power of health insurers. We test for this external effect in the context of Medicare Part D. We analyze how Part D-related insurer size increases impacted retail drug prices negotiated by insurers for their non-Part D commercial market. On average, Part D lowered retail prices for commercial insureds by 5.8% to 8.5%. The

cost-savings to the commercial market amount to \$3bn per year, which approximates the total annual savings experienced by Part D beneficiaries who previously lacked drug coverage.

16252

John Komlos, Marek Brabec
The Trend of BMI Values of US Adults by Centiles, birth cohorts 1882–1986

Trends in BMI values are estimated by centiles of the US adult population by birth cohorts 1882–1986 stratified by ethnicity. The highest centile increased by some 18 to 22 units in the course of the century while the lowest ones increased by merely 1 to 3 units. Hence, the BMI distribution became increasingly right skewed as the distance between the centiles became increasingly larger. The rate of change of BMI centile curves varied considerably over time. The BMI of white men and women experienced upsurges after the two World Wars and downswings during the Great Depression and again after 1970. However, among blacks the pattern is different during the first half of the century with men's rate of increase in BMI values decreasing substantially and that of females remaining unchanged at a relatively high level until the Second World War. However, after the war the rate of change of BMI values of blacks resembled that of the whites with an accelerating phase followed by a slow down around the 1970s. In sum, the creeping nature of the obesity epidemic is evident, as the technological and lifestyle changes of the 20th century affected various segments of the population quite differently.

16261

Aysegul Timur, Gabriel Picone, Jeffrey DeSimone

Has the European Union Achieved a Single Pharmaceutical Market?

This paper explores price differences in the European Union (EU) pharmaceutical market, the EU's fifth largest industry. With the aim of enhancing quality of life along with industry competitiveness and R&D capability, many EU directives have been adopted to achieve a single

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EU-wide pharmaceutical market. Using annual 1994–2003 data on prices of molecules that treat cardiovascular disease, we examine whether drug price dispersion has indeed decreased across five EU countries. Hedonic regressions show that over time, cross-country price differences between Germany and three of the four other EU sample countries, France, Italy and Spain, have declined, with relative prices in all three as well as the fourth country, UK, rising during the period. We interpret this as evidence that the EU has come closer to achieving a single pharmaceutical market in response to increasing European Commission coordination efforts.

16278

Tara Watson

Inside the Refrigerator: Immigration Enforcement and Chilling Effects in Medicaid Participation

Economists have puzzled over why eligible individuals fail to enroll in social safety net programs. “Chilling effects” arising from an icy policy climate are a popular explanation for low program take-up rates among immigrants, but such effects are inherently hard to measure. This paper investigates a concrete determinant of chilling, Federal immigration enforcement, and finds robust evidence that heightened enforcement reduces Medicaid participation among children of non-citizens. This is the case even when children are themselves citizens and face no eligibility barriers to Medicaid enrollment. Immigrants from countries with more undocumented U.S. residents, those living in cities with a high fraction of other immigrants, and those with healthy children are most sensitive to enforcement efforts. Up to seventy-five percent of the relative decline in non-citizen Medicaid participation around the time of welfare reform, which has been attributed to the chilling effects of the reform itself, is explained by a contempo-

aneous spike in immigration enforcement activity. The results imply that safety net participation is influenced not only by program design, but also by a broader set of seemingly unrelated policy choices.

16389

James Poterba, Steven Venti, David Wise
The Asset Cost of Poor Health

This paper examines the correlation between poor health and asset accumulation for households in the first nine waves of the Health and Retirement Survey. Rather than enumerating the specific costs of poor health, such as out of pocket medical expenses or lost earnings, we estimate how the evolution of household assets is related to poor health. We construct a simple measure of health status based on the first principal component of HRS survey responses on self-reported health status, diagnoses, ADLs, IADL, and other indicators of underlying health. Our estimates suggest large and substantively important correlations between poor health and asset accumulation. We compare persons in each 1992 asset quintile who were in the top third of the 1992 distribution of latent health with those in the same 1992 asset quintile who were in the bottom third of the latent health distribution. By 2008, those in the top third of the health distribution had accumulated, on average, more than 50 percent more assets than those in the bottom third of the health distribution. This “asset cost of poor health” appears to be larger for persons with substantial 1992 asset balances than for those with lower balances.

16418

Tanguy Brachet, Guy David, Reena Duseja
The Effect of Shift Structure on Performance: The Role of Fatigue for Paramedics

The effect of shift structure on worker performance and productivity is an issue of increasing

interest to firms and regulatory bodies. Using approximately 742,000 emergency medical incidents attended by 2,400 paramedics in the state of Mississippi, we evaluate the extent to which paramedics’ performance towards the end of their shift is impacted by its length. We find evidence that their performance deteriorates towards the end of long shifts, and argue that fatigue is the mediating factor. These findings have implications for workforce organization, calling attention to regulation designed to limit extended work hours.

16467

John Cawley, Chad Meyerhoefer
The Medical Care Costs of Obesity: An Instrumental Variables Approach

This paper is the first to use the method of instrumental variables (IV) to estimate the impact of obesity on medical costs, in order to address the endogeneity of weight and to reduce the bias from reporting error in weight. Models are estimated using data from the Medical Expenditure Panel Survey for 2000–2005. The IV model, which exploits genetic variation in weight as a natural experiment, yields estimates of the impact of obesity on medical costs that are considerably higher than the correlations reported in the previous literature. For example, obesity is associated with \$676 higher annual medical care costs, but the IV results indicate that obesity raises annual medical costs by \$2,826 (in 2005 dollars). The estimated annual cost of treating obesity in the U.S. adult non-institutionalized population is \$168.4 billion or 16.5% of national spending on medical care. These results imply that the previous literature has underestimated the medical costs of obesity, resulting in underestimates of the cost effectiveness of anti-obesity interventions and the economic rationale for government intervention to reduce obesity-related externalities.

NBER

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