

# NBER Reporter

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## Program Report

### Economics of Education

Caroline M. Hoxby\*

The NBER's Economics of Education Program has just celebrated its first anniversary, having started officially in September 2001. However, the program was created to recognize the large and rapidly growing body of economic research on education. It was felt that education, as a topic, needed a home of its own, partly to encourage progress and partly to encourage rigor. Progress happens faster when economists researching the same topic talk to one another, instead of each presenting research to his own field audience. Education topics force researchers to draw upon several economic fields, so rigor is enhanced when public economists ensure that their fellow researchers get the public economics right, macroeconomists ensure that the macroeconomics is right, and so on. Members of The Economics of Education Program are drawn from labor economics, public economics, macroeconomics and growth, industrial organization and contracts, development economics, and urban economics. Every field makes its special contribution. For instance, macroeconomics emphasizes the intergenerational consequences of education investment; development economists offer up evaluations of striking policy experiments that would be too daring for most developed countries. The necessarily brief coverage of a program report lends itself to describing empirical work, rather than theoretical work. However, many of the important contributions to the Program have been made by theorists, whose Working Papers and presentations have been crucial to moving the economics of education forward.

In its first year, the Economics of Education Program held two program meetings and two conferences. Members wrote 60-some Working Papers on education. In addition, program members interested in higher education attended two Higher Education Working Group meetings, organized by Charles T. Clotfelter. The program has thus far spawned two volumes: *The Economics of School Choice* (ESC), which will be published in early 2003 by University of Chicago Press; and *College Decisions: New Economic Research on Higher Education* (CD), which will be published about a year later. Although most program members are drawn from economics or similar departments, some are economists at graduate

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\* Hoxby is the Director of the NBER's Program on Economics of Education and a Professor of economics at Harvard University. Most of the numbers in brackets throughout this report refer to NBER Working Papers. A complete list of NBER Education Working Papers can be found at <http://papers.nber.org/papersbyprog/ED.html>

# NBER Reporter

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schools of education who help the program stay in touch with that world of research. The conferences have included policymakers and administrators, as well as program members.

What is the operating environment of the Economics of Education Program? Recent years have seen a host of policy developments for economists of education to master, and these will be described later. However, the most important development is probably not a policy one, but the now-almost-ubiquitous realization that U.S. comparative advantage and economic growth are highly dependent on skill-intensive industries [9071, 8337, 7288, 6881]. Americans, from "men on the street" to legislators, have concluded that the economic future depends on the supply of skilled workers, and this realization has given urgency to education reform. There is, of course, a correspondingly urgent need for education research.

With so much research going on, this report must be far more selective than I would like. Rather than attempting to discuss all the work, I focus on some recent policy changes that are driving research and a few themes that appear and reappear in Program members' work.

## K-12 Policy Developments that have been Stimulating Research

Several policy developments in elementary and secondary ("K-12") education are stimulating research. The most obvious is the school choice movement, which naturally draws economists because it raises interesting questions about incentives, market structure, public financing, housing choice, and intergenerational investments in human capital. The recent Supreme Court decision in *Zelman versus Simmons-Harris* (the Ohio voucher case) is sure to provide a fillip to research, as it will unleash a new wave of reforms. Owing to the Court's advice, many of the reforms will be "mixed" (blending vouchers, charter schools, magnet schools, intra-district choice, and open enrollment among districts). Program members are eager to analyze such mixed reforms: their research already suggests that different choice plans generate different incentives.

For instance, empirical work suggests that magnet schools keep the more affluent and education-oriented in central city districts (though not, of course, in the same schools as most central city children.) [See Julie Berry Cullen, Brian A. Jacob, and Steven Levitt, "Does School Choice Attract Students to Urban Public Schools? Evidence from over 1,000 Randomized

Lotteries,” July 2002; 7888]. Other work demonstrates that a district that enacts intra-district choice will lose its most education-oriented families, and part of its tax base with them [ESC, 7850]. Vouchers work differently when they are based on a child’s *own* household income, the incomes of a *district’s* children, or the failure of the child’s school [ESC, 7956, 7239]. Although competition from both charter schools and vouchers seems to raise the achievement of students in both choice schools and local public schools, the achievement effect depends on the parameters of the program [8873, 8343].

The 2002 No Child Left Behind (NCLB) act may provoke some intra-district choice action, but NCLB is mainly an *accountability* policy. Accountability is the second major policy movement stimulating research. Partly because of Goals 2000 (which advocated accountability) but mainly because of state legislatures’ frustration with schools that had not improved despite increased state funding, 49 states created accountability systems during the 1990s. The systems vary widely, but generally include statewide testing, school report cards, and some guidance to schools about the curriculum for which they will be held responsible. NCLB will regularize and give greater permanence to these systems.

The accountability movement has stimulated research for two reasons. First, it has unleashed a flood of data that has made analysis of many topics more feasible. More than half of the recent NBER Working Papers on education could not have been written without data generated by accountability systems. [Studies that reveal the richness of the data now available include 8916, 8918, 8599, 8502, 8156, and 7867.] Second, accountability systems are inherently interesting: they pose fascinating questions of incentive design.

Program members have been quick to point out the flaws in the incentives generated by the first generation of states’ accountability systems. For instance, accountability systems that focus on year-to-year gains in achievement (as opposed to achievement levels, or some combination of gains and levels) tend to over-reward and over-

penalize small schools, which are more likely to display unusually large or small gains, simply because noisy measures of students’ achievement are less likely to average out [8156]. Systems that have only one cut-off (such as pass-fail) or a few cut-offs tend to focus schools’ effort on the group of students whose performance is just below the cut-off [8968, 7875]. Cut-offs also can have unintended effects on house prices, property tax bases, and ultimately school budgets; house prices in the attendance areas of schools that just fail to meet a cut-off can fall substantially relative to those in areas that just meet it [8019, 9054]. Systems in which tests are unproctored and in which there is no turnover of test items invite cheating. Lest all the research sound like carping, it is nice to note that it has been constructive. Some of the evidence described has influenced the provisions and implementation of the NCLB act. Moreover, another study demonstrates that sophisticated accountability systems cost only trivially more than the simplest ones [8855].

School finance reforms, which change the ways in which states raise revenue for schools and redistribute among them, provide the impetus for important work on school finance — not just empirical analysis of American data, but also innovative theoretical work and analysis of the distinctive systems used in other countries. Recent school finance reforms that have attracted attention include those of New York, Michigan, Texas, and Massachusetts. Analyzing such reforms has proved to be a classic problem that demonstrates the challenges and promises of the economics of education. Researchers have found that it is essential to know the institutions; but applying public economics and urban economics is equally necessary for progress [8355, 8269]. School finance reforms have been shown to interact with property tax limitations, and there is increasing evidence that suggests that school finance reforms and property tax limitations are not independent (reforms cause limitation and vice versa).

Working out the implications of school finance for economic growth

and income inequality has proven to be a fascinating, complex problem for macroeconomists and calibrators [8588, 8377, 8101, 7986, 7450, 7132]. It is difficult to draw simple implications from this literature because much depends on the degree to which ability is inherited and whether peer effects are important. A splendid development in this literature is the incorporation of political economy, so that the parameters of the school finance system arise endogenously in recent models [ESC]. Another development worth highlighting is the increasingly close relationship between school finance and school choice research. For instance, calibration suggests that income-equalizing vouchers are a school finance method that raises growth and reduces inequality relative to other currently available systems [ESC]. (Intuitively, vouchers can be better targeted because they are individual-specific; also, with vouchers, greater redistribution is sustainable in a realistic political economy.)

## College Policy Developments that have been Stimulating Research

The last several years have seen important changes in the *nature* of government intervention in higher education. The most obvious has been states’ shifting toward merit scholarships and away from subsidizing tuition at public colleges (a policy that benefits all college-going students similarly, regardless of their need and merit). Many people know about Georgia’s Hope Scholarship, which eliminates tuition at in-state public colleges and provides substantial scholarships to in-state private colleges for B+ students. However, similar programs exist in 12 other states and many other states have reallocated their higher education budgets towards meritorious students in other ways. Merit scholarships appear to be gaining sway because states are worried about being left behind by the “new” skilled-based economy. Not surprisingly, the shift toward merit scholarships has occurred disproportionately in areas

where this worry is greatest: the South, the Southwest, and the Rust Belt.

Recent research shows that state aid based on merit tends not to increase enrollment greatly but does induce students to attend public universities more often [CD, 7756]. Even California's Calgrants program, a generous scholarship based on both merit and need, raises enrollment only modestly [See Thomas Kane, "A Quasi-Experimental Estimate of the Impact of Financial Aid on College-Going," August 2002]. The limited effects on enrollment probably reflect the fact that the most meritorious students would have attended college in any case. Interestingly, there is also no evidence of significant reductions in attendance at out-of-state private universities, suggesting that students whose decisions are most affected by the aid were not likely to attend college out-of-state anyway. Other recent work explores the value of keeping meritorious students in-state [CD, 8555].

Many people are surprised to hear that the largest federal program for education is not the Pell Grant or Title I, but the tuition tax credits enacted in 1998. Called the Hope and Lifelong Learning Tax Credits, these programs are not only large now, but are likely to grow much larger as they become more familiar. Currently, only a small share of eligible taxpayers take the credits. Essentially, the tax credits are a middle class tax cut with unusual incidence (middle class because the credits cannot be used in conjunction with a Pell grant and because the phase outs exclude upper-income households). Research suggests that the credits have very limited effects of enrollment, leading only to some "upgrading" of college attendance [CD].

If there is any theme to the recent evidence on aid and college attendance, it is that less recent federal aid programs, including the GI Bill, raised enrollment [7452, 7655, 7422], but that credit constraints are no longer a serious problem for students who are prepared for college. So, aid tends to alter the college they choose, rather than whether they go to college at all [9228, 9055, 7761].

Saving for college is a tricky issue because savers are taxed implicitly by

need-based aid [4032]. However, recent research suggests that college savings may be receiving a "shot in the arm" from three new tax-preferred college savings programs: Coverdell savings accounts; states' 529 college savings accounts; and states' pre-paid college savings plans [CD]. The Coverdell savings account is a Roth IRA designed for college saving; interest accumulates tax-free and qualified withdrawals are untaxed. The states' 529 accounts are similar, but are more generous: contribution limits are higher and some contributions are tax-deductible. States' pre-paid plans are the least flexible: account-holders are constrained to use them at certain colleges or lose most of the benefits.

## Teachers

Teachers are attracting a great deal of attention, not because policies are changing much, but because researchers are overcoming obstacles that prevented them from assessing teachers' effectiveness. Newly released data have been essential in this area. There is increasing evidence that differences among teachers account for much of the variation in achievement associated with schools (as opposed to families or innate ability). However, the evidence is not what one might expect. It suggests that a teacher's effect, though important and separately identifiable, is unrelated to her credentials and even in-service training [6691, 8916, but see 6781, 8432, and 7866]. Other work shows that teachers, perhaps because pay is so compressed, decide where to teach mainly on the basis of convenient location and students' socio-demographics. A teacher may accept a pay cut to get a job closer to her home and with more affluent students [See Donald Boyd, Hamilton Lankford, Susanna Loeb, and James Wyckoff, "The Joint Decisions of Teachers and Schools: How Teachers Sort on Initial Job Matches," August 2002; 8599; 7082]. Recent studies have added evidence to the longstanding suspicion that teacher quality has declined in the United States [9180, 8898, 8263]. Evidence from an Israeli experiment suggests that teachers respond constructively when offered monetary

incentives to ensure that their students pass a college preparation exam [See Victor Lavy, "Rank Order Tournaments among Teachers as Performance Incentive Schemes: Experimental Evidence about Their Effect on Students Outcomes," August 2002].

## Peer Effects

Peers effects are another important theme in recent research. (I am construing peer effects broadly to include all spillovers caused by the presence of a peer, regardless of the channel.) Peer effects arise frequently for several reasons. First, they are often the crucial element in models linking education and economic growth [8101]. Second, the market for higher education is almost impossible to explain coherently without postulating the presence of peer effects [CD]. Finally, many debates on school choice hinge on peer effects [ESC, 7854, 7850]. In all three cases, the *form* and not the mere existence of peer effects is key. As a rule, interesting theories require peer effects that are nonlinear, but require different nonlinearities that are mutually exclusive. For instance, growth models often posit that low achieving students benefit most from high achieving peers; higher education models posit the reverse. Fortunately, Program members recently have devised clever ways to identify peer effects empirically (a very difficult thing to do because, as a rule, people select their own peers). Randomly assigned roommates and other natural experiments have been used to study peer effects in college and graduate school [9025, 7469]. Researchers of K-12 education have exploited natural and policy experiments from population variation, desegregation, and housing mobility programs [9263, 8741, 8502, 8345, 7999, 7973, 7867, 7444]. Educational policies in developing countries sometimes shift peers substantially — these also have been exploited to identify peer effects. As a rule, the evidence suggests that peer effects exist, but their forms (especially non-linearities) are barely understood as yet.

## Education Expansion in Developing Countries

Making primary education universal is a common goal for developing countries, but what are the effects of policies designed to greatly expand enrollment? Indonesia's experience is that an aggressive school building program raises enrollment but then depresses the return to education when the more educated cohorts hit the labor market [8710, 7860]. Incentives for school building can lead to an inefficient number of schools even though they raise enrollment [see Michael Kremer, Sylvie Moulin, and Robert Namunyu, "The Political Economy of School Finance in Kenya," August 2002]; and changes in school resources that seem incredibly cheap by American standards also raise enrollment substantially [8481, 7399]. If there is any theme in the evidence, it is that greater resources for schools in developing countries bring more children and *more marginal* children into school, so that researchers find it harder to identify improvements in achieve-

ment than to identify increases in enrollment.

## Technology

So far, I have not mentioned "education production functions" (the attempt to estimate the relationship between school inputs and outputs) which once were the staple fare in the economics of education. Many of the studies described above have education production functions embedded in them, but recent work scarcely resembles the conventional linear regression of a test score on a series of school characteristics. This is not because researchers have gotten tired of class size or school spending, but because recent work tends to exploit interesting policy or natural experiments or carefully explores the foundations and implications of different education production functions [9054, 8918, 9040, 7820, 7656, 7349]. Technology is the one truly *new* school input. Program members have studied the effects of computers in the classroom [7424], of federal internet subsidies [9090], and even, in developing countries, of flip-charts [8018]. So far, the evidence seems to

suggest that technology has at best weak effects on achievement. Undoubtedly, much more evidence will be forthcoming in this area as technology spreads and our measures of it improve.

## In Conclusion

Education-related research is likely to remain a growth area in economics for some time, largely because of the importance of skills for understanding economic growth and income inequality. However, other conditions are favorable as well. Education is an excellent area for the arbitrage and elaboration of existing theory: many of the problems are inherently rich, amenable to analysis, and understudied. It is also unusually easy to observe the behavior of key "actors" because they operate in a semi-public domain. (It is much easier to find out what a private college does than what a private firm does.) Data availability is improving continuously — partly because of technology, partly because of accountability, and partly because economists gain better access as they become ever more significant contributors to the field.

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## Research Summaries

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### New Drugs: Health and Economic Impacts

Frank R. Lichtenberg\*

Many economists believe that new goods are at the heart of economic progress, and that innovative goods are

better than older products because they provide more "product services" in relation to their cost of production. The pharmaceutical industry has among the highest propensities to generate new goods; it is one of the most R and D-intensive industries in the economy. Moreover, in part because of extensive FDA regulation, there is unusually good data about the launch and diffusion of new pharmaceutical

goods. I have used these data to perform a number of econometric studies at the individual, disease, and country level, in order to assess the health and economic impacts of the development and use of new drugs.

Most of my studies are based on data covering all medical conditions (diseases) and all drugs. Therefore, they provide evidence about the health and economic impacts of new drugs *in*

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\* *Lichtenberg is a Research Associate in the NBER's Programs on Productivity and Health Care and the Courtney C. Brown Professor of Business at Columbia University. His profile appears later in this issue.*

general, not about specific drugs or their impacts on particular diseases.<sup>1</sup>

I hypothesize that people may obtain several kinds of benefits from using newer, as opposed to older, pharmaceutical products: longer life; reduced limitations on activities (including work); and reduced total medical expenditure. In this article, I describe some of the studies I have conducted to estimate the magnitude and value of these benefits, and compare them to the cost of using newer drugs.

## Increased Longevity

In one study using aggregate time-series data<sup>2</sup>, I examine the impact of new drugs' approvals on the longevity of Americans. Between 1960 and 1997, life expectancy at birth increased approximately 10 percent, from 69.7 to 76.5 years. Some economists believe that the value of life extension during this period nearly equaled the gains in tangible consumption. While life expectancy has tended to increase since 1960, there have been substantial fluctuations in the rate of increase. Growth in real per capita income also doesn't account for these fluctuations: the period in which life expectancy increased most rapidly (1973-5) was a period of dismal macroeconomic performance.

However, there is a highly statistically significant relationship between the number of new molecular entities (NMEs) approved by the FDA and increased longevity: *the periods during which the most new drugs have been approved by the FDA tend to be the periods in which longevity grew most rapidly*. This suggests that the greater the number of drugs that are available to physicians and consumers, the higher longevity will be. The estimates indicate that the average new drug approval increases the life expectancy of people born in the year that the drug is approved by .016 years (5.8 days). This may sound insignificant, but since there are approximately 4 million births per year in the United States, the average new drug approval increases the total expected life-years of the cohort by 63.7 thousand years (4 million births times .016 years/birth). New drug

approvals in a given year also increase the life expectancy of people born in future years, but by a smaller amount (because of obsolescence of drugs). I estimate that *current and future generations will live a total of 1.2 million life-years longer because of the average new drug approval*.

The cost to the pharmaceutical industry of bringing a new drug to market is often estimated to be about \$500 million. Hence, cost per life-year gained is \$424 (\$500 million / 1.2 million life-years). According to Murphy and Topel, this is a small fraction of the economic value of a life year, which they estimate to be on the order of \$150,000.

In another study using longitudinal, disease-level data<sup>3</sup>, I examine the impact of new drugs' approvals on mean age at death. I compute the stock of drugs available (that is, previously approved by the FDA) to treat a given condition in a given year by combining FDA data with data from First DataBank's National Drug Data File. The estimates indicate that approval of standard-review drugs — drugs whose therapeutic qualities the FDA considers to be similar to those of already marketed drugs — has no effect on longevity. But, approval of priority-review drugs — those considered by the FDA to offer significant improvements in the treatment, diagnosis, or prevention of a disease — has a significant positive impact on longevity. Increases in the stock of (labeled and unlabeled) drugs to treat a condition increase the mean age at which people die from that condition, and reduce the probability of dying before the age of 65.

The increase in the stock of priority-review drugs is estimated to have increased mean age at death by 0.39 years (4.7 months) during the period 1979-98. Ten percent of the total increase in mean age at death was attributable to the increase in the stock of priority-review drugs. The social rate of return on investment in pharmaceutical R and D is on the order of 18 percent. This rate of return reflects only the value of increased longevity among Americans; foreigners also benefit<sup>4</sup>, and the evidence suggests that there may be additional benefits of new drugs to

Americans, including reduced limitations on work and other activities, and reduced hospital expenditure.

## Reduced Activity Limitations

Another study using longitudinal, condition-level data<sup>5</sup> examines the effect of changes in both the average quantity and the average vintage (FDA approval year) of drugs consumed on work limitations. The estimates indicate that conditions for which there were above-average increases in utilization of prescriptions during 1996-8 tended to have above-average reductions in the probability of missed work-days. The estimated value to employers of the reduction in missed work-days exceed the employer's increase in drug costs.

The estimates are also consistent with the hypothesis that an increase in a condition's mean drug vintage reduces the probability that people with that condition will experience activity and work limitations, and reduces their average number of restricted-activity days. The estimates imply that activity limitations decline at the rate of about one percent per year of drug vintage, and that the rate of pharmaceutical-embodied technical progress with respect to activity limitations is about 18 percent per year. Estimates of the cost of the increase in drug vintage necessary to achieve reductions in activity limitations indicate that increases in drug vintage tend to be very "cost-effective."

Suchin Virabhak and I also examine the effect of drug vintage on activity limitations and perceived health status at the individual level<sup>6</sup>. We find that people who used newer drugs had better post-treatment health than people using older drugs for the same condition, after controlling for pre-treatment health, age, sex, race, marital status, education, income, and insurance coverage. They were more likely to survive, their perceived health status was higher, and they experienced fewer activity, social, and physical limitations. People consuming newer drugs tend to experience greater increases (or smaller declines) in physical ability than

people consuming older drugs. Most of the health measures indicate that the effect of drug vintage on health is higher for people with poor initial health than it is for people with good initial health. Therefore, in contrast to other kinds of technical progress (for example, information technology), which tends to increase economic inequality, pharmaceutical-embodied technical progress has a tendency to reduce inequality as well as promote economic growth, broadly defined.

## Reduced Total Medical Expenditures

I have performed several studies to assess the impact of pharmaceutical use in general on the demand for inpatient hospital care and overall medical expenditures. My first study on this issue<sup>7</sup> was based on disease-level data: I constructed a database of information about utilization of pharmaceuticals, ambulatory care, and hospital care, by disease, at two points in time (1980 and 1991 or 1992). I controlled for the presence of “fixed (diagnosis) effects” by analyzing relationships among *growth rates* of the variables. My main findings were:

- The number of hospital bed-days declined most rapidly for those diagnoses with the greatest increase in the total number of drugs prescribed and the greatest change in the distribution of drugs.
- An increase of 100 prescriptions is associated with 16.3 fewer hospital days.
- A \$1 increase in pharmaceutical expenditure is associated with a \$3.65 reduction in hospital care expenditure (ignoring any indirect cost of hospitalization), but it may also be associated with a \$1.54 increase in expenditure on ambulatory care.
- Diagnoses subject to higher rates of surgical innovation exhibited larger increases (or smaller declines) in hospitalization.
- My second study on this issue<sup>8</sup> was based on individual-level data, most of which were obtained from the 1996 Medical Expenditure Panel Survey (MEPS), which collected detailed data

from 23,230 people on use and expenditures for office and hospital-based care, home health care, and prescribed medicines. The MEPS Medical Conditions file contains summary information about each medical condition a person has, including the number of hospital events, emergency room events, outpatient events, office-based events, and home health events associated with the condition. The MEPS data enable us to control for many important attributes including sex, age, education, race, income, insurance status, who paid for the drug, the condition for which the drug was prescribed, and how long the person has had the condition. Moreover, the fact that many individuals in the sample have multiple medical conditions means that we can even control for *unobserved* individual characteristics — such as her physician’s “practice style” — by estimating a model that includes “individual effects.”

I examine the relationship between the age of the drug and the number and cost of non-drug medical events associated with the condition. Hospital stays are the most important of these, since they account for almost 42 percent of total medical expenditure. The estimates reveal that *people consuming newer drugs had significantly fewer hospital stays than people consuming older drugs*. Replacing a 15 year-old drug with a 5.5 year-old drug would increase the cost of the prescription by \$18, but would reduce the expected number of hospital stays by 0.006, that is about 6 fewer stays per thousand prescriptions. Since the average expenditure on a hospital stay in MEPS is \$7588, one might expect a reduction in hospital expenditure of \$44 ( $=0.00659 \times \$7588$ ) compared to an increase in drug cost of \$18. However, the reduction in hospital expenditure from the use of newer drugs is even larger than this (\$56) because newer drugs are associated with shorter, as well as fewer, hospital stays.

The estimates indicate that reductions in drug age tend to reduce *all* types of non-drug medical expenditure, although the reduction in inpatient expenditure is by far the largest. This reduction of \$71.09 in non-drug expenditure is much greater than the

increase in prescription cost (\$18.00), *so reducing the age of the drug results in a substantial net reduction in the total cost of treating the condition*.

It is sometimes suggested that, because generic drugs tend to be less expensive than branded drugs, allowing people to use only generic drugs might be an effective means of reducing health expenditure. Generic drugs tend to be much older than branded drugs. Suppose that, instead of consuming the actual mix of 60 percent branded and 40 percent generic drugs, people had to consume only generic drugs. This would increase the mean age of drugs consumed by 31 percent, from 29 years to 38 years. My estimates indicate that *denying people access to branded drugs would increase total treatment costs, not reduce them, and would lead to worse outcomes*.

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<sup>1</sup> One exception is F. R. Lichtenberg, “The Effect of New Drugs on HIV Mortality in the U.S., 1987-1998,” Economics and Human Biology, *forthcoming*.

<sup>2</sup> F. R. Lichtenberg, “Sources of U.S. Longevity Increase, 1960-1997,” NBER Working Paper No. 8755, January 2002.

<sup>3</sup> F. R. Lichtenberg, “Pharmaceutical Knowledge-Capital Accumulation and Longevity,” in C. Corrado, J. Haltiwanger, and D. Sichel, eds., *Measuring Capital in the New Economy*, University of Chicago Press, *forthcoming*.

<sup>4</sup> I am currently applying a similar approach to data on all OECD and some non-OECD countries.

<sup>5</sup> F. R. Lichtenberg, “The Effect of Changes in Drug Utilization on Labor Supply and Per Capita Output,” NBER Working Paper No. 9139, September 2002.

<sup>6</sup> F. R. Lichtenberg and S. Virabhak, “Pharmaceutical-Embodied Technical Progress, Longevity, and Quality of Life: Drugs as ‘Equipment for your Health,’” NBER Working Paper No. 9351, November 2002.

<sup>7</sup> F. R. Lichtenberg, “Do (More and Better) Drugs Keep People Out of Hospitals?” *American Economic Review*, 86 (May 1996), pp. 384-8.

<sup>8</sup> F. R. Lichtenberg, “Are the Benefits of Newer Drugs Worth Their Cost? Evidence from the 1996 MEPS,” *Health Affairs*, 20 (5) (September/October 2001), pp. 241-51.

# Liquidity Traps, Policy Rules for Inflation Targeting, and Eurosystem Monetary-Policy Strategy

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The field of monetary policy continuously provides new challenges for economic research. For instance, the experience of Japan since the early 1990s has generated new work on how to avoid and escape from a liquidity trap. The rapid spread of inflation targeting during the 1990s has stimulated new studies of how to understand and further improve this monetary policy regime. The ever-present uncertainty in practical monetary policymaking provides a constant demand for new ideas about conducting monetary policy under uncertainty. And, the controversial choice of a monetary policy strategy for the euro area has encouraged further research on monetary indicators and monetary targeting. These are all areas of focus in my own research over the last few years.<sup>1</sup>

## Escaping from a Liquidity Trap: The Foolproof Way

Japan's decade-long experience of deflation and a "liquidity trap" has stimulated research on how to escape from such a trap. In a liquidity trap, the central bank's "instrument rate" — a short nominal interest rate, such as the federal funds rate in the United States — is zero and the zero lower bound is binding, in the sense that deflation and/or recession calls for a more expansionary policy and a lower real interest rate.

As several authors have pointed out, an open economy such as Japan's has access to a very effective stimulative measure — namely, a currency depreci-

ation — if it wants to avoid a deflationary spiral. From that insight, I have constructed a specific proposal for a foolproof way to escape from a liquidity trap.<sup>2</sup> Although this proposal was directed initially to the Bank of Japan (BOJ) and the Ministry of Finance of Japan (MOF) — because the MOF is formally in charge of exchange rate policy in Japan — the foolproof way provides a method for any sufficiently open economy to escape from a liquidity trap, if it so desires.<sup>3</sup>

The idea is to announce and implement 1) an upward-sloping target path for the price level; 2) a depreciation and a temporary peg of the currency; and 3) the future abandonment of the peg in favor of inflation targeting when the price-level target path has been reached. The price-level target path provides the best nominal anchor and insurance against run-away inflation. It also provides an exit strategy for the temporary peg. The target path begins somewhere above the current price level; that difference is the "price gap." In Japan, several years of zero or negative inflation (that is, deflation) have resulted in a price level below previous expectations, increasing the real value of debt and contributing to deteriorating balance sheets for firms and banks. For Japan, the price gap may be 10-20 percent or more. The upward slope corresponds to a small positive long-run inflation target, say, 2 percent/year.

How to achieve this price-level target? This is the role of the depreciation and the temporary peg of the currency. Both are technically feasible. If the peg would fail, then the currency would appreciate back to where it was, making it a good investment. Initially, before the peg's credibility has been established, there will therefore be excess demand for the currency. This is fulfilled easily, though, because the central bank can print unlimited

amounts of the currency and sell them for foreign exchange. Indeed, there is a big difference between defending a fixed exchange rate for a strong currency under appreciation pressure (when foreign exchange reserves rise) and for a weak currency under depreciation pressure (when foreign exchange reserves fall). Thus, the peg can be maintained, and after a day or perhaps a few days, the peg's credibility will have been established.

Further, in order to be effective, the initial depreciation of the currency needs to be so large that it results in a real depreciation relative to any conceivable long-run equilibrium real exchange rate. For Japan, this may require a peg at 140 or 150 yen to the dollar, or even more. Then the future will inevitably bring a real appreciation. Thus, the market and the general public must expect a real appreciation in the future. But with an exchange rate peg, the real appreciation can only occur with a rise in the domestic price level. Hence, by pure logic, once the credibility of the exchange rate peg has been established, the market and the general public must expect future inflation in the country. In that way, gloomy deflation expectations will be replaced by optimistic inflation expectations.

Next, the expected future real appreciation of the currency will induce a desirable fall in the long real interest rate. Indeed, equilibrium on the international capital market requires that the expected real return on investment in the country and the rest of the world (including expected real exchange rate movements) move approximately parallel. This fall in the long real rate in the country also can be seen as the result of the increased inflation expectations noted earlier.

All this will jump-start the economy and increase output and the price level. First, the real depreciation will

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stimulate export and import-competing sectors. Second, the lower long real interest rate will stimulate domestic consumption and investment. Aggregate demand and output will rise. Third, the real depreciation, the increased aggregate demand, and the increased inflation expectations will all contribute to inflation and an increasing price level. The price level will approach the price-level target path from below. When the price-level target has been reached, the peg is abandoned and the currency floated. By adopting explicit inflation targeting, the central bank can then pursue a policy consistent with the initial price-level target path.

Japan has the option to follow this foolproof way unilaterally, without cooperation from countries in the region or the United States. The objections to a real depreciation of the yen that have been voiced by other countries in the region and by some U.S. officials appear to be mistaken. Any expansion in Japan requires a lower real interest rate, and a real depreciation is the unavoidable mirror image of a lower real interest rate. A real depreciation means that Japanese exporters get a short-term competitive edge, but growth in Japan and increased aggregate demand will increase Japan's imports from the rest of the world. Importantly, a real depreciation has both a substitution and an income effect on the trade balance. These effects are of opposite signs. While the real depreciation will tend to increase Japan's trade surplus, the income effect — caused by increased output, employment, and income in Japan — will tend to reduce the trade surplus, because of Japan's increased imports. Therefore, the net effect on the trade balance is probably quite small. The foolproof way is therefore not a beggar-thy-neighbor policy, except possibly in the very short run. In the medium and long run, the region, the United States, and the world will by all likelihood gain substantially from an expansion in Japan. In particular, if the rest of the world is sluggish, Japan is arguably needed even more as an engine of growth and trade.

Other proposals for recovery of Japan have focused on introducing inflation targeting and/or depreciating

the yen by foreign-exchange interventions.<sup>4</sup> The foolproof way is fully consistent with these proposals, but it provides better benchmarks, in the form of a peg for the yen, a price-level target path, and an exit strategy for the peg. The peg also provides an arena where the BOJ and the MOF can quickly demonstrate their resolve to end stagnation and deflation and thereby gain credibility.

Needless to say, the foolproof way is not a substitute but rather a complement to the structural reforms and cleanup of the financial sector in Japan that many observers have recommended. Arguably, such reforms are easier to undertake in a growing rather than a stagnating economy. The foolproof way implies that the BOJ and the MOF, if they so desire, can liberate Japan from its liquidity trap and replace stagnation and deflation by growth and low inflation. The foolproof way can jump-start Japan out of recession/depression and deflation. The foolproof way can help any sufficiently open economy to escape from a liquidity trap. It belongs among the contingency plans that prudent central banks may want to prepare for the worst-case scenario of falling into a liquidity trap and risking a spiral of deflation and depression.

## Monetary Policy Rules for Inflation Targeting: Targeting Rules Rather than Instrument Rules

Much recent work on monetary policy rules, for example in a conference volume edited by John Taylor,<sup>5</sup> focuses on a rather narrow interpretation of a monetary policy rule — an “instrument rule” — which expresses the central bank's instrument rate as a function of economic variables observed by the central bank. Knut Wicksell, Dale Henderson and Warwick McKibbin, Allan Meltzer, and Bennett McCallum have all suggested various instrument rules (the latter two for the monetary base rather than the instrument rate), but the best known and most studied instrument rule is the “Taylor rule” created by Taylor him-

self, where the instrument rate is a linear function of the gap between inflation and an inflation target and the gap between actual output and potential output, or the output gap. In the theoretical and empirical work on monetary policy, central banks are very often modeled as mechanically following a Taylor rule.

However, no central bank has committed itself to an instrument rule such as the Taylor rule. Instead, central banks have developed elaborate procedures for decisionmaking whereby huge amounts of data are collected, processed, and analyzed. Because of the lags in the effects of monetary-policy actions on inflation and output, the decision procedures in the more advanced central banks focus on projections of future inflation and output gaps. The instrument rate is set so that these projections are consistent with the banks' objectives, or what can be called “forecast targeting.” This means that all information that is relevant for the projections, including substantial amounts of judgment, ends up affecting the instrument setting, rather than just information on current inflation and the output gap. Subsamples for the Federal Reserve System's periods during which a Taylor-type rule fits best still leave at least one third of the variance of interest-rate changes unexplained.<sup>6</sup> Indeed, any realistic model of the economy requires more variables than just inflation and the output gap to describe the state of the economy, making Taylor-type rules less than optimal. Furthermore, any simple rule mentioned by central banks seems to refer to conditions for the target variables, such as inflation and the output gap, rather than to a formula for the instrument rates. Thus, the Bank of England and the Swedish Riksbank have referred to a rule that “inflation projections about two years ahead should approximately equal the inflation target.”

One view, promoted by Taylor, is that simple instrument rules, such as the Taylor rule, should not be followed mechanically but rather be used as a “guideline,” from which deviations may occur because of some “specific factor.”<sup>7</sup> I find this view too vague to be operational, since it does not pro-

vide any precise criterion for when deviations from the simple rule are motivated and when they are not.

Thus, there appears to be a substantial gap between the research on instrument rules and the practice of monetary policy. In a series of papers, including one I coauthored with Glenn Rudebusch and another coauthored with Michael Woodford, I discuss and propose a way to bridge that gap.<sup>8</sup> I have argued that, both from a descriptive and a prescriptive perspective, in order to be useful for discussing real-world monetary policy the concept of monetary-policy rules has to be broadened and defined as “a prescribed guide for monetary-policy conduct,” thus including “targeting rules” as well as “instrument rules.”<sup>9</sup>

A “general” targeting rule specifies the objectives to be achieved, for instance by listing the target variables, the targets (target levels) for those variables, and the (explicit or implicit) loss function to be minimized. A “specific” targeting rule specifies conditions for the target variables (or forecasts of the target variables) — the rule of thumb of the Bank of England and the Riksbank are examples. Specifying monetary policy in terms of targeting rules has a number of advantages. It allows for using all relevant information, in particular, for allowing the use of judgment; is more robust to both disturbances and model variation than instrument rules; and likely leads to better monetary-policy outcomes than instrument rules. Presumably, these advantages provide one explanation for why real-world monetary policy and monetary-policy reform have shunned commitment to instrument rules.

Monetary policy by the world’s more advanced central banks these days is at least as optimizing and forward-looking as the behavior of the most rational private agents. I therefore find it strange that a large part of the literature on monetary policy still prefers to represent central-bank behavior with the help of mechanical instrument rules. The concept of general and specific targeting rules is designed instead to provide a discussion of monetary policy that is fully consistent with the optimizing and forward-looking nature of modern mon-

etary policy. From this point of view, general targeting rules essentially specify operational objectives for monetary policy and specific targeting rules essentially specify operational optimal first-order conditions for monetary policy, in the same way that rational private agents these days are modeled in terms of optimal first-order conditions. In particular, an optimal targeting rule expresses the equality of the marginal rates of transformation and the marginal rates of substitution between the target variables in an operational way.

## Transparency of Monetary Policy

In two papers with Jon Faust, I examine the role of transparency in monetary policy and the endogenous choice of transparency by central banks.<sup>10</sup> Increased transparency makes the central bank’s reputation and credibility with the private sector more sensitive to its actions. This moderates the bank’s policy, and induces the bank to follow a policy closer to the socially optimal one. Full transparency of the central bank’s intentions is generally socially beneficial, but frequently not in the interest of the bank. When central banks can choose both the degree of control in monetary policy and the degree of transparency, a maximum feasible degree of control with a minimum degree of transparency is a possible outcome, we find. The Deutsche Bundesbank and the Federal Reserve System are, arguably, examples of this. One interpretation of these results is that society is better if it, rather than the central bank, decides on the level of transparency in monetary policy.

## Monetary Policy under Uncertainty

In three papers with Michael Woodford, I have explored optimal monetary policy under the very realistic case of uncertainty about the state of the economy using models with forward-looking variables, such as asset prices.<sup>11</sup> We find a simple way to show that the classic so-called *certainty-equivalence* theorem in a linear model with

standard quadratic monetary-policy objectives also holds when there are forward-looking variables. This implies that the optimal monetary-policy response to the optimal estimate of the current uncertain state of the economy is the same as if that estimate were certain. Hence, the optimal response to the *optimal estimate* of the state of the economy is *independent* of the degree of uncertainty of the estimate. We also derive the optimal weights on observable indicators in estimating the underlying state of the economy. These weights depend on — and are generally decreasing in — the degree of uncertainty. Hence, the monetary-policy response to the *indicators* is *dependent* on the degree of uncertainty.

Under the assumption of symmetric information between the central bank and the private sector, we can demonstrate a *separation principle* according to which the optimal estimation of the underlying state of the economy is independent of the monetary policy pursued. Under asymmetric information, the separation principle does not hold, but we can still derive the conditions defining the optimal estimation procedure.

These findings have substantial implications for practical monetary policy. They imply that monetary policy best fulfills its objectives if it focuses on mean (that is, probability-weighted average) forecasts, even if these forecasts are highly uncertain. For instance, they imply that central banks best fulfill their objectives if they construct their best estimates of potential output and the output gap and respond to these estimates with the same force as if they were not uncertain. In particular, these findings run counter to the idea that central banks should more or less disregard uncertain estimates of the output gap.<sup>12</sup>

## Eurosystem Monetary Policy Strategy and Monetary Targeting

The Eurosystem, consisting of the European Central Bank (ECB) and the twelve national central banks in the euro area, has chosen a heavily criticized “two pillar” monetary-policy

strategy with considerable emphasis on a money-growth indicator (consisting of the gap between M3 growth and a reference value, currently 4.5 percent/year). In two papers, I scrutinize the choice of strategy and conduct of monetary policy in the euro area.<sup>13</sup> The emphasis on monetary indicators in general and the money-growth indicator in particular lacks both theoretical and empirical basis and the monetary-policy strategy appears less well designed and transparent than that of inflation-targeting central banks.<sup>14</sup>

In three papers, one coauthored with Glenn Rudebusch and another with Stefan Gerlach, I further explore the theoretical and empirical case for monetary targeting and monetary indicators.<sup>15</sup> First, using an empirical model of the United States, Rudebusch and I show that monetary targeting would be a most inferior policy in the United States, resulting in much higher variability of both inflation and the output gap than does flexible inflation targeting. Since there are some economic similarities between the United States and the euro area — for instance, the size and the degree of openness — these results probably have some bearing on the euro area. Second, I show that the so-called P\* model of inflation — emphasized by the Bundesbank and the ECB and often interpreted as supporting monetary targeting — in no way supports monetary targeting above inflation targeting, even if the model were completely right, counter to previous views. One reason is that the P\* model puts emphasis on the *real money gap*, the gap between real money balances and long-run equilibrium real balances, as an indicator of future inflation rather than the Eurosystem's *nominal money-growth gap*. Third, Stefan Gerlach and I show that, even though the real money gap has predictive power for future inflation in euro area data, it does not perform better than the more conventional predictor, the output gap. The Eurosystem's money-growth gap is a much worse predictor of future inflation than either the real money gap or the output gap.

The findings in these papers are completely consistent with the fact that central banks other than the Eurosystem — including the Federal

Reserve System, the former monetary targeter Swiss National Bank, and inflation-targeting central banks — have reduced the emphasis on monetary indicators and/or abandoned monetary targeting.

<sup>1</sup> My research through the fall of 1997 was surveyed in "Monetary Policy and Inflation Targeting," NBER Reporter, Winter 1997/8, pp. 5-8.

<sup>2</sup> L. E. O. Svensson, "The Zero Bound in an Open-Economy: A Foolproof Way of Escaping from a Liquidity Trap," NBER Working Paper No. 7957, October 2000, and in Monetary and Economic Studies, Bank of Japan, 19 (S-1) (2001), pp. 277-312; "How Japan Can Recover," Financial Times, (Sept. 25, 2001); "Monetary Policy and Real Stabilization," in Rethinking Stabilization Policy, A Symposium Sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Sept. 29-31, 2002, forthcoming.

<sup>3</sup> See: [www.princeton.edu/~svensson/japan/japan.htm](http://www.princeton.edu/~svensson/japan/japan.htm) for more details on Japan and the foolproof way.

<sup>4</sup> B. S. Bernanke, "Japanese Monetary Policy: A Case of Self-Induced Paralysis?" in A. S. Posen and R. Mikitani, eds., Japan's Financial Crisis and Its Parallels to US Experience, Special Report 13, Institute for International Economics, Washington, DC, 2000, pp. 149-66; P. R. Krugman, "It's Baaack! Japan's Slump and the Return of the Liquidity Trap," Brookings Papers on Economic Activity, 2 (1998), pp. 137-187; A. S. Posen, Restoring Japan's Economic Growth, Institute for International Economics, Washington, DC, 1998; A. H. Meltzer, "Commentary: What More Can the Bank of Japan Do?" Monetary and Economic Studies, Bank of Japan, 17 (3) (1999), pp. 189-191; B. T. McCallum, "Theoretical Analysis Regarding a Zero Lower Bound on Nominal Interest Rates," Journal of Money Credit and Banking, 32 (2000), pp. 870-904.

<sup>5</sup> J. B. Taylor, ed., Monetary Policy Rules, Chicago: University of Chicago Press, 1999.

<sup>6</sup> See, for instance, J. P. Judd, and G. D. Rudebusch, "Taylor's Rule and the Fed: 1970-1997," Federal Reserve Bank of San Francisco Economic Review, (3) (1998), pp. 3-16.

<sup>7</sup> J. B. Taylor, "Using Monetary Policy in Emerging Market Economies," in Stabilization and Monetary Policy: The

International Experience, Bank of Mexico, (2000), pp. 441-457.

<sup>8</sup> L. E. O. Svensson, "Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets," NBER Working Paper No. 5797, October 1997, and in European Economic Review, 41 (1997), pp. 1111-46; "Inflation Targeting as a Monetary Policy Rule," NBER Working Paper No. 6790, November 1998, and in Journal of Monetary Economics, 43 (1999), pp. 607-654; "What Is Wrong with Taylor Rules? Using Judgment in Monetary Policy through Targeting Rules," Journal of Economic Literature, forthcoming; "Requiem for Forecast-Based Instrument Rules," Princeton University working paper, 2001; G. D. Rudebusch, and L. E. Svensson "Policy Rules for Inflation Targeting," NBER Working Paper No. 6512, April 1998, and in J. B. Taylor, ed., Monetary Policy Rules; L. E. O. Svensson and M. Woodford, "Implementing Optimal Policy through Inflation-Forecast Targeting," forthcoming in an NBER Conference Volume.

<sup>9</sup> C. A. Sims, "Macroeconomics and Reality," Econometrica, 48 (1980), pp. 1-48, and K. S. Rogoff, "The Optimal Degree of Commitment to an Intermediate Monetary Target," Quarterly Journal of Economics, 100 (1985), pp. 1169-90, provide early discussions of targeting rules.

<sup>10</sup> J. Faust and L. E. O. Svensson, "Transparency and Credibility: Monetary Policy with Unobservable Goals," NBER Working Paper No. 6452, March 1998, and in International Economic Review, 42 (2001), pp. 369-97; "The Equilibrium Degree of Transparency and Control in Monetary Policy," NBER Working Paper No. 7152, June 1999, and in Journal of Money, Credit and Banking, 34 (2002), pp. 520-39.

<sup>11</sup> L. E. O. Svensson and M. Woodford, "Indicator Variables for Optimal Policy," NBER Working Paper No. 7953, October 2000, and in Journal of Monetary Economics, forthcoming; "Optimal Policy with Partial Information in a Forward-Looking Model: Certainty-Equivalence Redux," Princeton University working paper, 2002; "Indicator Variables for Optimal Policy under Asymmetric Information," NBER Working Paper No. 8255, April 2001, and in Journal of Economic Dynamics and Control, forthcoming.

<sup>12</sup> A. Orphanides, "The Quest for Prosperity without Inflation," Working Paper No. 15,

European Central Bank, 2000.

<sup>13</sup> L. E. O. Svensson, "Monetary Policy Issues for the Eurosystem," NBER Working Paper No. 7177, June 1999, and in Carnegie-Rochester Conferences Series on Public Policy, 51-1 (1999), pp. 79-136; "The First Year of the Eurosystem: Inflation Targeting or Not?" NBER Working Paper No. 7598, August 2000, and in American Economic Review: Papers and Proceedings, 90 (May

2000), pp. 95-9.

<sup>14</sup> I have been invited to submit regular Briefing Papers for the Committee on Economic and Monetary Affairs (ECON) of the European Parliament for its hearings with ECB officials. These are available on [www.princeton.edu/~svensson](http://www.princeton.edu/~svensson).

<sup>15</sup> L. E. O. Svensson, "Does the P\* Model Provide Any Rationale for Monetary Targeting?" NBER Working Paper No. 7178, June 2000, and in German

Economic Review, 1 (February 2000), pp. 69-81; S. Gerlach, and L. E. O. Svensson, "Money and Inflation in the Euro Area: A Case for Monetary Indicators?" NBER Working Paper No. 8025, December 2000; G. D. Rudebusch, and L. E. O. Svensson, "Eurosystem Monetary Targeting: Lessons from U.S. Data," NBER Working Paper No. 7179, June 1999, and in European Economic Review, 46 (2002), pp. 417-42.

## Technology and Inequality

Daron Acemoglu\*

Many OECD economies have experienced sharp increases in wage and income inequality over the past several decades. In the United States, for example, the college premium — the wages of college graduates relative to the wages of high school graduates — increased by over 25 percent between 1979 and 1995. Overall earnings inequality also soared: in 1971, a worker at the 90th percentile of the wage distribution earned 266 percent more than a worker at the 10th percentile. By 1995 this number had risen to 366 percent.<sup>1</sup> Are new technologies — in particular, computers, computer-assisted machines and robotics, and advances in communication technology — responsible for these changes? More generally, what are the implications of technical change for the labor market?

Some economists now believe that, although other factors including the decline in the real value of the minimum wage, de-unionization, and globalization have played some role, the major driving force behind the changes in the U.S. wage structure is technology. This consensus is built on

the notion of technology-skill complementarity: technical change favors more skilled (educated) workers, replaces tasks previously performed by the unskilled, and increases the demand for skills. Consequently, many commentators see a direct causal relationship between technological changes and these radical shifts in the distribution of wages taking place in the U.S. economy.<sup>2</sup>

Although the consensus is now broad, the idea that technological advances favor more skilled workers is a 20th-century phenomenon. In 19th-century Britain, skilled artisans destroyed weaving, spinning, and threshing machines during the Luddite and Captain Swing riots, in the belief that the new machines would make their skills redundant. They were right: the artisan shop was replaced by the factory and later by interchangeable parts and the assembly line. Products previously manufactured by skilled artisans came to be produced in factories by workers with relatively few skills, and many previously complex tasks were simplified, reducing the demand for skilled workers.

A major 19th-century technological advance, interchangeable parts, in fact was designed to be "skill-replacing" (un-skill-biased). Eli Whitney, a pioneer of interchangeable parts, described the objective of this technology as: "to

substitute correct and effective operations of machinery for the skill of the artist which is acquired only by long practice and experience; a species of skill which is not possessed in this country to any considerable extent."<sup>3</sup>

There are also no compelling theoretical reasons to expect technological change always and everywhere to be skill-biased. On the contrary, if replacing skilled workers is more profitable, new technologies may attempt to replace skilled workers, just as interchangeable parts did. Even the most purportedly skill-biased technological advance, the microchip, can be used in scanners to complement unskilled work just as effectively as in personal computers to complement skilled workers.

Recent research takes these issues into consideration and analyzes the origins of skill bias and the conditions under which new technologies would be more or less skill biased. In this article, I survey some of this recent research, and how it might shed light on the recent increase in inequality. I also briefly discuss the links between technology and trade, technology and changes in the organization of production, the interaction between technical change and labor market institutions, and potential reasons for cross-country differences in inequality trends.

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## Technology and the Recent Changes in Wage Inequality

There is general agreement among economists that technical change in the United States and the OECD over the past 60 years, or even over the past century, has been skill-biased. That is because the past 60 years have seen a large increase in the supply of more educated workers, yet returns to education have risen. In the absence of substantial skill bias in technology, the large increase in the supply of skilled workers would have depressed the skill premium, as the economy moved along a downward-sloping relative demand curve — in other words, as skilled workers substituted for the unskilled in production and as consumers substituted goods produced using skilled workers intensively for labor-intensive goods. Because this did not happen, the relative demand for skills must have increased, most likely because of changes in technology. Of course here, “technology” needs to be construed broadly: it is not simply the techniques and machines available to firms, but also the organization of production, organization of labor markets, consumer tastes, and so on.

Many commentators in fact believe that there has been an acceleration in skill bias beginning in the 1970s or the 1980s. The most popular, but by no means the only, version of this hypothesis claims that there has been a notable acceleration in the skill bias of technology, driven by advances in information technology, or perhaps a “Third Industrial Revolution.” A variety of studies document how the introduction of many modern technologies often is associated with an increase in the employment of and demand for more skilled workers.<sup>4</sup> But probably the most powerful argument in favor of an acceleration in skill bias is that returns to schooling rose over the past 30 years despite the unusually rapid increase in the supply of educated workers. As a result of the entry of the large and well-educated baby-boom cohort starting in the late 1960s, and because of the Vietnam-era draft laws and increasing government sup-

port for higher education, the educational attainment of the U.S. labor force increased sharply starting in the early 1970s. Consequently, the relative supply of skills increased more rapidly on average in the three decades following 1970 than in the previous three decades. Without an acceleration in skill bias, we would expect a slower increase in the returns to education in the post-1970 era. In contrast, the U.S. skill premium increased rapidly during the past three decades, while it was approximately constant in the pre-1970 era. Furthermore, during this time period the U.S. labor market also experienced a sharp increase in within-group inequality — that is, inequality among similarly educated workers, which likely indicates the presence of some new and powerful forces.<sup>5</sup>

## Endogenous Technical Change

Why did the demand for skills accelerate over this period? And why has new technology favored more skilled workers throughout the 20th century, but not during the 19th century as was discussed above? One approach views technology as exogenous, stemming from advances in science or from the behavior of entrepreneurs driven by a variety of nonprofit motives. By this approach, demand for skills increased faster during the past 30 years, this approach would maintain, because of a technological revolution led by the microchip, personal computers, and perhaps the Internet.

However, the fact that skill-biased technical change accelerated more or less immediately after the relative supply of more educated workers accelerated, starting in the early 1970s, is a bit of a coincidence. This makes me lean towards a theory that links changes in the relative supply of and the demand for skills, and attempts to explain why new technologies have been skill-biased throughout the 20th century and have become more so during the past 30 years. The first step in the argument is the realization that technology is not simply an outside force acting on the labor market and wage inequality. Rather it is an outcome of

the decisions made by firms and workers, in the same way as the level of employment or wages are. In other words, technology is “endogenous.”<sup>6</sup>

The spinning and weaving machines of the 19th century were invented because they were profitable. They were profitable because they replaced the scarce and expensive factors — the skilled artisans — by relatively cheap and abundant factors — unskilled manual labor of men, women, and children. Similarly, electrical machinery, air-conditioning, large organizations all were introduced because they presented profit opportunities for entrepreneurs. If various new machines and production methods came into being when called forth by profit opportunities, it is also likely that further skill-biased technical change and an acceleration in skill bias are also, at least in part, responses to profit incentives. Put simply and extremely, it can be argued that the increased skill bias of technology throughout the 20th century and its acceleration during the past 30 years resulted from the changes in profit opportunities which were, in turn, a consequence of the steady increase in the supply of skilled workers over the past century and its surge starting in the early 1970s.

## Directed Technical Change and the Demand for Skills

But why is the skill bias of technology related to the supply of skilled workers? The basic idea is that technical change will be *directed* towards more profitable areas.<sup>7</sup> In particular, when developing skill-biased techniques is more profitable, new technology will tend to be skill-biased.

Two factors determine the profitability of new technologies: *the price effect* and *the market size effect*. When relative prices change, the relative profitability of different types of technologies also changes. Technologies used predominantly in the production of goods that are now more expensive will be demanded more, and the invention and improvement of these technologies will become more profitable. Similarly, the potential market size for

a technology is a first-order determinant of its profitability. Everything else equal, it is more profitable to introduce machines that will be used by a larger number of workers because these greater market sizes will enable greater sales and profits for the producers and inventors. It is through the market size effect that an increase in the supply of skills induces technology to become more skill biased. Consequently, when there are more skilled workers around, the market size effect will make the production of skill-complementary machines and technologies more profitable. Somewhat surprisingly, this market size effect can be so strong that the relative demand curve for skills can be upward sloping in contrast to the standard downward-sloping relative demand curve. In this case, the skill premium and returns to education will be higher when there are more skilled workers in the economy.

In this light, the recent acceleration in the skill bias of technology is potentially a response to the rapid increase in the supply of skills starting in the early 1970s. As the market size for skill-complementary technologies such as personal computers or computer-assisted machinery expanded, it became more profitable to create and introduce more such technologies. This hypothesis not only explains the increase in the demand for skills, and the resulting rise in the returns to education and inequality, but also helps us understand the timing of the increase. New technologies take a while to be created and brought to the market. Therefore, the first effect of a large increase in the relative supply of skills might be to move the economy along a downward-sloping constant-technology relative demand curve. However, as new skill-biased technologies are brought to the market, this constant-technology relative demand curve shifts out, increasing returns to education, potentially even beyond its initial level.<sup>8</sup>

What about the secular skill-biased technical change throughout the 20th century? Perhaps there is a natural explanation: the relative supply of skilled workers has been increasing throughout the century, so we should expect steady skill-biased technical change. What about the skill-replacing

technologies of the 19th century? One possible, conjectural argument is that the early 19th century was characterized by skill-replacing developments because the increased supply of unskilled workers in the English cities (resulting from migration from rural areas and from Ireland) made the introduction of these technologies profitable.<sup>9</sup> Therefore, a theory of directed technical change provides us with an explanation for: secular skill-biased technical change throughout the 20th century; the rise in inequality over the past several decades; and, possibly, the skill-replacing technologies of the early 19th century.

## Globalization and Inequality

Another major economic development of the past 30 years is the increased globalization of production, and greater trade between the United States and less developed nations (LDCs). A number of commentators have suggested that globalization and increased trade might be responsible for the rise in U.S. inequality. The arguments above — that technological change has been important in the rise in inequality — do not imply that other factors, such as globalization, have not played a major role.

Nevertheless, most economists discount the role of globalization and trade for a variety of reasons. First, the volume of trade is still small. Second, the major intervening mechanism for the trade explanation, a large increase in the relative prices of skill-intensive goods because of greater world demand for these, has not been observed. Third, inequality also has increased in many of the LDCs trading with the United States, whereas the simplest trade and globalization explanations predict a decline in inequality in relatively skill-scarce economies, like the LDCs.

But trade and globalization may have been more important than traditionally assumed. Trade influences what types of technologies are more profitable to develop. In particular, trade creates a tendency for the price of skill-intensive products to increase.

Then, via the price effect emphasized above, the incentives for the introduction of new skill-biased technologies are strengthened. In other words, trade and globalization induce further skill-biased technical change.

With this type of induced technical change, trade can have a larger effect on inequality than traditional calculations suggest. Moreover, it can do so without a large impact on the relative prices of skill-intensive goods because the induced technical change will help boost the supply of these goods. As a result, we may not even see much evidence of the original triggering mechanism, the change in relative prices. Finally, to the extent that the LDCs are also using technologies developed in the United States and the OECD, there will be a force towards increasing inequality in those countries as well, counteracting the static equalizing effects of trade in economies with relative skill scarcity.<sup>10</sup>

## Changes in the Organization of Production

The increase in the demand for skills and inequality in the U.S. economy may be as much attributable to the changes in the organization of production as to the direct effect of new technologies. Today's production relations, how jobs and monitoring are organized, and how firms recruit employees are all very different from 30 years ago.<sup>11</sup>

A perspective that views technology, and the organization of production, as endogenous is also helpful in thinking about these issues. An important driving force of the changes in production may be the increased supply of skills. When skilled workers are scarce, it is not profitable for firms to design their jobs specifically for skilled workers and to be extremely selective in their recruitment. In such a world, firms are often happy to hire many low-skill workers, train them, and employ them in relatively well-paid jobs. In contrast, in a world with many skilled workers, it pays to design jobs specifically for them and to be more selective in recruiting. This increases

the productivity and pay of more skilled workers, and effectively excludes low- and medium-skilled workers from well-paid jobs.<sup>12</sup>

Many of the developments in the U.S. labor market, including the recent trends in recruitment and human resource practices, the disappearance of middle-level-pay occupations, reduced training for low-skill employees, the greater dispersion in capital-labor ratios across industries, and the reduced mismatch between workers and jobs, can be explained by a theory based on an induced change in the organization of production and associated changes in recruiting strategies.<sup>13</sup> Moreover, such an approach can explain the decline in the real wages of low-skill workers — a phenomenon that pure technological theories have difficulty explaining — because technological change, even when it is skill biased, also should increase the wages of low-skilled workers. With organizational change, though, resources will get shifted away from low-skill workers and jobs that paid them high wages will disappear.

## Technology, Labor Market Institutions, and Social Norms

Emphasizing technology does not deny that changes in labor market institutions have been important. The erosion in the real value of the minimum wage and the declining role of unions undoubtedly have been important for changes in U.S. inequality, especially at the bottom of the wage distribution.<sup>14</sup> In addition, the late 1980s and the 1990s have seen an explosion in CEO pay, which is difficult to explain with changes in technology alone, and which suggests that there may have been concurrent changes in social norms pertaining to inequality and fairness.<sup>15</sup> Why have labor market institutions and social norms related to inequality changed at about the same time that skill bias of technology accelerated? This may be a coincidence, or the overall changes in inequality may be the result of changing labor market institutions and social norms, and less the product of tech-

nology. In my view, a more fruitful approach is to acknowledge the independent effects of both changes in technology and changes in labor market institutions and social norms, and to link the two.

Recent research suggests how increases in inequality, for example attributable to technological advances, might affect labor market institutions and political preferences about redistribution. Similar arguments also might be used to link social norms of inequality and fairness to technology. Briefly, an increase in inequality might make it harder for certain labor market arrangements, like unions, to survive. Unions typically compress the wage structure, increasing the pay of less skilled workers at the expense of more skilled workers. An increase in the underlying inequality in the economy will make this more costly for high-skill workers, who then will withdraw from the union sectors and from unionized establishments. Similarly, an increase in inequality may reduce the support that highly paid individuals give to the welfare state or to redistributive government programs. These considerations imply that technical change that increases the demand for skills can have much amplified effects on inequality, because it also will change labor market institutions and preferences towards redistribution.<sup>16</sup> These forces might be amplified even more when technology also affects social norms, for example, as it becomes acceptable for CEOs to be paid much more than production workers.

## Cross-Country Differences

While inequality increased in English-speaking economies, there was much less of an increase in many continental European countries. To date, there is no consensus for why there was such a divergence in inequality trends among these relatively similar economies. Considering endogenous technology choices may be useful here. Recent research suggests that labor market institutions compressing the structure of wages, as in many continental European economies,

might induce firms to introduce additional new technologies to be used with their unskilled employees. Wage compression makes unskilled workers more expensive to employ and, conditional on wishing to employ them, it increases the value of raising their productivity.<sup>17</sup>

Therefore, labor market institutions, such as binding minimum wages, union wage floors, and generous unemployment insurance programs, may have an amplified role in reducing inequality. They will do so directly and they will do so by encouraging technical change to be less skill-biased.

Overall, however, our understanding of the reasons for cross-country differences in inequality is weak, and much research is necessary on this topic, as well as on the relationship between technology and labor market institutions and social norms.

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<sup>1</sup> See L. F. Katz and D. H. Autor, "Changes in the Wage Structure and Earnings Inequality," in *The Handbook of Labor Economics*, Vol. 3, O. Ashenfelter and D. Card, eds., Amsterdam: Elsevier, 2000; or P. Gottschalk, "Inequality in Income, Growth and Mobility: The Basic Facts," *Journal of Economic Perspectives*, 11 (1997) pp. 21-40, for recent surveys of the changes in the U.S. wage structure; and P. Gottschalk and M. Joyce, "Cross-National Differences in the Rise in Earnings Inequality: Market and Institutional Factors," *Review of Economics and Statistics*, 80 (1998), pp. 489-502; R. B. Freeman and L. F. Katz, "Introduction and Summary," in R. B. Freeman and L. F. Katz, eds., *Differences and Changes in Wage Structures*, Chicago: The University of Chicago Press, 1995, pp. 1-22, for cross-country trends.

<sup>2</sup> See, for example, D. H. Autor, A. B. Krueger, and L. F. Katz, "Computing Inequality: Have Computers Changed the Labor Market?" NBER Working Paper No. 5956, March 1997, and in *Quarterly Journal of Economics*, 113 (1998), pp. 1169-214; E. Berman, J. Bound, and S. Machin, "Implications of Skill-Biased Technological Change: International Evidence," NBER Working Paper No. 6166, September 1997, and in *Quarterly Journal of Economics*, 113 (1998), pp. 1245-80; F. Caselli, "Technological Revolutions," *American Economic*

Review, 87 (1999), pp. 78-102; O. Galor and O. Maor, "Ability Biased Technological Transition, Wage Inequality and Economic Growth," Quarterly Journal of Economics, 115 (2000), pp. 469-98; J. Greenwood and M. Yorukoglu, "1974," Carnegie-Rochester Conference Series on Public Policy, 46 (1997), pp. 49-95; A. B. Krueger, "How Computers Have Changed the Wage Structure: Evidence from Microdata, 1984-1989," NBER Working Paper No. 3858, October 1991, and in Quarterly Journal of Economics, 110 (1993), pp. 33-60. See D. Card and J. E. DiNardo, "Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles," NBER Working Paper No. 8769, February 2002, for the case against the role of technology in the changes in the U.S. wage structure.

<sup>3</sup> Quoted in H. J. Habakkuk, *American and British Technology in the 19th Century*, London: Cambridge University Press, 1962.

<sup>4</sup> See, for example, D. H. Autor, A. B. Krueger, and L. F. Katz, "Computing Inequality: Have Computers Changed the Labor Market?" And A. P. Bartel, C. Ichniowski, and K. L. Shaw, "New Technology, Human Resource Practices and Skill Requirements," Carnegie-Mellon mimeo, 2002.

<sup>5</sup> See D. Acemoglu, "Technical Change, Inequality and the Labor Market," NBER Working Paper No. 7800, July 2000, and in *Journal of Economic Literature*, Vol. 40 (2002), pp. 7-72, for a discussion of the case for and against an acceleration in skill bias.

<sup>6</sup> See P. David, *Technical Choice, Innovation and Economic Growth: Essays on American and British Experience in the 19th Century*, London: Cambridge University Press, 1975; H. J. Habakkuk, *American and British Technology in the 19th Century; and especially J. Schmookler, Invention and Economic Growth*, Cambridge, MA: Harvard University Press, 1966. For early historical discussions of endogenous technology, see P. Aghion and P. Howitt, *Endogenous Growth Theory*, Cambridge, MA: MIT Press, 1998; G. Grossman and E. Helpman, *Innovation and Growth in the Global Economy*, Cambridge, MA: MIT Press, 1991; and P. M. Romer, "Endogenous Technological Change," *Journal of Political Economy*, 87 (1990), pp. 71-102, for analyses of endogenous

aggregate technological change.

<sup>7</sup> For the basic idea and models of directed technical change, see D. Acemoglu, "Why Do New Technologies Complement Skills? Directed Technical Change and Wage Inequality," Quarterly Journal of Economics, 113 (1998), pp. 1055-90; and D. Acemoglu, "Directed Technical Change," NBER Working Paper No. 8287, May 2001, and in *Review of Economic Studies*, 69 (2002), pp. 781-810.

<sup>8</sup> D. Acemoglu, "Why Do New Technologies Complement Skills? Directed Technical Change and Wage Inequality."

<sup>9</sup> See D. Acemoglu, "Technical Change, Inequality and the Labor Market," and D. Acemoglu, "Directed Technical Change," for more details on this argument.

<sup>10</sup> See D. Acemoglu, "Patterns of Skill Premia," NBER Working Paper No. 7018, March 1999, forthcoming in *Review of Economic Studies*. See A. Wood, *North-South Trade, Employment and Inequality: Changing Fortunes in a Skill Driven World*, Oxford: Clarendon Press, 1994, for the argument that trade with the LDCs may lead to defensive innovations. For more recent models of trade affecting inequality by its impact on technology, see M. Thoenig and T. Verdier, "Trade Induced Technical Bias and Wage Inequalities: A Theory of Defensive Innovations," Delta mimeo, 2002, forthcoming in *American Economic Review*, and P. Epifani and G. Gancia, "The Skill Bias of World Trade," MIT mimeo, 2002.

<sup>11</sup> See D. H. Autor, F. Levy, and R. J. Murnane, "The Skill Content of Recent Technological Change: An Empirical Exploration," NBER Working Paper No. 8337, June 2001; P. Cappelli and S. Wilk, "Understanding Selection Processes: Organization Determinants and Performance Outcomes," Wharton School mimeo, 1997; and R. J. Murnane and F. Levy, *Teaching the Basic New Skills*, NY: The Free Press, 1996, for changes in the organization of production and the recruitment process; and T. F. Bresnahan, E. Brynjolfsson, and L. M. Hitt, "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-level Evidence," NBER Working Paper No. 7136, May 1999, and in *Quarterly Journal of Economics*, 117 (2002), pp. 339-76; and E. Caroli and J. van Reenen, "Skill-Biased Organizational Change: Evidence from a Panel of British and French Establishments," *Quarterly Journal of Economics*, 116

(2002), pp. 1449-92, for the effect of firm organization on the demand for skills.

<sup>12</sup> See D. Acemoglu, "Changes in Unemployment and Wage Inequality: An Alternative Theory and Some Evidence," NBER Working Paper No. 6658, July 1998, and in *American Economic Review*, 89 (1999), pp. 1259-78; and also M. Kremer and E. Maskin, "Segregation by Skill and the Rise in Inequality," Harvard mimeo, 1999.

<sup>13</sup> See D. Acemoglu, "Changes in Unemployment and Wage Inequality: An Alternative Theory and Some Evidence," for a summary of this evidence.

<sup>14</sup> See D. Card, "The Effect of Unions on the Structure of Wages: A Longitudinal Analysis," *Econometrica*, 64 (1996), pp. 957-79; J. E. DiNardo, N. M. Fortin, and T. Lemieux, "Labor Market Institutions, and the Distribution of Wages, 1973-1992: A Semiparametric Approach," NBER Working Paper No. 5093, April 1995, and in *Econometrica*, 64 (1995), pp. 1001-44; R. B. Freeman, "How Much Has Deunionization Contributed to the Rise of Male Earnings Inequality?" NBER Working Paper No. 3826, August 1991; and D. S. Lee, "Wage Inequality in the U. S. During the 1980s: Rising Dispersion or Falling Minimum Wage?" *Quarterly Journal of Economics*, 114 (1999), pp. 941-1024, for the effect of the minimum wage and deunionization on inequality.

<sup>15</sup> See E. Saez and T. Piketty, "Income Inequality in the United States: 1913-1998," NBER Working Paper No. 8467, September 2001, forthcoming in *Quarterly Journal of Economics*, on the rise in inequality at the top of the U.S. income distribution, and a discussion of changing social norms.

<sup>16</sup> See D. Acemoglu, P. Aghion, and G. Violante, "Technical Change, Deunionization, and Inequality," Carnegie-Rochester Conference Series On Public Policy, 2002, on the effect of inequality on deunionization; and J. Hassler, S. Mora, K. Storlessseten, and F. Zilibotti, "Survival of the Welfare State," Stockholm mimeo, 2002, forthcoming in *American Economic Review*; and R. Benabou, "Human Capital, Technical Change, and the Welfare State," Princeton mimeo, 2002, forthcoming in *European Economic Review*.

<sup>17</sup> D. Acemoglu, "Cross-country Inequality Trends," NBER Working Paper No. 8832, March 2002, forthcoming in *Economic Journal*.



# Patent Policy Reform and Its Implications

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Economists have long viewed the patent system as a crucial lever with which policymakers can affect the speed and nature of innovation in the economy. It is not surprising, then, that the profound changes that have roiled the U.S. patent system over the past two decades — the strengthening of patent rights by the specialized court that hears patent appeals and the reduced resources available to assess patent applications — are attracting increasing attention from the economics profession.

Here I briefly review some of the key changes that have taken place in the U.S. patent system, as well as a selection of studies that examine their short- and long-run implications. While this abbreviated treatment will not do justice to the complex issues involved, the interested reader will be directed to a variety of more detailed readings.<sup>1</sup>

## The Backdrop

The ferment in the U.S. patent system had its origin in two shifts. Neither was thoroughly discussed at the time, nor did policymakers appear to appreciate the *interaction* between these two changes.<sup>2</sup>

The first was a seemingly technical shift in the appellate process. Since the birth of the republic, almost all formal disputes involving patents have been tried in the federal judicial system. The initial litigation must occur in a district court. Before 1982, appeals of patent cases were heard in the appellate courts of the various circuits. These circuits differed considerably in their interpretation of patent law, with some of them more than twice as likely to uphold patent claims than others.

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These differences persisted because the Supreme Court rarely heard patent-related cases.

The result was widespread “forum shopping” in patent cases. Patent applicants would crowd the hallway in the office where the list of awards was distributed at noon on each Tuesday. Upon discovering that their patent had issued, they would rush to the pay phones to instruct their lawyers to file a patent-infringement lawsuit against competitors in a patent-friendly district court. Meanwhile, representatives of firms who might infringe the issued patent would race to the phones as well. They would order their lawyers to file a lawsuit seeking to have the new patent declared invalid in a “skeptical” district. Often the fate of the case — and many million dollars in damages — would hinge on which lawyer got his suit time-stamped first. (Judges would often combine such dueling lawsuits into a single action, heard in the district court where the initial action was filed.)

In 1982, the U.S. Congress decided to tackle this situation. It established a centralized appellate court for patent cases: the Court of Appeals for the Federal Circuit (CAFC). In the congressional hearings that preceded the decision, lawmakers reassured constituents that the change would bring much-needed consistency to the volatile world of patent litigation. But even from the inception of the legislative push, informed insiders suspected that the new court would substantially boost patent-holders’ rights.

And that is precisely what happened. The CAFC was staffed mostly with judges in the federal system who had experience as patent attorneys. Not surprisingly, many had an outlook that was sympathetic to the patent system. Over the next decade, in case after case, the court significantly broadened patent-holders’ rights. A comparison of the CAFC’s rulings

with those of the previous courts illustrates the magnitude of the change. Whereas the circuit courts had affirmed 62 percent of district-court findings of patent infringement in the three decades before the creation of the CAFC, the CAFC in its first eight years affirmed 90 percent of such decisions.<sup>3</sup> The court expanded patent-holders’ rights along a number of other dimensions as well.

The impact of the strengthening of patent rights alone would be difficult to predict: after all, a voluminous theoretical literature has debated the virtues of strong and weak patent protection. Yet these changes to the judicial system did not happen alone — simultaneously, the U.S. Patent and Trademark Office (PTO) itself was also changing. In 1999, Congress converted the PTO from a tax-revenue-funded agency that collected nominal fees for patent applications into one funded solely by fees. Indeed, the PTO has become a “profit center” for the government, collecting more in application fees than it costs to run the agency. Meanwhile, levels of compensation of patent examiners fell well below comparable positions in the private sector. Simultaneously, and perhaps not coincidentally, the PTO increasingly defined its mission as serving patent applicants. Many critics have suggested that these pressures have led to a lowering of the standards for examining of patent awards.

## The Nature of the Changes

What are the consequences of these changes? How have these shifts affected the way in which firms apply for patents, and use their patents once they are awarded?

Economists have explored these questions primarily through industry studies.<sup>4</sup> One effort examined the

biotechnology industry, which has been the site of some of the most intensive patent litigation.<sup>5</sup> I examined the propensity of firms to patent in sub-classes of rival firms that had already received awards. My analysis showed that firms with high litigation costs were less likely to patent in more “crowded” subclasses with many other awards, particularly those of firms with low litigation costs. This pattern was consistent with the literature on costly litigation, which suggests that firms with high litigation costs will take greater precautions to avoid litigation, and raises questions as to whether the strengthening of patent protection was affecting the direction of technological innovation.

Bronwyn Hall and Rosemarie Ziedonis, meanwhile, analyze in detail the behavior of semi-conductor firms.<sup>6</sup> Combining empirical analyses with interviews of lawyers and managers at semi-conductor firms, they document the critical role of patent strategy. The complex nature of semi-conductor technology implies that firms must use rivals’ technologies, so cross-licensing agreements are an economic necessity. Furthermore, the capital intensity of the industry implies that the costs of an injunction would be punishing. As a result, firms build large portfolios of patents, which they then cross-license with rivals.

Hall and Ziedonis suggest that the strengthening of patent protection has led to an increased emphasis on seeking patent protection, even if the pace of innovation at large firms has not increased. At the same time, they acknowledge that recent years have seen much entry of “fabless” manufacturers, who design chips but leave the manufacturing to others. Without strong patent protection, it is unclear whether such vertical disintegration could have occurred.

My recent study of securing patents on financial formulas and methods highlights various concerns about patent quality.<sup>7</sup> Awards in this category have exploded, particularly after a 1998 decision by the CAFC unambiguously established the patentability of such innovations. Analyses of the awards and surveys of patent lawyers suggest that academic research is germane to

many of the patents being awarded (and indeed, that much of academic finance research could be patented). Despite this seeming overlap, very few of the finance patents awarded today cite academic research as “relevant previous discoveries.” In fact, there are numerous examples of academic papers anticipating the patented discovery by many years, which should have made it impossible to patent the “discovery.” Comparisons of finance patents with awards in other academic-related fields suggest that the seemingly poor quality of financial patents is attributable to the lack of experience of the examiners reviewing the applications: these examiners are far less likely to have a doctorate in a relevant field or to have examined a significant number of patents in this area.

## The Impact on Innovation

What impact have these changes had on the rate of innovation? To what extent do these changes really affect the pace of innovation in a given industry?

Initially this literature tended to examine a single policy change in depth. Of the works along these lines, Lee Branstetter and Mariko Sakakibara’s examination of the increase in the scope of Japanese patent protection stands out.<sup>8</sup> Prior to 1988, the Japanese patent system essentially allowed only one claim per patent, which led to very narrow awards. In that year, Japan converted to a system much like the U.S. system, in which a single patent can have multiple claims. The authors examine the impact of this change on innovation by studying the shifts in research spending in Japan around this time, as well as the change in filings in the United States (whose patent system did not change in this time). Their study shows that neither of these changes occurred. The certainty with which the authors can conclude that the shift in patent protection did not affect innovation, however, is tempered by the fact that the effect of the policy shift may have been relatively minor, and there was the possibility of economy-wide shocks

during the same period.

My recent work generalizes this approach by examining the impact of major patent policy shifts in 60 nations over the past 150 years that enhanced or reduced the amount of patent protection provided (but not the scope of awards).<sup>9</sup> I examine the changes in patent applications by residents of the nation undertaking the policy change. I tabulate the filings that the residents made domestically, although confounding factors may influence this measure. Thus, I focus on filings made by residents of the nation undertaking the policy change *in a nation with a relatively constant patent policy*, Great Britain. The basic patterns are striking. Once overall trends in patenting are adjusted for, the changes in patenting by residents of the country undertaking the policy change are weak, and indeed negative, both in Great Britain and in the country itself. Cross-sectional analyses suggest that the impact of patent protection-enhancing shifts was greater in nations with weaker initial protection and greater economic development, consistent with economic theory. My interpretation of the results must be cautious, because the measure of innovative output is a crude one and other forms of technology policy are not considered. But, subject to the caveats, this evidence suggests that these policy changes have a limited effect on domestic innovation.

## Institutional Responses to the Patent Policy Changes

One emerging research area examines the mechanisms through which firms can address problems of overlapping patents. A number of legal scholars, including Robert Merges, have argued that collective rights organizations (such as patent pools) should be encouraged, in order to address the coordination and hold-up problems that such patents introduce. These arguments were placed into an economic framework in an important paper by Carl Shapiro.<sup>10</sup> He argued that cross-licenses and patent pools are natural responses by firms to address the problems posed by overlapping patent

holdings. Despite the desirability of this solution, antitrust law historically has viewed these mechanisms with suspicion. Using a simple Cournot model, Shapiro demonstrates that a few relatively simple principles — such as insuring that patents licensed together are complements, not substitutes — can help assure policymakers that these mechanisms are socially beneficial.

This work in turn has stimulated other research, examining the normative and positive features of these mechanisms. In a series of empirical and theoretical papers, Jean Tirole and I examine a variety of mechanisms by which firms share their intellectual property holdings: open source projects,<sup>11</sup> patent pools,<sup>12</sup> and (in ongoing work) standard setting organizations, for example. In a similar vein, Jeffrey Furman and Scott Stern examine tissue type collections, through which the fruits of academic research are shared.<sup>13</sup> Given the ubiquity of challenges associated with overlapping patent holdings, and the slow pace of policy reform in this arena, it is likely that these institutions will play an even more important role in the years to come, and that further research into their workings will be valuable.

In short, the shifts in patent policy and practice over the past two decades appear to be having a substantial impact on the American economy. While economists to date have had relatively little impact on the patent policy process, the growth of research into critical questions is encouraging.

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<sup>1</sup> Two recent review articles are good starting places: N. T. Gallini, "The Economics of Patents: Lessons from Recent U.S. Patent Reform," *Journal of Economic Perspectives*, 16 (Spring 2002), pp. 131-54; and A. B. Jaffe, "The U.S. Patent

*System in Transition: Policy Innovation and the Innovation Process*," NBER Working Paper No. 7280, August 1999, and in *Research Policy*, 29 (2000), pp. 531-57.

<sup>2</sup> This section is based on A. B. Jaffe and J. Lerner, *Into the Patent Thicket*, Princeton, NJ: Princeton University Press, 2004. It should also be noted that there were important changes around this time in policies concerning the commercialization of patented academic research and in the harmonization of the global patent system, neither of which will be discussed here.

<sup>3</sup> These statistics are gleaned from G. K. Koenig, *Patent Invalidation: A Statistical and Substantive Analysis*, New York: Clark Boardman, 1980; and R. L. Harmon, *Patents and the Federal Circuit*, Washington: Bureau of National Affairs, 1991.

<sup>4</sup> Some exceptions, with an explicitly cross-industry perspective, exist as well. Examples include W. M. Cohen, R. R. Nelson, and J. P. Walsh, "Protecting Their Intellectual Assets: Appropriability Conditions and Why Firms Patent and Why They Do Not in the American Manufacturing Sector," NBER Working Paper No. 7552, February 2000; and S. Kortum and J. Lerner, "Stronger Protection or Technological Revolution: What Is Behind the Recent Surge in Patenting?" NBER Working Paper No. 6204, September 1997, and in *Carnegie-Rochester Series on Public Policy*, 48 (1998), pp. 247-304. An alternative approach has been to look at specific policy shifts: examples include D. K. N. Johnson and D. Popp, "Forced Out of the Closet: The Impact of the American Inventors Protection Act on the Timing of Patent Disclosure," NBER Working Paper No. 8374, July 2001, and in *RAND Journal of Economics*, 34 (2003), forthcoming; and J. O. Lanjouw and J. Lerner, "Tilting the Table? The Use of Preliminary Injunctions," *Journal of Law and Economics*, 44 (2001), pp. 573-603.

<sup>5</sup> J. Lerner, "Patenting in the Shadow of

Competitors," *Journal of Law and Economics*, 38 (1995), pp. 563-95.

<sup>6</sup> B. H. Hall and R. H. Ziedonis, "The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995," NBER Working Paper No. 7062, March 1999, and in *Rand Journal of Economics*, 32 (2001), pp. 101-28.

<sup>7</sup> J. Lerner, "Where Does State Street Lead? A First Look at Finance Patents, 1971-2000," NBER Working Paper No. 7918, September 2000, and in *Journal of Finance*, 57 (2002), pp. 901-30.

<sup>8</sup> M. Sakakibara and L. Branstetter, "Do Stronger Patents Induce More Innovation? Evidence from the 1988 Japanese Patent Law Reforms," NBER Working Paper No. 7066, and in *Rand Journal of Economics*, 32 (2001), pp. 77-100.

<sup>9</sup> J. Lerner, "Patent Policy and Innovation Over 150 Years," NBER Working Paper No. 8977, June 2002.

<sup>10</sup> C. Shapiro, "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting," *Innovation Policy and the Economy*, 1 (2000), pp. 119-50.

<sup>11</sup> J. Lerner and J. Tirole, "Some Simple Economics of Open Source," *Journal of Industrial Economics*, 52 (2002), pp. 197-234; "The Scope of Open Source Licensing," NBER Working Paper No. 9363, December 2002.

<sup>12</sup> J. Lerner and J. Tirole, "Efficient Patent Pools," NBER Working Paper No. 9175, September 2002; J. Lerner, M. Strojwas, and J. Tirole, "The Structure and Performance of Patent Pools: Empirical Evidence," unpublished working paper, Harvard University and University of Toulouse, 2002.

<sup>13</sup> J. L. Furman and S. Stern, "Climbing Atop the Shoulders of Giants: The Impact of Institutions on Cumulative Research," unpublished working paper, Boston University and Northwestern University, 2002.

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## NBER Profile: *Josh Lerner*

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Josh Lerner is an NBER Research Associate in the Corporate Finance Program and the Productivity Program. In addition, he is an organizer of the NBER group on Innovation Policy and the Economy, and serves as co-editor of their publication, *Innovation Policy and the Economy*.

Lerner is also the Jacob H. Schiff Professor of Investment Banking at Harvard Business School, with a joint appointment in the Finance and Entrepreneurial Management Units. He graduated from Yale College with a Special Divisional Major that combined physics with the history of technology. After working for several years on issues concerning technological innovation and public policy — at the Brookings Institution, for a public-pri-

vate task force in Chicago, and on Capitol Hill — he obtained a Ph.D. in Economics from Harvard University.

Much of Lerner's research focuses on the structure and role of venture capital organizations. (He has two books on the subject: *The Venture Capital Cycle*, MIT Press, 1999, and *The Money of Invention*, HBS Press, 2001.) He also examines policies concerning intellectual property protection, particularly patents, and their impact on growth and high-technology industries. His work has been published in a variety of top academic journals.

He lives in Hamilton, Massachusetts, with his wife, Wendy Wood, and lots of four-legged friends. In his spare time, he enjoys nature and his Sicilian donkeys.

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## NBER Profile: *Frank R. Lichtenberg*

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Frank R. Lichtenberg is a Research Associate in the NBER's Program on Productivity and Program on Health Care. He is also the Courtney C. Brown Professor of Business at the Columbia University Graduate School of Business.

Lichtenberg received a B.A. in history from the University of Chicago and an M.A. and Ph.D. in economics from the University of Pennsylvania. He previously taught at Harvard University and the University of Pennsylvania. He also has served as an expert for the Federal Trade Commission, the U.S. Dept. of Justice, and various state Attorneys General, and has testified before Congress. He has worked for several U.S. government agencies, including the Department of Justice, the Congressional Budget Office, and the Census Bureau, and has been a visiting scholar at the Wissenschaftszentrum

Berlin, the University of Munich, and elsewhere.

Some of Professor Lichtenberg's research has examined how the introduction of new technology arising from research and development affects the productivity of companies, industries, and nations. Recently he has performed studies of the impact of pharmaceutical innovation on longevity, the effect of computers on productivity in business and government organizations, and the consequences of takeovers and leveraged buyouts for efficiency and employment. His work is widely published in leading economic journals.

In his free time, Lichtenberg enjoys various sports (cycling, running, skiing, and squash), as well as music, theatre, and travel. He and his wife, Michelle, have two sons, Andrew and Alec, and live in Scarsdale, NY.



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## Conferences

### Japan Conference

The NBER, CEPR, CIRJE, and EIJS jointly organized a conference on the Japanese economy in Tokyo on September 13-14. The co-chairmen of the meeting were: Magnus Blomstrom, NBER and Stockholm School of Economics; Jennifer Corbett, Australian National Union; Fumio Hayashi, NBER and the University of Tokyo; and Anil K Kashyap, NBER and the Graduate School of Business, University of Chicago. The following papers were discussed:

**Joe Peek**, University of Kentucky, and **Eric S. Rosengren**, Federal Reserve Bank of Boston, "Corporate Affiliations and the (Mis)Allocation of Credit"  
Discussant: Kaoru Hosono, Nagoya City University

**Patrick M. McGuire**, Bank for International Settlements, "Bank Ties and Bond Market Access: Evidence on Investment-Cash Flow Sensitivity in Japan"  
Discussant: Kazuyuki Suzuki, Meiji University

**John Sutton**, London School of Economics, "Market Share

Dynamics in Japanese Manufacturing"  
Discussant: Thomas Hubbard, NBER and University of Chicago

**Rasmus Fatum**, University of Alberta, and **Michael Hutchison**, University of California, Santa Cruz, "Is Foreign Exchange Market Intervention an Alternative to Monetary Policy? Evidence from Japan"  
Discussant: Linda Tesar, NBER and University of Michigan

**Takatoshi Ito**, NBER and University of Tokyo, "Is Foreign Exchange Intervention Effective? The Japanese Experiences in the 1990s" (NBER Working Paper No. 8914)  
Discussant: Linda Tesar

**Kazuo Ogawa**, Osaka University, "Financial Distress and Employment: The Japanese Case in the 90s"  
Discussant: Hidehiko Ichimura, University College, London

**Tokuo Iwaisako**, Hitotsubashi University, "Household Portfolios in Japan: Interaction between Equity

and Real Estate Holdings over the Life Cycle"  
Discussant: Luigi Guiso, Università di Sassari

**Yasushi Hamao**, University of Southern California; **Jianping Mei**, New York University; and **Yexiao Xu**, University of Texas, "Idiosyncratic Risk and Creative Destruction in Japan"  
Discussant: Jessica Wachter, NBER and New York University

**Colin Mayer**, University of Oxford; **Koen Schoors**, University of Ghent; and **Yishay Yafeh**, Hebrew University, "Sources of Funds and Investment Activities of Venture Capital Funds: Evidence from Germany, Israel, Japan, and the UK"  
Discussant: Seki Obata, Hitotsubashi University

**Donald R. Davis** and **David Weinstein**, NBER and Columbia University, "Do Industries Exhibit Increasing Returns? Evidence from the Strategic Bombing of Japan"  
Discussant: Takatoshi Tabuchi, University of Tokyo

The strong corporate affiliations in Japan have been cited as one of the major impediments to making the fundamental changes necessary to escape the economic malaise that has afflicted the Japanese economy over the past decade. While Japanese corporate affiliations during good economic times were heralded as an effective way to increase credit availability and reduce agency costs, these same affiliations may impede needed economic restructuring during difficult economic circumstances, insofar as they insulate firms from the market discipline that otherwise would be imposed by credi-

tors. **Peek** and **Rosengren** show that corporate affiliations have contributed to significant misallocations of credit, because troubled borrowers with strong corporate affiliations with their lenders are more likely to obtain additional credit than their healthier brethren. In contrast, lenders who are not affiliated with the firm are less likely to extend additional credit as firms become more troubled.

**McGuire** asks whether bank ties are *costly* for mature and healthy firms, and whether banks continue to facilitate investment once non-bank financing options become available. He

investigates the investment-cash flow sensitivity of Japanese firms, and finds it *lowest* for those firms known to have faced bond market constraints. He then estimates that the *spread* in sensitivity was much larger for main bank client firms, once bond market access is taken into account. This result, coupled with the results on the relative profitability and bond activity of bank-affiliated firms, is consistent with *banks* capturing the benefits of relationship lending. Finally, McGuire shows that the differences across bank-affiliated and independent firms (in performance and sensitivity) disappeared after

deregulation, suggesting that relationship banking persisted only because of the capital market restrictions.

How long does a typical “market leader” in an industry maintain its position? One view associated *inter alia* with Alfred Chandler asserts that leadership tends to persist for a long time, while a rival, “Schumpeterian” view emphasizes the transience of leadership positions. The central problem with this debate is that no benchmark is proposed relative to which the duration of leadership might be judged long or short. **Sutton** introduces a formal model of market share dynamics, and uses it to provide a benchmark case, corresponding to a “neutral” situation in which neither positive (“Chandlerian”) effects nor negative (“Schumpeterian”) effects are present. Empirically observed patterns of persistence can be gauged against this view. He applies this benchmark to a study of 45 narrowly defined industries within Japanese manufacturing over the period 1974-99. A series of tests on the data indicates that he cannot reject the null hypothesis of simple Markovian behavior (that is, no bias in either the Chandlerian or Schumpeterian direction).

Japanese official intervention in the foreign exchange market is by far the largest in the world, although there is little or no evidence that it is effective in moving exchange rates. Up until recently, however, official data on intervention has not been available for Japan. **Fatum** and **Hutchison** investigate the effectiveness of intervention using recently published official daily data and an event study methodology. Focusing on daily Japanese and U.S. official intervention operations, they identify separate intervention “episodes” and analyze the subsequent effect on the exchange rate. They find strong evidence that sterilized intervention systematically affects the exchange rate in the short run. This result holds even when intervention is not associated with (simultaneous) interest rate changes and regardless of whether intervention is “secret” (in the sense of no official reports or rumors of intervention reported over the newswires). To some extent, intervention might be a useful policy instrument during the

zero-interest rate policy period in Japan, but the effects are likely to be short term in nature.

**Ito** examines Japanese foreign exchange interventions from April 1991 to March 2001 using newly disclosed official data. All the yen-selling (dollar-purchasing) interventions were carried out when the yen/dollar rate was below 125, while all the yen-purchasing (dollar-selling) interventions were carried out when the yen/dollar rate was above 125. The Japanese monetary authorities, by buying the dollar low and selling it high, have produced large profits, in terms of realized capital gains, unrealized capital gains, and carrying (interest rate differential) profits, from interventions during the ten years. Profits amounted to 9 trillion yen (2 percent of GDP) in ten years. Interventions are effective in the second half of the 1990s, when daily yen/dollar exchange rate changes were regressed on various factors, including interventions. The U.S. interventions in the 1990s always were accompanied by the Japanese interventions. The joint interventions were 20-50 times more effective than the Japanese unilateral interventions. Japanese interventions were prompted by rapid changes in the yen/dollar rate and the deviation from the long-run mean (say, 125 yen). The interventions in the second half were less predictable than those in the first half.

**Ogawa** analyzes the extent to which financial distress in the 1990s affected employment behavior in Japan. Based on firm-level panel data that include small firms, he estimates a dynamic labor demand function, taking the impact of financial distress on employment into consideration. He finds that the firm’s ratio of debt to total assets exerts a significantly negative effect on employment in small firms. He also finds that employment in small firms is sensitive to the lending attitude of financial institutions.

**Iwaisako** studies the relationship between portfolio choice and age for Japanese households, using micro data and paying particular attention to the interaction between decisions to hold stocks and real estate. His major findings are: equity shares in financial wealth (S/FW) increase with age

among young households, peaking in the fifties age group, then becoming constant. This peak comes much later in the life cycle than the peak Amerkis and Zeldes (2001) report for U.S. households. 2) The same age-related pattern exists for real estate shares in household total wealth (RE/TW). 3) With respect to both, S/FW and RE/TW, the age-related patterns are explained mostly by the decision about holding stocks versus real estate. 4) No age-related pattern in equity holding is observed for households that do not own real estate. In sum, the age-related pattern observed in stock holding appears to be explained mostly by the household’s tenure choice of housing. Households about to purchase and having just purchased houses cannot take risky positions in financial investments because they are saving for down payments or have heavily leveraged positions in terms of housing loans. Therefore, any serious attempt at modeling Japanese households’ dynamic portfolio choice should incorporate the effect of housing tenure choice.

The dramatic rise and fall of the Japanese equity market provides **Hamao, Mei, and Xu** with a unique opportunity to examine market-and-firm-specific risks over different market conditions. Unlike the U.S. experience, in Japan there is a surprising fall in firm-level volatility and turnover in stocks after the market crash. Accordingly, correlations among individual stocks have increased and the number of stocks needed to achieve a given level of diversification has declined. As a consequence, the authors suggest that it has become more difficult over the past decade for both investors and managers to separate high-quality from low-quality firms, making the Japanese market less efficient. Moreover, changes in firm-level volatilities are related positively to corporate bankruptcies, indicating that improvements in information efficiency occur when regulations on corporate bankruptcies are relaxed. These results suggest that the sharp fall in firm-level volatility during 1990-6 may be attributable to a lack of corporate restructuring. This is more evident for firms with business group and main

bank affiliations, whose firm-level volatility is less dependent on economic conditions than that of firms with no affiliations. Thus, the authors argue that a lack of “creative destruction” may have led to Japanese market inefficiency and a vicious cycle of capital misallocation.

Using a newly constructed dataset, **Mayer, Schoors, and Yafeh** compare sources of funds and investment activities of venture capital (VC) funds in Germany, Israel, Japan, and the United Kingdom. Sources of VC funds differ significantly across countries, for example, banks are particularly important in Germany, corporations in Israel, insurance companies in Japan, and pension funds in the United Kingdom. VC investment patterns also differ across countries in terms of the stage, sector of financed companies, and geographical focus of invest-

ments. The authors find that these differences in investment patterns are related to the variations in funding sources — for example, bank and pension fund backed VC firms invest in later stage activities than individual and corporate backed funds — and the authors examine various theories concerning the relation between finance and activities. They also report that the relations differ across countries; for example, bank-backed VC firms in Germany and Japan are as involved in early stage finance as other funds in these countries, whereas they tend to invest in relatively late stage finance in Israel and the United Kingdom.

Theories of multiple equilibriums (ME) are now widespread across many fields of economics. Yet little empirical work has asked if such MEs are salient features of real economies. **Davis and Weinstein** examine this in the context

of the Allied bombing of Japanese cities and industries in WWII. A key identifying test for MEs is the “ratchet effect”: small shocks allow a full recovery while large shocks do not. The authors examine this theory for 114 Japanese cities in eight manufacturing industries. The data reject the existence of multiple equilibriums. In the aftermath of ever gargantuan shocks, a city recovers not only its population and its share of aggregate manufacturing, but also the specific industries it had before.

These papers will be available in the NBER Working Paper series. In addition, a Summary Report of the conference, including a transcript of the luncheon remarks by the Japanese Vice Minister for International Affairs at the Ministry of Finance, Haruhiko Kuroda, will be published and will also be available on the NBER’s website.

## Tax Policy and the Economy

The NBER’s Seventeenth Annual Conference on Tax Policy and the Economy, organized by James M. Poterba of NBER and MIT, took place in Washington, DC on October 8. These papers were discussed:

**David Figlio**, NBER and University of Florida, “Fiscal Implications of School Accountability Initiatives”

**Edward Glaeser**, NBER and Harvard University, and **Jesse**

**Shapiro**, Harvard University, “The Benefits of the Home Mortgage Interest Deduction”

**Matthew D. Shapiro** and **Joel B. Slemrod**, NBER and University of Michigan, “Did the 2001 Tax Rebate Stimulate Spending? Evidence from Taxpayer Surveys”

**Jagdeesh Gokhale**, Federal Reserve Bank of Cleveland, and **Laurence J. Kotlikoff**, NBER and Boston University, “Who Gets Paid to Save?”

**Julie H. Collins** and **Douglas A. Shackelford**, NBER and University of North Carolina, “Do U.S. Multinationals Face Different Tax Burdens than Other Companies?”

**Mihir Desai**, NBER and Harvard University, “The Corporate Profit Base, Tax Sheltering Activity, and the Changing Nature of Employee Compensation” (NBER Working Paper No. 8866)

The No Child Left Behind Act of 2001 established new national rules for school accountability, requiring mandated testing of all students in grades three through eight, mandated state grading of schools, and provided financial rewards and sanctions for schools based on their aggregate test performance. **Figlio** describes some of the key direct and indirect fiscal consequences of school accountability systems, focusing particularly on this new federal law. His analysis of the

direct consequences suggests that the federal law likely will offset, perhaps considerably, school equalization systems in some states. The indirect fiscal consequences may exacerbate the effects of the direct fiscal consequences, because school accountability systems likely have effects on the classification (and attendant costs) of disabled students, as well as on input prices and on the property tax base.

**Glaeser** and **Shapiro** study the home mortgage interest deduction

which creates incentives to buy more housing and to become a homeowner. The case for the deduction rests on the social benefits from housing consumption and homeownership. But there is little evidence of large externalities from the level of housing consumption, although there appear to be externalities from homeownership. The externalities from living around homeowners are far too small to justify the deduction. The externalities from home ownership itself are larger,



but the home mortgage interest deduction is a particularly poor instrument for encouraging homeownership because it is targeted at the wealthy, who are almost always homeowners. The irrelevance of the deduction is supported by the time-series data which show that the ownership subsidy moves with inflation and has changed significantly between 1960 and today, but the homeownership rate has been essentially constant.

In 2001, many households received rebate checks as advance payments of the benefit of the new, 10 percent federal income tax bracket. A survey conducted at the time the rebates were mailed finds that few households said that the rebate led them to (mostly) spend more. A follow-up survey in 2002, as well as a similar survey conducted after the attacks of 9/11, also indicates low spending rates. **Shapiro** and **Slemrod** investigate the robustness of these survey responses and evaluate whether such surveys are useful for policy evaluation. They also draw lessons from the surveys for macroeconomic analysis of the tax rebate.

The Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA) greatly expands the limits on contributions to tax-deductible accounts, including 401(k), 403b, Keogh, and traditional IRA plans. It also raises the limit on contributions to non-tax-deductible Roth IRAs. But, most important for the issue of tax fairness, it provides a significant, but little known, non-refundable tax credit for qualified account contributions up to \$2,000 made by low-earning workers. **Gokhale** and **Kotlikoff** review the pre-EGTRRA lifetime tax gains (or losses) available to low-, middle-, and high-lifetime earners from participating fully in 401(k) accounts, traditional

IRA accounts, and Roth IRA accounts. They show how these subsidies have been changed by the new legislation. The authors' bottom line is that EGTRRA mitigates, but doesn't fully eliminate, the lifetime tax increases facing many low-income households from making significant contributions to tax-deferred retirement accounts. Additional research is needed to understand how many low- and moderate-income households are paying higher taxes, at the margin, because of their saving through tax-deferred accounts. Most low- and moderate-income households may be contributing less than the maximum possible amount to these accounts and, thereby, are limiting their losses. But even these households are being ill served in so far as they have been told by the government, their employers, and their financial advisors that saving in tax-deferred accounts will deliver major tax savings.

**Shackelford** and **Collins** attempt to estimate the tax costs of being a U.S. multinational. Their study is motivated by the increasing difficulties that the U.S. faces in attempting to tax multinationals in the presence of global capital markets, as recently was highlighted by WTO decisions and corporate inversions. They find that companies domiciled in the United States face higher tax burdens than U.S. domestic-only companies; higher tax burdens than Canadian multinationals; and similar tax burdens to British multinationals. Based on their review of prior evidence and the new evidence presented here, they conclude that at least some U.S. companies are facing heavier tax burdens because they are positioned globally.

**Desai** examines the evolution of the corporate profit base and the rela-

tionship between book income and tax income for U.S. corporations over the last two decades. This relationship has broken down over the 1990s, in a manner that is consistent with increased sheltering activity. Desai traces the growing discrepancy between book and tax income associated with: differential treatments of depreciation; the reporting of foreign source income; and in particular, the changing nature of employee compensation. For the largest public companies, the proceeds from option exercises equaled 27 percent of operating cash flow from 1996 to 2000 and these deductions appear to be fully utilized, thereby creating the largest distinction between book and tax income. While the differential treatment of these items historically has accounted fully for the discrepancy between book and tax income, this paper shows that book and tax income have diverged markedly for reasons not associated with these items during the late 1990s. In 1998, more than half of the difference between tax and book income — approximately \$154.4 billion or 33.7 percent of taxable income — cannot be explained by these factors. Desai demonstrates that the breakdown in the relationship between tax and book income is consistent with increasing levels of sheltering during the late 1990s. He also explores an alternative explanation of these results — coincident increased levels of earnings management — and finds that the nature of the breakdown between book and tax income cannot be explained fully by this alternative explanation.

These papers will be published by the MIT Press as *Tax Policy and the Economy, Volume 17*. They are also available at "Books in Progress" on the NBER's website.

## Inter-American Seminar on Economics

The NBER and ITESM in Monterrey, Mexico jointly organized the 2002 Inter-American Seminar on Economics, which took place in Mexico on November 15-16. Sebastian Edwards, NBER and University of California, Los Angeles, put together this program:

**Joshua Aizenman**, NBER and University of California, Santa Cruz, “Volatility, Employment, and the Patterns of FDI in Emerging Markets”  
Discussant: Luis Rivas, MHCP, Nicaragua

**Peter Schott**, NBER and Yale University, and **Steve Redding**, CEPR, “Distance, Skill Deepening, and Developing: Will Peripheral Countries Ever Get Rich?”  
Discussant: Rafael Rubio, Hylsa, Mexico

**Shang-Jin Wei**, International Monetary Fund, and **Yi Wu**, Georgetown University, “The Life-and-Death Implications of

Globalization”  
Discussant: Alejandro Davila-Flores, Universidad Autonoma de Coahuila, Mexico

**Alejandro Ibarra-Yunez**, Monterrey Tech EGADE, Mexico, “Mexico and its Quest to Sign Multiple Free Trade Agreements: Spaghetti Regionalism or Strategic Foreign Trade?”  
Discussant: Ma. Lourdes Dieck, Secretary of the Economy, Mexican Government

**Gerardo Esquivel**, El Colegio de Mexico, and **Jose Antonio Rodriguez-Lopez**, University of California, Berkeley, “The Effects of Trade Liberalization and Technological Progress on Mexico’s Wage Inequality, 1988-2000”  
Discussant: Juan Rafael Vargas, Costa Rica, UDLA – Puebla

**Sebastian Galiani** and **Pablo Sanguinetti**, Universidad di Tella, Argentina, “The Impact of Trade Liberalization on Wage Inequality:

Evidence from Argentina”  
Discussant: Andre Varela, Monterrey Tech, Mexico

**Alejandra Cox Edwards**, California State University, Long Beach, and **Manuelita Ureta**, Texas A&M, “International Migration, Remittances, and Schooling: Evidence from El Salvador”  
Discussant: Bonnie Palifka, Monterrey Tech

**Pinelopi Goldberg**, NBER and Yale University, and **Nina Pavcnik**, NBER and Dartmouth College, “The Response of the Informal Sector to Trade Liberalization”  
Discussant: Stephen Bronars, University of Texas, Austin

**Ricardo Hausmann**, Harvard University, and **Dani Rodrik**, NBER and Harvard University, “Economic Development as Self Discovery”  
Discussant: Peter Schott

**Aizenman** explores the implications of the deepening presence of multinationals in emerging markets on the cost of macroeconomic volatility there. He finds that macroeconomic volatility has a potentially large impact on the employment and investment decisions of multinationals that produce intermediate inputs in developing countries. For industries with costly capacity, the multinationals tend to invest in more stable emerging markets. Higher volatility of productivity shocks in an emerging market that produces intermediate inputs will reduce the multinationals’ expected profits. High enough instability in such a market induces the multinationals to diversify their production, investing in several emerging markets. This effect is stronger in lower margin industries. Diversification can be costly to emerging markets, though: it increases the responsiveness of the multinationals’ employment in each country to pro-

ductivity shocks, channels the average employment from more to less volatile locations, and reduces the multinationals’ total expected employment in emerging markets.

Do workers in countries located far from global economic activity have less incentive to accumulate human capital than workers near the center? **Schott** and **Redding** model the relationship between countries’ distance from global economic activity, endogenous investments in education, and economic development. Firms in remote locations pay greater trade costs on both their exports and their imports of intermediate inputs, reducing the amount of value added left to remunerate the domestic factors of production. As a result, the skill premium and the incentives to accumulate human capital will be depressed if skill-intensive sectors have higher trade costs, more pervasive input-output linkages, or stronger increasing returns

to scale. Empirically, the authors demonstrate that countries with lower market access have lower levels of educational attainment and that the world’s most peripheral countries are becoming increasingly remote over time.

As an alternative to examining the effect of trade openness on economic growth, **Wei** and **Wu** investigate the connection between openness and a society’s health status. There are a number of advantages with this approach, including a more direct link with welfare and a more comparable data definition across countries. The authors report several pieces of evidence suggesting that higher trade openness (especially when measured by a lower tariff rate) is associated with a longer life expectancy and lower infant mortality. On the other hand, financial openness does not seem to help promote better health.

After signing ten free trade agreements between 1993 and 2001, Mexico

is becoming a world leader in foreign trade policy. Are multiple Regional Trade Areas (RTAs) building blocs towards freer trade with transparent rules of the game? Mexico's multiple agreements generally have used the principle of NAFTA consistency, after the acceptance that NAFTA has become a broader and deeper accord than the Uruguay multilateral achievements. **Ibarra-Yunez** analyzes the pros and cons of multiple RTAs by Mexico and includes a game model of equilibrium and a political economy approach to the non-economic reasons for Mexico's foreign trade stance.

In recent years, there has been a rapid increase in wage inequality between skilled and unskilled workers in Mexico. This increment in the wage gap has coincided with a period of rapid technological change and with the process of trade liberalization in Mexico that began in 1985. The wage gap also has increased in several other countries, and the academic literature suggests two main explanations for this trend: trade liberalization (or globalization) and skill-biased technological progress. **Esquivel** and **Rodriguez-Lopez** separate out the effects of globalization and technological progress on the evolution of real wages of skilled and unskilled workers in Mexico's manufacturing industry. They find that technological progress played a major role in the increase in wage inequality in Mexico between 1988 and 2000. They also find that trade liberalization pressed for a decrease in the wage gap in the period 1988-94, but that effect was offset by the relatively large negative impact of technological progress on the real wage of unskilled workers.

Wage inequality in Argentina increased during the 1990s. During this period, a rapid and deep process of trade liberalization was implement-

ed. **Galiani** and **Sanguinetti** ask whether trade liberalization played any role in shaping the Argentine wage structure during the 1990s. Specifically, they test whether those sectors where import penetration deepened are also the sectors where a higher increase in wage inequality is observed. They find evidence that supports this hypothesis. However, similar to what has been found for some developed economies, trade deepening can only explain a small proportion of the observed rise in wage inequality.

The post-civil war experience of El Salvador provides an opportunity for examining the impact of parental budget constraints on children's schooling. In 1997, 14 percent of rural and 15 percent of urban households received remittances from family members living abroad, and the modal amount of remittances was US \$100. **Edwards** and **Ureta** examine the impact of remittances on school attendance. They find that remittances have a significant effect on school retention. This result suggests that subsidies to the demand for schooling, particularly in poor areas, may have a large impact on school attendance and retention, even if parents have low levels of schooling. However, two aspects of this experiment likely affect the observed outcome, and deserve more study before the potential impact of school subsidies is fully understood. First, the case studied here involves direct transfers to specific households whose budget allocation decisions can be monitored by the grantor. Second, the institutional setting in El Salvador is such that the expansion of school facilities is driven primarily by the active participation of parents in the allocation of public and private funds. Parents have played a leading role in financing the expansion of private schools in urban areas, and the Ministry of Education allocates

resources to parents' associations, enabling them to hire teachers and buy teaching materials in rural areas.

**Goldberg** and **Pavcnik** study the relationship between trade liberalization and informality. It is often claimed that increased foreign competition in developing countries leads to an expansion of the informal sector, defined as the sector that does not comply with labor market legislation. Using data from two countries that experienced large trade barrier reductions in the 1980s and 1990s, Brazil and Colombia, the authors examine the responses of the informal sector to liberalization. In Brazil, there is no evidence of a relationship between trade policy and informality. In Colombia, there is evidence of such a relationship, but only for the period preceding a major labor market reform that increased the flexibility of the Colombian labor market. These results point to the significance of labor market institutions in assessing the effects of trade policy on the labor market.

In the presence of uncertainty about what a country can be good at producing, there can be great social value to discovering the costs of domestic activities, because such discoveries can be imitated easily. **Hausmann** and **Rodrik** develop a general-equilibrium framework for a small open economy to clarify the analytical and normative issues. They highlight two failures of the *laissez-faire* outcome: there is too little investment and entrepreneurship *ex ante*, and too much production diversification *ex post*. Optimal policy consists of counteracting these distortions: to encourage investments in the modern sector *ex ante*, but to rationalize production *ex post*.

These papers will be published in a special issue of the *Journal of Development Economics*.

## Organizational Economics

The NBER held a conference on “Organizational Economics” in Cambridge on November 22-23. NBER Research Associate Robert Gibbons, also of MIT, organized the two-day meeting. The following papers were discussed:

**Oliver S. Hart**, NBER and Harvard University, and **Bengt R. Holmstrom**, NBER and MIT, “A Theory of Firm Scope”

**Carliss Y. Baldwin** and **Kim B. Clark**, Harvard University, “Where Do Transactions Come From? A Perspective from Engineering Design”

**Henry B. Hansmann**, Yale University; **Reinier H. Kraakman**, Harvard University; and **Richard Squire**, U.S. Court of Appeals, “Legal Entities, Asset Partitioning, and the Evolution of Organizations”  
Discussants: David S. Scharfstein, NBER and MIT, and Ulrike Malmendier, Stanford University

**Casey Ichniowski**, NBER and Columbia University; **Kathryn Shaw**, NBER and Carnegie Mellon University; and **Jon P. Gant**, Syracuse University, “Working Smarter By Working Together: Connective Capital in the Workplace”

**Paul Oyer**, Stanford University, and **Scott Schaefer**, Northwestern University, “Why Do Some Firms Give Stock Options To All Employees? An Empirical Examination of Alternative

Theories”  
Discussant: Edward P. Lazear, NBER and Stanford University

**Wouter Dessein**, University of Chicago, “Coordination through Authority vs. Consensus”

**Eric Zitzewitz**, Stanford University, “Nationalism in Winter Sports Judging and Its Lessons for Organizational Decisionmaking”

**Eric Van Den Steen**, MIT, “On the Origin and Evolution of Corporate Culture”  
Discussants: Judith A. Chevalier, NBER and Yale University, and Benjamin Hermalin, University of California, Berkeley

**W. Bentley MacLeod**, University of Southern California, “Optimal Contracting with Subjective Evaluation”

**Francine Lafontaine**, NBER and University of Michigan, and **Scott E. Masten**, University of Michigan, “Contracting in the Absence of Specific Investments and Moral Hazard: Understanding Carrier-Driver Relations in U.S. Trucking” (NBER Working Paper No. 8859)

**Daniel W. Elfenbein**, Harvard University, and **Josh Lerner**, NBER and Harvard University, “Ownership and Control Rights in Internet Portal Alliances, 1995-99”  
Discussants: Jonathan Levin, Stanford University, and Timothy F. Bresnahan, NBER and Stanford University

**Daron Acemoglu**, NBER and MIT; **Michael Kremer**, NBER and Harvard University; and **Atif Mian**, University of Chicago, “Markets, Firms, and Governments”

**Canice J. Prendergast**, NBER and University of Chicago, “Selection and Oversight in the Public Sector, with The Los Angeles Police Department as an Example” (NBER Working Paper No. 8664)  
Discussant: Barry R. Weingast, Stanford University

**Luis Garicano**, University of Chicago, and **Thomas N. Hubbard**, NBER and University of Chicago, “Specialization, Firms, and Markets: The Division of Labor Within and Between Law Firms”

**Allen N. Berger** and **Nathan H. Miller**, Federal Reserve Board; **Mitchell A. Petersen**, NBER and Northwestern University; **Raghuram G. Rajan**, NBER and University of Chicago; and **Jeremy C. Stein**, NBER and Harvard University, “Does Function Follow Organizational Form? Evidence From the Lending Practices of Large and Small Banks” (NBER Working Paper No. 8752)

**Raghuram G. Rajan** and **Julie Wulf**, University of Pennsylvania, “The Flattening Firm: Evidence from Panel Data on the Changing Nature of Corporate Hierarchies”  
Discussants: Michael D. Whinston, NBER and Northwestern University, and George P. Baker, NBER and Harvard University

The literature on firms, based on incomplete contracts and property rights, emphasizes that the ownership of assets — and thereby firm boundaries — is determined so as to encourage relationship-specific investments by the appropriate parties. This approach applies to owner-managed firms better than to large companies.

**Hart** and **Holmstrom** attempt to broaden the scope of the property rights approach by developing a simpler model with three key ingredients: decisions are non-contractible, but transferable through ownership; managers (and possibly workers) enjoy private benefits that are non-transferable; and owners can divert a firm’s profit.

With these assumptions, firm boundaries matter. Nonintegrated firms fail to account for the external effects that their decisions have on other firms. An integrated firm can internalize such externalities but it does not put enough weight on the private benefits of managers and workers. The authors first explore this trade-off in a basic

model that focuses on the difficulties companies face in cooperating through the market if benefits are distributed unevenly; therefore, they sometimes may end up merging. Hart and Holmstrom then extend the analysis to study industrial structure in a model with intermediate production. This analysis sheds light on industry consolidation in periods of excess capacity.

**Baldwin** and **Clark** seek to explain the location of transactions (and contracts) in a system of production. Systems of production are engineered, and the question of where to place “transactions” is one of the basic engineering problems that face the designers of such systems. The authors characterize a system of production as a network of tasks that agents perform and the transfers of material, energy, and information between and among agents. They then argue that although *transfers* between agents are absolutely necessary and ubiquitous in any human-built system of production, *transaction costs* make it impossible for all transfers to be transactions. The particular transaction costs they are concerned with are the so-called “mundane” costs of creating a transactional interface: the costs of defining what is to be transferred, of counting the transfers, and of valuing and paying for the individual transfers. The authors argue that the *modularity* of a system of production determines the system’s pattern of mundane transaction costs. In this fashion, the engineering design of a system of production necessarily establishes where transactions can go and what types of transactions are feasible and cost-effective in a given location.

**Hansmann**, **Kraakman**, and **Squire** note that the law’s critical contribution to the evolution of organizations has been the creation of legal entities — firms that can serve as credible contracting actors in their own right. Affirmative asset partitioning has been at the core of this contribution. The affirmative partitioning typically established by organizational law involves giving firm creditors a prior claim on those assets that are used by the firm in its productive processes. That has required both that the necessary legal rules be in place, and that the

commercial environment be such that those assets can be credibly monitored. With the accommodation of corporate subsidiaries at the end of the 19<sup>th</sup> century, and the development of ever more sophisticated forms of secured financing in the 20<sup>th</sup> century, it has become increasingly possible to differentiate between the pool of assets that a firm uses in production and the pools of assets that it pledges as security to its creditors. This allows, among other things, for far greater flexibility in designing the scope of the firm as a nexus of contracts. The future is likely to continue to take us further in this direction, with the possibility that the contractual part of organizational law will come to be increasingly divorced from the asset partitioning part of organizational law, and that the latter function will come to be merged ever more with the general law of secured transactions.

**Ichniowski**, **Shaw**, and **Gant** use a unique, personally collected database to investigate how a firm’s human resource management (HRM) policies can create organizational capital by developing structures that promote productive exchange of knowledge among employees. In short, HRM practices can get employees to “work smarter” by getting them to work together more effectively. The authors investigate precisely how innovative HRM practices might change workers’ behavior to make them more productive. They present a simple model that incorporates an organization’s “connective capital” — that is, the stock of human capital that employees can access through their connections to other workers — as an input in its production function. Employees develop connective capital through communications links with other employees in order to tap into the knowledge of their co-workers as they seek to solve problems together. The authors find that HRM practices aimed at promoting greater levels of employee involvement substantially increase interaction among employees, particularly among production workers, relative to more traditional HRM practices. Employees in plants with new HRM practices are working in environments with higher levels of connective capital, because

the richer set of inter-worker linkages in these plants give workers access to the knowledge, ideas, and experience of a wide array of co-workers. Given the technological similarity of the production lines the authors investigate in this study, the high levels of connective capital appear to be an important reason for the productivity gains realized under new HRM practices.

Many firms issue stock options to all employees. **Oyer** and **Schaefer** consider three potential economic justifications for this practice: providing incentives to employees; inducing employees to sort; and helping firms to retain employees. They gather data from three distinct sources on firms’ stock option grants to middle managers, and use two methods to assess which theories appear to explain the observed “granting” behavior. First, they directly calibrate models of incentives, sorting, and retention, and ask whether observed magnitudes of option grants are consistent with each potential explanation. Then they conduct a cross-sectional regression analysis of firms’ option-granting choices. They reject an incentives-based explanation for broad-based stock option plans, and conclude that sorting and retention explanations appear to be consistent with the data.

One of the defining characteristics of organizations — as opposed to markets — is the presence of a managerial hierarchy that coordinates economic activity by use of authority. However, organizations also frequently delegate decisions to groups of agents — committees, cross-functional teams — as opposed to managers. **Dessein** proposes a model of organizational decisionmaking with endogenous communication costs and puts forward a theory of why and when authority is a superior coordination device relative to some form of consensus (that is, majority rule or unanimity). He argues that coordination by authority results in faster decisionmaking and a less distorted aggregation of information. However, this comes at the expense of a narrowness in decisionmaking, where the agents in control are biased in favor of their own ideas. Authoritative coordination tends to be indicated for problems that

are urgent or complex, or where the variance in the quality of potential solutions is limited. Finally, Dessein shows how imposing a unanimity rule as opposed to a majority rule can alleviate some of the drawbacks of consensus.

**Zitzewitz** exploits nationalistic biases in the judging of Olympic winter sports to study the problem of designing a decisionmaking process that uses the input of potentially biased agents. Judges score athletes from their own countries higher than other judges do, and they appear to vary their biases strategically in response to the stakes, the scrutiny given the event, and the degree of subjectiveness of the performance aspect being scored. Ski jumping judges display a taste for fairness in that they compensate for the nationalistic biases of other panel members, while figure skating judges appear to engage in vote trading and bloc judging. Career concerns create incentives for judges: biased judges are less likely to be chosen to judge the Olympics in ski jumping but more likely to be chosen for figure skating; this is consistent with judges being chosen centrally in ski jumping and by national federations in figure skating. The sports truncate extreme scores to different degrees: both ski jumping and, especially, figure skating truncate too aggressively; this may contribute to the vote trading in figure skating. These findings have implications for both the current proposals for reforming the judging of figure skating and for designing decisionmaking in organizations more generally.

**Van den Steen** starts from the most prevalent definition of corporate culture in the management literature: “shared beliefs or assumptions.” He shows that corporate culture evolves from the common experiences of a firm’s members. His model captures a number of important stylized facts: the culture of the firm is heavily influenced by the initial beliefs of the founder(s) or early leader, and can persist even long after that founder or early leader is gone. External succession of the CEO is more likely to lead to a change in corporate culture than to internal succession. Otherwise identical firms may develop very different

cultures. Older firms tend to have stronger cultures. Suboptimal cultures may persist, even if the members of the organization know that their culture is almost surely suboptimal. By focusing on the dynamics, Van den Steen further concludes that firms with a stronger culture on average will perform better *even though*, in this model, the strength of corporate culture does not have any effect on performance. After a radical change in the environment, on the other hand, firms with a stronger culture may tend to underperform other firms, although again the strength of corporate culture has no effect on performance.

**MacLeod** extends the standard principal-agent model to allow for subjective evaluation. The optimal contract results in more compressed pay relative to the case with verifiable performance measures. Moreover, discrimination against an individual implies lower pay and performance, suggesting that the extent of discrimination as measured after controlling for performance may underestimate the level of true discrimination. Finally, the optimal contract entails the use of bonus pay rather than the threat of dismissal; hence neither “efficiency wages” nor the right to dismiss an employee are necessary ingredients for an optimal incentive contract.

**Lafontaine** and **Masten** consider functions of contracting other than the protection of relationship-specific investments and the provision of marginal incentives, and apply the theory to explain variation in the form of compensation of over-the-road truck drivers in the United States. Specifically, they argue that contracts in this industry serve to economize on the costs of price determination for heterogeneous transactions. They show that the actual terms of those contracts vary systematically with the nature of hauls in a way that is consistent with the theory. By contrast, they find that vehicle ownership, which defines a driver’s status as an owner operator or company driver, depends on driver, but not on trailer or haul characteristics.

**Elfenbein** and **Lerner** examine from a contract theory perspective the structure of more than 100 alliances by Internet portals and other firms

between 1995 and 1999. In justifying the assumption of incompleteness, models of incomplete contracts frequently invoke unforeseen contingencies, the cost of writing contracts, and the cost of enforcing contracts. The setting in which Internet portals formed alliances was rife with these sorts of transaction costs. The authors argue that these alliances can be viewed as incomplete contracts; they find that the division of ownership and the allocation of control rights are consistent with the incomplete contracting literature.

**Acemoglu, Kremer, and Mian** examine the relative merits of markets, firms, and governments in environments where high-powered incentives can stimulate both productive effort and unproductive effort to signal ability. In a pure “market environment,” workers have strong incentives to distort the composition of effort. Firms may be able to flatten incentives and improve efficiency by obscuring information about workers’ output and thus reducing their willingness to signal. However, firms themselves may not be able to commit to failing to provide greater compensation to employees who distort their efforts to improve observed performance. Government organizations, on the other hand, often have flatter wage schedules, thereby naturally weakening the power of incentives. The authors suggest that there are also endogenous reasons for why governments, even when run by self-interested politicians, may be able to commit to lower-powered incentives than firms; in the presence of common shocks, governments internalize the negative externality of higher observed output from one employee on the evaluation of the rest of employees. This model may help to explain the widespread role of governments in the provision of pensions, education, health care, and law enforcement.

Public sector officials typically are not rewarded for performance by explicit pay mechanisms. Instead, they often are monitored by sporadic investigation, where the relevant issues for oversight are who oversees performance and what triggers an investigation. **Prendergast** considers a choice between internal and external moni-

toring of public agencies. He argues that a drawback with internal oversight is that officials have (efficiently) different preferences from the population whose objectives they implement. Specifically, they are biased against consumers, and are unwilling to investigate their legitimate complaints. But external parties are usually less well informed than are insiders, and often rely on a consumer complaint to pique their interest. As a result, bureaucrats become excessively worried about the prospect of an investigation, where external monitoring may result in a failure to efficiently deny benefits to consumers. Prendergast provides evidence from the Los Angeles Police Department to show that officers appear to have responded to increased external oversight by reducing crime-fighting activities in an attempt to avoid investigation.

What is the role of firms and markets in mediating the division of labor? **Garicano** and **Hubbard** use confidential microdata from the Census of Services to examine law firms' boundaries. They first examine how the specialization of lawyers and firms increases as lawyers' returns to specialization increase. The authors then ask which pairs of specialists tend to work in the same versus different firms; this provides evidence on the scope of firms that are not field-specialized. They find that whether firms or markets mediate the division of labor varies across

fields in a way that corresponds to differences in the value of cross-field referrals, consistent with **Garicano** and **Santos'** (2001) proposition that firms facilitate specialization by mediating exchanges of economic opportunities more efficiently than markets.

Theories based on incomplete contracting suggest that small organizations may do better than large organizations in activities that require the processing of soft information. **Berger, Miller, Petersen, Rajan, and Stein** explore this idea in the context of bank lending to small firms, an activity that typically is thought of as relying heavily on soft information. They find that large banks are less willing than small banks to lend to informationally "difficult" credits, such as firms that do not keep formal financial records. Moreover, controlling for the endogeneity of bank-firm matching, large banks lend at a greater distance, interact more impersonally with their borrowers, have shorter and less exclusive relationships, and do not alleviate credit constraints as effectively. All of this is consistent with small banks being better able to collect and act on soft information than large banks.

Using a detailed database of managerial job descriptions, reporting relationships, and compensation structures in over 300 large U.S. firms, **Rajan** and **Wulf** find that the number of positions reporting directly to the CEO has gone up significantly over

time. They also find that the number of levels between the lowest managers with profit-center responsibility (division heads) and the CEO has decreased and that more of these managers are reporting directly to the CEO. The authors do not find that divisions within the firm are becoming larger, so the proximate explanation of these findings is not that organizational restructuring is making more divisional heads important enough to report directly. Instead, the findings suggest that layers of intervening management are being eliminated and the CEO is coming into direct contact with more managers in the organization, even while managerial responsibility is being extended downwards. Consistent with this, the authors find that the elimination of the intermediate position of Chief Operating Officer accounts for a significant part (but certainly not all) of the increase in CEO reports. Accompanying the flattening of organizations is a change in the structure of pay. Pay and long-term incentives are becoming more like those of a partnership. Salary and bonus at lower levels are lower than in comparable positions in a tall organization, but the pay differential is steeper toward the top. At the same time, employees in flatter organizations seem to have more long-term pay incentives, like stock and stock options, offered to them.

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## Economic Analysis of Government Expenditure Programs

An NBER-Universities Research Conference on the topic “Economic Analysis of Government Expenditure Programs” took place in Cambridge on December 6 and 7. Mark Duggan and Steven D. Levitt, NBER and the University of Chicago, organized this program:

**Brian A. Jacob**, NBER and Harvard University, and **Lars Lefgren**, Brigham Young University, “Are Idle Hands the Devil’s Workshop? Incapacitation, Concentration, and Juvenile Crime”  
Discussant: Bruce A. Sacerdote, NBER and Dartmouth College

**Ingrid G. Ellen**, **Amy E. Schwartz**, and **Ioan Voicu**, New York University, “Estimating the External Effects of Subsidized Housing Investment on Property Values”  
Discussant: Jeffrey B. Liebman, NBER and Harvard University

**Price V. Fishback** and **Shawn Kantor**, NBER and University of Arizona, and **William C. Horace**, NBER and Syracuse University, “Federal Programs in Times of Crisis: The Impact of the New Deal on Local Economies During the Great Depression”  
Discussant: Robert A. Margo, NBER and Vanderbilt University

**Barry K. Goodwin**, Ohio State University; **Ashok Mishra**, USDA Economic Research Service; and **Francois Ortalo-Magne**, University of Wisconsin-Madison, “Differentiated Policy Impacts on Agricultural Land Values”  
Discussant: Erzo Luttmer, Harvard University

**Nora Gordon**, University of California, San Diego, “Do Federal Grants Boost School Spending? Evidence from Title I”  
Discussant: Robert P. Inman, NBER and University of Pennsylvania

**William N. Evans**, NBER and University of Maryland, and **Ping Zhang**, University of Maryland, “The Impact of Earmarked Lottery Revenue on State Educational Expenditures”  
Discussant: Patrick Bayer, Yale University

**Leemore Dafny**, NBER and Northwestern University, “How Do Hospitals Respond to Price Changes?”  
Discussant: Joseph Doyle, MIT

**Sebastian Galiani**, Universidad de San Andres; **Paul J. Gertler**, NBER and University of California, Berkeley; and **Ernesto Schargrodsky**, Universidad Torcuato di Tella, “Water for Life: The Impact of the Privatization of Water Services on Child Mortality”  
Discussant: Rohini Pande, Columbia University

**Jacob** and **Lefgren** examine the short-term effect of school on juvenile crime. They bring together daily measures of criminal activity and detailed school calendar information from 27 jurisdictions across the country and find that the level of property crime committed by juveniles decreases by 15 percent on days when school is in session, but that the level of violent crime *increases* by nearly 20 percent on such days. These results do not appear to be driven by inflated reporting of crime on school days or substitution of crime across days. These findings provide evidence for both incapacitation and concentration models of schooling — when juveniles are not provided with constructive activities, they are more likely to engage in certain anti-social behaviors; at the same time, the increase in interactions associated with school attendance leads to more interpersonal conflict and violence. These results underscore the social nature of violent crime. Furthermore, they sug-

gest that youth programs — particularly those with no educational component, such as midnight basketball or summer concerts — may entail important tradeoffs in terms of their effects on juvenile crime.

**Ellen**, **Schwartz**, and **Voicu** analyze the external effects of subsidized housing on the value of surrounding properties. In particular, they estimate the spillover effects of the new, publicly-assisted housing units produced in New York City as part of the Ten Year Plan program. Their results suggest that the city’s investment in new housing generated significant external benefits and that these benefits were sustained over time. The magnitudes of the external effects increase with project size and decrease with the proportion of units in multi-family, rental buildings. Consistent with expectations, spillover effects diminish with distance from the housing investment sites. Further, spillovers are typically larger in the more distressed neighbor-

hoods, and smaller projects are likely to be less effective if surrounded by high levels of blight. The spillover benefits also reflect, at least to some extent, the elimination of a disamenity. In addition, some of the external benefits of new housing seem to be occupancy effects, occurring through the number and characteristics of inhabitants.

**Fishback**, **Horace**, and **Kantor** find that the economic effects of the various forms of New Deal spending were quite different. These contrasts help to answer questions in today’s political debates about the role of fiscal policy. The authors’ strongest finding is that the public works programs that built large-scale civil infrastructure projects had strong positive effects on the economy. At the margin, an additional dollar spent on dams, roads, schools, and buildings by the PWA, PRA, and PBA had an income multiplier over two for the entire decade of the 1930s. The short-term effects of the public works projects through



1935 were somewhat smaller, which suggests that some of the most dramatic effects of these projects were not felt until completion when they were able to stimulate productivity in the private sector. The relief programs' effect on the growth of retail sales over 1929-39 is estimated to be somewhat smaller, with a multiplier effect of around 1.7. These grant programs had much stronger positive effects than the loan programs, probably because the actual and anticipated repayment of the loans from state and local governments and private borrowers to the federal government limited their impact. Federal spending on the AAA program, the basis for our modern farm programs, had at best a small positive effect on local economies and possibly a negative effect. The Federal Housing Administration's insurance of home mortgages and home improvement loans also may have contributed to stimulating local economies.

A new omnibus package of farm legislation (the 2002 Farm Bill) will provide in excess of \$190 billion in financial support to U.S. agriculture, an increase of \$72 billion over existing programs. **Goodwin, Mishra, and Ortalo-Magne** study the distribution of such benefits. Farm subsidies make agricultural production more profitable by increasing and stabilizing farm prices and incomes. If these benefits are expected to persist, farm land values should capture the subsidy benefits. Using a large sample of individual farm land values to investigate the extent of this capitalization of benefits, the authors confirm that subsidies have a very significant impact on farm land values. Thus, landowners are the real beneficiaries of farm programs. As land is exchanged, new owners will pay prices that reflect these benefits, leaving the benefits of farm programs in the hands of former owners who may be exiting production. Approximately 45 percent of U.S. farm land is not operated by its owner. Farm owners benefit not only from capital gains but also from lease rates which incorporate a significant portion of agricultural payments even if the farm legislation mandates that benefits must be allocated to producers. Finally, there is evidence that farm programs that are

meant to stabilize farm prices provide a valuable insurance benefit.

Title I, which allocates money for compensatory education to school districts based on their child poverty, is seen as the single most important federal education program. This is largely because of its size: it cost \$9.6 billion in 2001 and represents 35 percent of the Department of Education's elementary and secondary spending. Whether Title I is actually important is controversial, however, because it is not clear that it raises the spending of schools that serve poor children. Title I money must make its way through as many as three other levels of government (states, local parent governments such as counties or municipalities, and school districts), each of which can offset changes to Title I so that spending on poor students changes less than the federal government intends. **Gordon** overcomes the simultaneity problems inherent in estimating the effect of Title I by using sharp changes in per-pupil grant amounts resulting from the release of decennial census data to identify how state and local education revenues and school district spending react to changes in Title I. She finds that state education revenue and school districts' own revenue efforts initially are unaffected by Title I changes so that Title I raises instructional spending dollar for dollar. Three years later, however, local governments have offset changes in Title I, so that the federal spending has only small and statistically insignificant net spending effects on schools.

Over the past four decades there has been a rapid growth in both the number and size of state lotteries in the United States. Many states deposit lottery profits into their general funds, but 16 states earmark lottery profits for primary and secondary education. **Evans and Zhang** use a panel data set of the states with lotteries to examine the impact of earmarking lottery revenues on state educational spending. They have two primary results. First, they find that about 50 to 80 cents out of an earmarked dollar is spent on public education. Second, states with lotteries spend a higher share of the marginal lottery dollar on education than income generated from other

sources such as alcohol and cigarette taxes. Each dollar of lottery profit increases school spending by about 30-50 cents. The authors find a high likelihood that a dollar of earmarked lottery profits generates less than a dollar of spending on K-12 education, but more than the spending generated from a dollar of lottery profits put into the general fund.

**Dafny** investigates whether hospitals respond in profit-maximizing ways to changes in diagnosis-specific prices, as determined by Medicare's Prospective Payment System and other cost-conscious insurers. She exploits an exogenous 1988 policy change that generated a relative price increase of 7 percent (around \$300) for 43 percent of all Medicare admissions. Using the unaffected admissions as a control group, she finds that hospitals did not increase the intensity of care provided to affected admissions, with intensity measured by total costs, length of stay, number of surgical procedures, number of intensive-care-unit days, and in-hospital death rate. Neither did hospitals increase the volume of patients admitted to more remunerative diagnoses, notwithstanding the strong a priori expectation that such a response should prevail in fixed-price settings. However, hospitals did exhibit a strong *nominal* response to the policy change, "upcoding" patients to diagnosis codes associated with large reimbursement increases, and earning \$300-\$410 million in extra reimbursement annually. This response was particularly strong among for-profit hospitals. Taken together, these findings suggest that hospitals do not alter their treatment or admissions policies based on diagnosis-specific prices; however, they employ sophisticated coding strategies in order to maximize total reimbursement.

While most countries are committed to increasing access to safe water and thereby reducing child mortality, there is little consensus on how to actually improve access to water. One important proposal under discussion is whether to privatize water provision. In the 1990s Argentina embarked on one of the largest privatization campaigns in the world including the privatization of local water companies covering approximately 30 percent of

the country's municipalities. Using the variation in ownership of water provision across time and space generated by the privatization process, **Galiani**, **Gertler**, and **Schargrofsky** find that

child mortality fell 8 percent in areas that privatized their water services overall; the effect was largest (26 percent) in the poorest areas. While privatization is associated with significant

reductions in deaths from infectious and parasitic diseases, it is uncorrelated with deaths from causes unrelated to water conditions.

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## Bureau News

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### McClellan to Head FDA

Mark B. McClellan, a former NBER Research Associate and professor of economics at Stanford University, has been confirmed by the Senate as head of the Food and Drug Administration. Most recently, he had been a member of the President's Council of Economic Advisers and an

adviser to the National Economic Council for health care policy. Some of his recent NBER Working Papers, written with several NBER researchers, include: "Is More Information Better? The Effects of 'Report Cards' on Health Care Providers" (W8697); "Area Differences in Utilization of

Medical Care and Mortality among U.S. Elderly" (W8628); "The Effects of Hospital Ownership on Medical Productivity" (W8537); "Medical Liability, Managed Care, and Defensive Medicine" (W7537); and "How Liability Law Affects Medical Productivity" (W7533).

### King to Lead Bank of England

Mervyn A. King, who had been an NBER Research Associate since 1978 in the Programs in Public Economics, Asset Pricing, and Monetary Economics, will become Governor of the Bank of England next summer. King is currently Deputy Governor, a

position he attained in June 1998. Prior to that, he was the Bank of England's Chief Economist and Executive Director, and a founding member of the Monetary Policy Committee.

King studied at King's College, Cambridge, and Harvard. He has taught

at Cambridge and Birmingham Universities, Harvard, MIT, and the London School of Economics, where he had been a Professor of Economics since 1984. He has also written a number of books and articles on monetary policy, corporate finance, and taxation.

## Economic Fluctuations and Growth

The NBER's Program on Economic Fluctuations and Growth met in Chicago on October 18. Organizers Daron Acemoglu, NBER and MIT, and Thomas J. Sargent, NBER and Stanford University, chose these papers for discussion:

**Stephen L. Parente** and **Rui Zhao**, University of Illinois, "From Bad Institutions to Worse: The Role of History in Development"  
Discussant: Luigi Zingales, NBER and University of Chicago

**James Feyrer**, Dartmouth College, "Demographics and Productivity"  
Discussant: Peter J. Klenow, Federal

Reserve Bank of Minneapolis

**Steven J. Davis**, NBER and University of Chicago; **Felix Kubler**, Stanford University; and **Paul Willen**, University of Chicago, "Borrowing Costs and the Demand for Equity over the Life Cycle"  
Discussant: M. Fatih Guvenen, University of Rochester

**John Ameriks**, TIAA-CREF Institute, and **Andrew Caplin** and **John Leahy**, NBER and New York University, "Wealth Accumulation and the Propensity to Plan" (NBER Working Paper No. 8920)  
Discussant: Robert E. Hall, NBER

and Stanford University

**Russell W. Cooper**, NBER and Boston University, and **Jonathan L. Willis**, Federal Reserve Bank of Kansas City, "The Economics of Labor Adjustment: Mind the Gap" (NBER Working Paper No. 8527)  
Discussant: Eduardo M. Engel, NBER and Yale University

**Charles I. Jones**, NBER and University of California, Berkeley, "Why Have Health Expenditures as a Share of GDP Risen So Much?"  
Discussant: Robert Coppel, University of Chicago

**Parente** and **Zhao** consider the role of history in the evolution of a country's institutions and in its development. In particular, they ask how a policy implemented at an economy's agrarian stage of development to protect the vested interests of landowners will affect a country's subsequent development. The authors find that such a policy negatively affects the economy's development path in two ways. First, it delays the formation of industry. Second, it facilitates the formation of industry insider groups that further slow the growth process by delaying the adoption of better technology and limiting its use to a smaller group of workers.

**Feyrer** studies the impact of workforce demographics on aggregate productivity. He finds that the age structure of the workforce significantly affects aggregate productivity. A large cohort of workers aged 40 to 49 has a large positive impact on productivity. Feyrer estimates that U.S. productivity growth in the 1970s was 2 percent lower than trend because of the entry of the baby boom into the workforce. As the baby boomers entered their forties in the 1980s and 1990s, productivity growth rebounded. Japanese demographics predict almost the opposite pattern, with high growth in the 1970s

followed by low growth in the 1990s. Demographics also can explain part of the productivity divergence between rich and poor nations between 1960 and 1990.

**Davis**, **Kubler**, and **Willen** analyze consumption and portfolio behavior in a life-cycle model calibrated to U.S. data on income processes, borrowing costs, and returns on risk-free and equity securities. Even a modest wedge between borrowing costs and the risk-free return dramatically shrinks the demand for equity. When the cost of borrowing equals or exceeds the expected return on equity — the relevant case according to the data — households hold little or no equity during much of the life cycle. The model also implies that the correlation between consumption growth and equity returns is low at all ages, and that risk aversion estimates based on the standard excess return formulation of the consumption Euler Equation are greatly biased upward. The bias diminishes, but remains large, for "samples" of households with positive equity holdings.

Why do similar households end up with very different levels of wealth? **Ameriks**, **Caplin**, and **Leahy** show that differences in attitudes and skills related to financial planning are a sig-

nificant factor. The authors use new and unique survey data to assess these differences and to measure each household's "propensity to plan." They show that those with a higher propensity spend more time developing financial plans, and that this shift in planning effort is associated with increased wealth. The propensity to plan is not correlated with survey measures of the discount factor and the bequest motive, raising a question as to why it is associated with wealth accumulation. Part of the answer may lie in the very strong relationship found between the propensity to plan and the care with which households monitor their spending. It appears that this detailed monitoring activity helps households to save more and to accumulate more wealth.

**Cooper** and **Willis** study inferences about the dynamics of labor adjustment obtained by the "gap methodology" of Caballero and Engel [1993] and Caballero, Engel, and Haltiwanger [1997]. In that approach, the policy function for employment growth is *assumed* to depend on an unobservable gap between the target and current levels of employment. Using time-series observations, these studies reject the partial adjustment model and find that aggregate employ-

ment dynamics depend on the cross-sectional distribution of employment gaps. Thus, nonlinear adjustment at the plant level appears to have aggregate implications. The authors argue that this conclusion is not justified: these findings of nonlinearities in time-series data may reflect mismeasurement of the gaps rather than the aggregation of plant-level nonlinearities.

Aggregate health expenditures as a share of GDP have risen in the United States from about 5 percent in 1960 to nearly 14 percent in recent years. **Jones** explores a simple explanation for this based on technological progress. Medical advances allow diseases to be cured today — at a cost — that could not be cured at any price in the past. When this technological progress is

combined with a Medicare-like transfer program to pay the health expenses of the elderly, Jones's model can reproduce the basic facts of recent U.S. experience, including the large increase in the health expenditure share, a rise in life expectancy, and an increase in the size of health-related transfer payments as a share of GDP.

## International Finance and Macroeconomics

The NBER's Program on International Finance and Macroeconomics met in Cambridge on October 18. Organizers Charles M. Engel, NBER and University of Wisconsin, and Linda Tesar, NBER and University of Michigan, chose the following papers to be discussed:

**Daron Acemoglu** and **Simon Johnson**, NBER and MIT; **James Robinson**, University of California, Berkeley; and **Yunyong Thaicharoen**, Bank of Thailand, "Institutional Causes, Macroeconomic Symptoms: Volatility, Crises, and Growth" (NBER Working Paper No. 9124) Discussant: Ross Levine, NBER and University of Minnesota, and Romain Wacziarg, NBER and Stanford University

**Itay Goldstein**, Duke University, and **Assaf Razin**, NBER and Cornell University, "Volatility of FDI and Portfolio Investments: The Role of Information, Liquidation Shocks, and Transparency" Discussant: Michael W. Klein, NBER and Tufts University, and Enrique G. Mendoza, NBER and Duke University

**Xavier Gabaix**, NBER and MIT, "Eliminating Self-Fulfilling Liquidity Crises Through Fundamentals-Revealing Securities" Discussant: Nouriel Roubini, NBER and New York University, and Roberto Chang, Rutgers University

**Philippe Bacchetta**, Gerzensee, and **Eric Van Wincoop**, University of Virginia, "Can Information

Dispersion Explain the Exchange Rate Discount Puzzle?" Discussant: Kenneth A. Froot, NBER and Harvard University, and Margarida Duarte, Federal Reserve Bank of Richmond

**Maurice Obstfeld**, NBER and University of California, Berkeley; **Jay Shambaugh**, Dartmouth College; and **Alan M. Taylor**, NBER and University of California, Davis, "The Trilemma in History: Tradeoffs among Exchange Rates, Monetary Policies, and Capital Mobility" Discussant: Jeffrey A. Frankel, NBER and Harvard University, and Lars E. O. Svensson, NBER and Princeton University

**Acemoglu** and his co-authors document that countries that inherited more "extractive" institutions from their colonial past were more likely to experience high volatility and economic crises during the postwar period. More specifically, societies where European colonists faced high mortality rates more than one hundred years ago are much more volatile and prone to crises. Based on their previous work, the authors interpret this relationship as attributable to the causal effect of institutions on economic outcomes: Europeans did not settle in, and were more likely to set up extrac-

tive institutions in, areas where they faced high mortality. Once the authors control for the effect of institutions, macroeconomic policies appear to have only a minor impact on volatility and crises. This suggests that distortionary macroeconomic policies are more likely to be symptoms of underlying institutional problems rather than the main causes of economic volatility, and also that the effects of institutional differences on volatility do not appear to be mediated primarily by any of the standard macroeconomic variables. Instead, it appears that weak institutions cause volatility through a

number of microeconomic, as well as macroeconomic, channels.

**Goldstein** and **Razin** develop a model of foreign direct investments (FDI) and foreign portfolio investments. FDI is characterized by hands-on management style which enables the owner to obtain relatively refined information about the productivity of the firm. This superiority, relative to portfolio investments, comes with a cost: a firm owned by the relatively well-informed FDI investor has a low resale price because of asymmetric information between the owner and potential buyers. Consequently, investors,

who have a higher (lower) probability of getting a liquidity shock that forces them to sell early, will invest in portfolio (direct) investments. This result can explain the greater volatility of portfolio investments relative to direct investments. The authors show that this pattern may become weaker as the transparency in the capital market or the corporate governance in the host economy increase.

**Gabaix** proposes a mechanism that realistically could be used to avoid self-fulfilling liquidity crises. It rests on the general idea of “fundamentals revealing” securities. Those securities give a market-based assessment of variables such as “future solvency of the country if it receives a bail-out at reasonable rates in the near future.” Hence, they are likely to be more informative and robust to misspecification than contingent rates based on macroeconomic variables. In all variants and extensions **Gabaix** considers, self-fulfilling crises are eliminated by the mechanism.

Exchange rates tend to be disconnected from fundamentals over substantial periods of time. The recent “microstructure approach to exchange rates” has shed some important light on this puzzle: most exchange rate volatility at short to medium horizons is related to order flows. This suggests that investor heterogeneity is key to understanding exchange rate dynamics, in contrast to the common representative agent approach in macroeconomic models of exchange rate determination. **Bacchetta** and **Wincoop** introduce investor heterogeneity into an otherwise standard monetary model of exchange rate determination. There is both heterogeneous information about fundamentals and non-fundamentals-based heterogeneity. The implications of the model are consistent with the evidence on the relationship between exchange rates and fundamentals: the exchange rate is disconnected from fundamentals in the short to medium run; over longer horizons the exchange rate is primarily driven by fundamentals;

and, exchange rate changes are a weak predictor of future fundamentals.

Recently, the political economy of macroeconomic policy choice has been guided by the simple prescriptions of the classic trilemma. Policymakers often speak of the hollowing out of exchange rate regimes in a world of unstoppable capital mobility, and policy autonomy and a fixed nominal anchor present an unpleasant dichotomy for emerging markets beset by the fear of floating. Yet the trilemma is not an uncontroversial maxim, and its empirical foundations deserve greater attention. Using new techniques to study the coherence of international interest rates at high frequency, along with an examination of capital mobility policies and a data-based classification of exchange rate regimes, **Obstfeld** and his co-authors look at the empirical content of the trilemma based on consistent data over more than 130 years. On the whole, the predictions of this influential adage are borne out by history.

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## Labor Studies

The NBER's Program on Labor Studies met in Cambridge on October 18. Program Director Richard B. Freeman of Harvard University and NBER Research Associate Lawrence F. Katz, also of Harvard, organized this program:

**Bruce D. Meyer**, NBER and Northwestern University, and **James X. Sullivan**, University of Notre Dame, "Measuring the Well-Being of the Poor Using Income and Consumption"

**James J. Choi**, Harvard University; **David Laibson**, NBER and

Harvard University; **Brigitte C. Madrian**, NBER and University of Chicago; and **Andrew Metrick**, NBER and University of Pennsylvania, "Benign Paternalism and Active Decisions: A Natural Experiment in Savings"

**Michael Ostrovsky** and **Michael Schwarz**, Harvard University, "Equilibrium Information Disclosure: Grade Inflation and Unraveling"

**Austan Goolsbee** and **Jonathan Guryan**, NBER and University of Chicago, "The Impact of Internet

Subsidies in Public Schools" (NBER Working Paper No. 9090)

**Christopher Avery** and **Caroline M. Hoxby**, NBER and Harvard University, "Do and Should Financial Aid Packages Affect Students' College Choices?"

**Lance Lochner**, NBER and University of Rochester, and **Alexander Monge-Naranjo**, Northwestern University, "Education and Default Incentives with Government Student Loan Programs"

**Meyer** and **Sullivan** examine the relative merits of consumption and income measures of the material well being of the poor. Consumption offers several advantages over income because it is a more direct measure of well being than income and is less subject to under-reporting bias. Measurement problems with income complicate analyses of changes in the well being of the poor because the biases appear to have changed over time and are correlated with government policies. On the other hand, income is often easier to report and is available for much larger samples, providing greater power for testing hypotheses. The authors begin by considering the conceptual and pragmatic reasons why consumption might be better or worse than income. Then, using several empirical strategies, they examine the quality of income and consumption data. Although the evidence tends to favor consumption measures, these analyses suggest that both measures should be used to assess the material well being of the poor.

Decision makers tend to blindly accept default options. In this paper, **Choi**, **Laibson**, **Madrian**, and **Metrick** identify an overlooked but practical alternative to defaults. They analyze the experience of a company that required its employees to either

affirmatively elect to enroll in the company's 401(k) plan or affirmatively elect *not* to enroll in the company's 401(k) plan. Employees were told that they had to actively make a choice, one way or the other, with no default option. This "active decision" regime provides a neutral middle ground that avoids the implicit paternalism of a one-size-fits-all default election. The active decision approach to 401(k) enrollment yields participation rates that are up to 25 percentage points higher than those under a regime with the standard default of non-enrollment. Requiring employees to make an active 401(k) election also raises average saving rates and asset accumulation with no increase in the rate of attrition from the 401(k) plan.

**Ostrovsky** and **Schwarz** explore information disclosure in matching markets — for example, how informative are the transcripts released by universities? The authors show that the same amount of information is disclosed in all equilibriums. They then demonstrate that if universities disclose the equilibrium amount of information, unraveling does not occur; if they reveal more, then some students will find it profitable to contract early.

In an effort to alleviate the perceived growth of a digital divide, the U.S. government enacted a major sub-

sidy for Internet and communications investment in schools starting in 1998. The program subsidized spending by 20-90 percent, depending on school characteristics. Using new data on school technology usage in every school in California from 1996 to 2000, as well as application data from the E-Rate program, **Goolsbee** and **Guryan** show that the subsidy did succeed in significantly increasing Internet investment. The implied first-dollar price elasticity of demand for Internet investment is between -0.9 and -2.2, and the greatest sensitivity shows up among urban schools and schools with large black and Hispanic student populations. Rural and predominantly white and Asian schools show much less sensitivity. Overall, by the final year of the sample, there were about 66 percent more Internet classrooms than there would have been without the subsidy. Using a variety of test score results, however, it is clear that the success of the E-Rate program, at least so far, has been restricted to the increase in access. The increase in Internet connections has had no measurable impact on any measure of student achievement.

Every year, thousands of high school seniors with high college aptitude face complicated "menus" of scholarship and aid packages designed

to affect their college choices. Using an original survey designed for this paper, **Avery** and **Hoxby** investigate whether students respond to their “menus” like rational investors in human capital. Whether they make the investments efficiently is important not only because they are the equivalent of the “Fortune 500” for human capital, but also because they are likely available to the most analytic and long-sighted student investors. Avery and Hoxby find that the typical high aptitude student chooses his college and responds to aid in a manner that is broadly consistent with rational investment. However, some serious anomalies exist: excessive response to loans and work-study, strong response to superficial aspects of a grant (such as whether it has a name), and response to a grant’s share

of college costs rather than its amount. Approximately 30 percent of high aptitude students respond to aid in a way that apparently reduces their lifetime present value. While both a lack of sophistication/information and credit constraints can explain the behavior of this 30 percent of students, the weight of the evidence favors a lack of sophistication.

**Lochner** and **Monge-Naranjo** examine data on student loan default from the *Baccalaureate and Beyond Survey*. Their main findings include: 1) conditional on debt, the probability of default is declining in both predicted and actual post-school earnings; 2) conditional on earnings, the probability of default is increasing in debt; 3) default rates vary across undergraduate majors, but those differences disappear

when controlling for debt and earnings; and most interestingly, 4) there is a U-shaped relationship between ability and the probability of default, even after controlling for debt and earnings. The authors go on to develop a model of endogenous human capital investment and default that attempts to replicate these facts. Within the context of the model, they ask what types of heterogeneity and market shocks explain their empirical findings, and how different are consumption and investment under the current program with respect to the optimal lending program. In contrast to the conventional wisdom, the model suggests that credit constraints do not necessarily imply under-investment in human capital, given the current lending system.

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## International Trade and Organizations

The NBER's Working Group on International Trade and Organizations met in Cambridge on October 26. The group's director, Gordon H. Hanson, of NBER and the University of California, San Diego, organized this program:

**Niko Matouschek**, Northwestern University, and **Paolo Ramezzana**, University of Virginia, "Globalization, Market Efficiency,

and the Organization of Firms"

**George P. Baker**, NBER and Harvard University; **Robert Gibbons**, NBER and MIT; and **Kevin J. Murphy**, NBER and University of Chicago, "Relational Contracts and the Theory of the Firm"

**Gene M. Grossman**, NBER and Princeton University, and **Elhanan**

**Helpman**, NBER and Harvard University, "Managerial Incentives and the International Organization of Production"

**Robert C. Feenstra**, NBER and University of California, Davis, and **Gordon H. Hanson**, "Ownership and Control in Outsourcing to China"

**Matouschek** and **Ramezzana** develop a matching model in which bilateral bargaining between agents is inefficient because of the presence of private information about the gains from trade. Globalization, by reducing market frictions, increases the probability that bilateral trade breaks down, but also reduces the costs of such breakdowns. Overall, a fall in market frictions reduces welfare if the initial level of market frictions is high; otherwise it increases welfare. Firms respond to the increased probability of trade breakdowns caused by globalization by adopting more flexible vertical structures that make it less costly for them to transact with third parties, for instance by switching from vertical integration to outsourcing, thereby further increasing the probability of trade breakdowns.

Relational contracts — informal agreements sustained by the value of future relationships — are prevalent within and between firms. **Baker**, **Gibbons**, and **Murphy** develop repeated-game models showing why and how relational contracts within firms (vertical integration) differ from those between firms (non-integration).

They show that integration affects the parties' temptations to renege on a given relational contract, and hence affects the best relational contract the parties can sustain. In this sense, the integration decision can be an instrument in the service of the parties' relationship. The authors' approach also has implications for joint ventures, alliances, and networks, and for the role of management within and between firms.

**Grossman** and **Helpman** develop a model in which the heterogeneous firms in an industry choose their modes of organization and the location of their subsidiaries or suppliers. The authors assume that the principals of a firm are constrained in the nature of the contracts they can write with suppliers or employees. The main result concerns the sorting of firms with different productivity levels into different organizational forms. The authors use the model to examine the implications of falling trade costs for the relevant prevalence of outsourcing and foreign direct investment.

**Feenstra** and **Hanson** examine the organization of export processing operations in China. During the 1990s,

export processing accounted for over half of China's total exports. The authors take into account who owns the plant and who controls the inputs that the plant processes. To explain how parties organize export processing in China, they apply two influential theories of the firm, the Holmstrom-Milgrom model and the Grossman-Hart-Moore model. In the Holmstrom-Milgrom framework, it is optimal for a single party to own the processing factory and to control the inputs used in export processing. In the Grossman-Hart-Moore framework, the gains to giving one party factory ownership tend to be greater when that party lacks control over inputs. The authors find that multinational firms engaged in export processing in China tend to split factory ownership and input control with factory managers in China. Chinese ownership of export processing factories is more common when the foreign buyer (the multinational) controls the inputs than when the processing factory (the factory manager) controls the inputs. This evidence is consistent with Grossman-Hart-Moore but is strongly inconsistent with Holmstrom-Milgrom.



## Health Care

The NBER's Program on Health Care met in Cambridge on November 1. Alan M. Garber, NBER and Stanford University, organized the meeting, at which these papers were discussed:

**Sherry A. Glied**, NBER and Columbia University, and **Adriana Lleras-Muney**, NBER and Princeton University, "Health Inequality, Education, and Medical Innovation"

**Dana Goldman**, Rand Corporation, and **Darius Lakdawalla**, NBER and Rand Corporation, "Health Disparities and Medical Technology"

**Janet Currie**, NBER and University of California, Los Angeles, and **Mark Stabile**, NBER and University of Toronto, "Socioeconomic Status and Health: Why is the Relationship Stronger for Older Children?"

**Kate Bundorf**, NBER and Stanford University, "The Effects of Offering Health Plan Choice within Employment-Based Purchasing Groups"

**Michael Chernew**, NBER and University of Michigan; **David M. Cutler**, NBER and Harvard University; and **Patricia Keenan**, Harvard University, "Rising Health Care Cost and the Decline in Health Insurance Coverage"

Recent studies suggest that health inequalities across socioeconomic groups in the United States are large and have been growing. **Glied** and **Lleras-Muney** hypothesize that, as in other non-health contexts, this pattern occurs because more educated people benefit more than do the less educated from technological advances in medicine. They test this hypothesis by examining the evolution of mortality differentials and medical innovation over time. Glied and Lleras-Muney focus on cancer mortality and examine the incidence of cancer and survival rates conditional on disease incidence. Although there have not been great improvements in cancer survival overall, there has been substantial progress in the treatment of some forms of cancer. Glied and Lleras-Muney find that more educated people are better able to take advantage of new medical innovations.

Although better-educated people are healthier, the relationship between health and education varies substantially across groups and over time. **Goldman** and **Lakdawalla** ask how health disparities by education vary according to underlying health characteristics and market forces. Consumer theory suggests that improvements in the productivity of health care will tend to confer the most benefits upon the heaviest users of health care. Since richer and more educated patients tend to use the most health care, this suggests that new technologies — by making more diseases treatable, reduc-

ing the price of health care, or improving its productivity — will tend to widen disparities in health. On the other hand, by the same reasoning, new technologies that are "timesaving" can lessen health disparities if they lower the productivity of patients' time investments in health. These ideas explain several empirical patterns. First, compared to healthy people, the chronically ill exhibit wider disparities in health status, but the terminally ill exhibit narrower ones. Second, the advent of complex new HIV technologies increased immune function among HIV patients, but seemed to benefit educated patients disproportionately. In contrast, however, new drugs for hypertension lowered health inequality, by making investments in diet, exercise, and weight control much less important for hypertension control.

The well-known relationship between socioeconomic status (SES) and health exists in childhood and grows more pronounced with age. However, it is difficult to distinguish between two possible explanations of this. Are low-SES children less able to respond to a given health shock? Or, do low SES children experience more shocks? Using panel data on Canadian children, **Currie** and **Stabile** show that: 1) the cross-sectional relationship between low family income or low maternal education and health is very similar in Canada and the United States; and 2) both high and low-SES children recover from past health shocks to about the same degree.

Hence, it must be that the relationship between SES and health grows stronger over time mainly because low-SES children receive more negative health shocks. In addition, the authors examine the effect of health shocks on math and reading scores. They find that health shocks affect test scores and future health in very similar ways. These results suggest that public policy aimed at reducing SES-related health differentials in children should focus on reducing the incidence of health shocks as well as on reducing disparities in access to palliative care.

Over the last two decades, employers increasingly have offered workers a choice of health plans. Yet, relatively little is known about the effects of this trend on consumers. The availability of choice has the potential benefits of lowering the cost and increasing the quality of health care through greater competition among health plans, as well as allowing consumers to enroll in the type of coverage that most closely matches their preferences. On the other hand, concerns exist about the potential for adverse selection within employment-based purchasing in response to the availability of choice. **Bundorf** examines the effects of offering choice in employment-based purchasing groups on access to and the cost of employer-sponsored coverage. She hypothesizes that the introduction of managed care, HMOs specifically, facilitated the offering of choice within employment-based purch-

chasing groups. She then uses geographic variation in the availability of HMOs in the 1990s as an instrument for offering health plan choice. She finds that greater availability of choice was associated with sizable reductions in the premiums of employer-sponsored coverage and modest increases in the proportion of workers covered by the plans offered by employers. However, a large portion of the premium reduction was attributable to a major shift from family to single coverage within employment-based purchasing groups. The results suggest that gains to employees from the availability of choice in the form of lower premiums and increased employee coverage came at the cost of reductions in dependent coverage.

**Chernew, Cutler, and Keenan**

examine the determinants of declining insurance coverage during the 1990s, with a focus on the role of rising health care costs relative to other explanations, such as regulatory changes (including changing Medicaid rules and tax rates) or the rise of working spouses. They use annual March supplements to the Current Population Survey (CPS) as the primary data source for insurance coverage and analyze coverage for two periods, 1989-91 and 1998-2000. Their models control for changes in population demographics and employment patterns. They estimate the impact of changing health care costs, tax subsidies, Medicaid reforms, other state regulatory reforms, a rise in spousal employment, and general economic conditions on declining coverage. The researchers find that the decline in

coverage over the 1990s was not uniform across metropolitan areas (MSAs), even after accounting for the sampling variation in coverage estimates. Moreover, cost growth also varied across MSAs. Preliminary estimates suggest that a large share (over 50 percent) of the decline in coverage is attributable to rising health care costs. This effect is largely caused by the relationship between rising health care costs and private coverage. There is no statistically significant relationship between rising health care costs and public coverage. Apart from the general policy interest of the findings, the importance of premiums (as opposed to loads) suggests that renewed attention to how the price of insurance is conceptualized may be warranted.

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## Monetary Economics

The NBER's Program on Monetary Economics met in Cambridge on November 1. Organizers Simon Gilchrist, NBER and Boston University, and John V. Leahy, NBER and New York University, chose the following papers to be discussed:

**Daron Acemoglu** and **Simon Johnson**, NBER and MIT; **James Robinson**, University of California, Berkeley; and **Yunyong Thaicharoen**, Bank of Thailand, "Institutional Causes, Macroeconomic Symptoms: Volatility, Crises and Growth" (NBER Working Paper No. 9124) Discussant: Stephen H. Haber, NBER and Stanford University (See *International Finance and*

*Macroeconomics*" earlier in this section for a summary of this paper.)

**Timothy Cogley**, Arizona State University, and **Thomas J. Sargent**, NBER and New York University, "Drifts and Volatilities; Monetary Policies and Outcomes in the Post WWII U.S." Discussant: Mark W. Watson, NBER and Princeton University

**Jean Boivin**, NBER and Columbia University, and **Marc Giannoni**, Columbia University, "Has Monetary Policy Become Less Powerful?" Discussant: Charles Evans, University of Chicago

**Ariel Burstein**, University of

Michigan, "Inflation and Output Dynamics with State Dependent Pricing Decisions" Discussant: Robert King, NBER and Boston University

**Peter N. Ireland**, NBER and Boston College, "Technology Shocks in the New Keynesian Model" Discussant: Miles S. Kimball, NBER and University of Michigan

**N. Gregory Mankiw**, NBER and Harvard University, and **Ricardo Reis**, Harvard University, "What Measure of Inflation Should a Central Bank Target?" Discussant: Pierpaolo Benigno, New York University

**Cogley** and **Sargent** present posterior densities for several objects relevant to designing and evaluating monetary policy, including: measures of inflation persistence; the natural rate of unemployment; a core rate of inflation; and 'activism coefficients' for monetary policy rules. The posteriors imply that all of these objects vary substantially in post WWII U.S. data. After adjusting for changes in volatility, the persistence of inflation increases during the 1970s, then falls in the 1980s and 1990s. Innovation variances change systematically, and are substantially larger in the late 1970s than during other times. Measures of uncertainty about core inflation and the degree of persistence covary positively. The authors use their posterior distributions to evaluate the power of several tests that have been used to test the null of time-invariance of autoregressive coefficients of vector autoregressions against the alternative of time-varying coefficients. Except for one test, they find that those tests have low power against the form of time variation captured by their model. That one test also rejects time invariance in the data.

Recent VAR studies have shown that since the beginning of the 1980s

monetary policy shocks have had a reduced effect on the economy. **Boivin** and **Giannoni** first estimate an identified VAR over the pre- and post-1980 periods, and corroborate the existing results, suggesting a stronger systematic response of monetary policy to the economy in the later period. Then they present and estimate a fully specified model that replicates well the dynamic response of output, inflation, and the federal funds rate to monetary policy shocks in both periods. Using the estimated structural model, they perform counterfactual experiments to quantify the relative importance of changes in monetary policy and changes in the private sector in explaining the reduced effect of monetary policy shocks. Their main finding is that changes in the systematic elements of monetary policy are consistent with a more stabilizing monetary policy in the post-1980 period and largely account for the reduced effect of unexpected exogenous interest rate shocks. Consequently, there is little evidence that monetary policy has become less powerful.

**Burstein** studies the effects of monetary policy on output and inflation in a dynamic general equilibrium model. He assumes that firms face a fixed cost of changing their pricing

plans: once a firm pays this fixed cost, it can choose both its current price and a plan specifying an entire sequence of future prices. He finds that the model's predictions are qualitatively consistent with the conventional wisdom about the response of the economy to three widely studied monetary experiments. Allowing firms to choose a sequence of prices rather than a single price generates inflation inertia in the response of the economy to small changes in the growth rate of money. Allowing firms to choose when to change their pricing plan generates a non-linear response of inflation and output to small and large changes in the money growth rate. The non-linear solution method allows one to quantify the range of changes in the growth rate of money for which time dependent models are a good approximation to state dependent models. This approach also reveals that the model generates an asymmetric response of output and inflation to monetary expansions and contractions.

**Ireland** notes that in a New Keynesian model, technology and cost-push shocks compete as factors that stochastically shift the Phillips curve. A version of this model, estimated via maximum likelihood, points to the cost-push shock as far more important

than the technology shock in explaining the behavior of output, inflation, and interest rates in the postwar U.S. data. These results weaken the links between the current generation of New Keynesian models and the real business cycle models from which they were originally derived; they also suggest that Federal Reserve officials often

have faced difficult trade-offs in conducting monetary policy.

**Mankiw** and **Reis** first assume that a central bank commits itself to maintaining an inflation target and then ask what measure of the inflation rate the central bank should use if it wants to maximize economic stability. They show how the weight of a sector in the

stability price index depends on the sector's characteristics, including size, cyclical sensitivity, sluggishness of price adjustment, and magnitude of sectoral shocks. When they calibrate the problem to U.S. data, one tentative conclusion is that the central bank should use a price index that gives substantial weight to the level of nominal wages.

## Macroeconomics and Individual Decisionmaking

The NBER's Working Group on Macroeconomics and Individual Decisionmaking met in Cambridge on November 2. Organizers George A. Akerlof, University of California, Berkeley, and Robert J. Shiller, NBER and Yale University, chose these papers to discuss:

**Truman Bewley**, Yale University, "An Interview Study of Wage Setting"  
Discussant: Beth Ann Wilson, Federal Reserve Board of Governors

**Hanming Fang** and **Giuseppe Moscarini**, Yale University,

"Overconfidence, Morale, and Wage-Setting Policies"

**Edward L. Glaeser**, NBER and Harvard University, "Political Economy of Hatred"  
Discussant: Vai-Lam Mui, University of Notre Dame

**Roland Benabou**, NBER and Princeton University, and **Jean Tirole**, Institut d'Economie Industrielle, "Belief in a Just World and Redistributive Politics"  
Discussant: Bruce Sacerdote, NBER and Dartmouth College

**John Shea**, NBER and University of Maryland, "Childhood Deprivation and Adult Wealth"  
Discussant: Laurence J. Kotlikoff, NBER and Boston University

**John Ameriks**, TIAA-CREF Institute; **Andrew Caplin**, NBER and New York University; and **John V. Leahy**, NBER and Boston University, "Wealth Accumulation and the Propensity to Plan" (NBER Working Paper No. 8920)  
Discussant: Annamaria Lusardi, Dartmouth College (See "Economic Fluctuations and Growth" earlier in this section for a summary of this paper.)

**Bewley** summarized tentative conclusions from a survey currently being conducted on pricing in manufacturing, service, wholesale, and retail companies, as well as their intermediaries or brokers of various sorts. The survey asks how prices are set, how they are adjusted when costs or demand change, and whether any influences stand in the way of price changes. **Bewley** finds a surprising amount of price flexibility, both downward and upward. Downward price rigidity primarily occurs in retail sales of differentiated commodities with repeat customers and fluctuating costs and in sales to businesses of small differentiated items. Other influences sometimes do cause downward price rigidity, such as the fear of starting a price war and long-term contracts. Another conclusion from the

survey is that most price setters are aware of the distinction between fixed and variable costs and use only variable costs to determine the lowest price they will accept before walking away from a deal. Another finding is that marginal costs at one production unit tend to be flat or to decline with output, until a capacity constraint is reached, and these constraints are usually reached abruptly. Another of **Bewley's** themes was the near universality of price discrimination. Sellers vary the product in order to price discriminate, and the bargaining that occurs over many sales is a way to gather information from customers used to extract as high a margin as possible from each of them. Still another theme is the importance of product differentiation. Even if there are few sellers,

competitive pressures quickly erode margins on undifferentiated good and services, known as "commodities" in business parlance. The prices of such "commodities" fluctuate freely. **Bewley** also explains why long-term, fixed price contracts exist in such industries as coal, steel, and rail and truck transport, where the sales are to other companies. The contracts free sellers to invest in production by guaranteeing them a market and protect buyers against increases in the price of supplies. Buyers do not want price increases because they would be at a disadvantage against a competitor who was protected against price increases by a long-term contract.

Psychologists consistently have documented people's tendency to be overconfident about their own ability.

**Fang** and **Moscarini** interpret workers' confidence in their own skills as morale, and investigate the implication of worker overconfidence on the firm's optimal wage-setting policies. In their model, a wage contract both provides incentives and conveys to workers the firm's opinion about their ability, hence affecting their morale. The authors, in numerical examples, show that worker overconfidence is a necessary condition for the firm to prefer no wage differentiation so as to preserve some workers' morale. A non-differentiation wage policy itself will breed more worker overconfidence; thus, "overconfidence begets overconfidence." Furthermore, wage compression is more likely when aggregate productivity is low.

What determines the intensity and objects of hatred? **Glaeser** theorizes that hatred arises when people believe that out-groups are responsible for past and future crimes. However, the reality of past crimes has little to do with the level of hatred. Instead, hatred is the result of an equilibrium in which politicians supply stories of past atrocities in order to discredit the opposition and consumers listen to the stories. The supply of hatred is a function of the degree to which minorities gain or lose from particular party platforms; as such, groups that are particularly poor or rich are likely to be hated. Strong constitutions that limit the policy space and ban specific anti-

minority policies in turn will limit hate. The demand for hatred falls if consumers interact regularly with the hated group, unless those interactions are primarily abusive. The power of hatred is so strong that its opponents motivate their supporters by "hating the haters."

**Benabou** and **Tirole** propose a model of why people may feel a need to believe in a just world; of why this need, and therefore the prevalence of the belief, may vary considerably across countries; and of its implications for redistributive policies (taxes and welfare payments) and the stigma born by the poor. At the heart of the model are general-equilibrium interactions between each individual's psychologically based "demand" for a belief in a just world (or similar ideology) and the degree of redistribution chosen by the polity. Because of complementarities between an individual's desired beliefs or ideological choices, arising through the aggregate political outcome, there can be two equilibriums. The first is characterized by a high prevalence of the "belief in a just world" among the population (a high degree of repression or denial of bad news about the world), and a relatively laissez-faire public policy; both are mutually sustaining. The other equilibrium is characterized by more "realistic pessimism" (less collective denial, leading to a more cynical majority), and a more generous welfare state, which in

turn reduces the need for individuals to invest in optimistic beliefs. In this equilibrium, there is also less stigma attached to being poor, in the sense that fewer agents are likely to blame poverty on a lack of effort or willpower.

Popular mythology holds that children growing up during the Great Depression are more frugal than subsequent generations. **Shea** asks whether childhood deprivation raises adult thriftiness. Specifically, he examines whether children whose fathers are displaced from their jobs have more wealth as adults than children with otherwise similar fathers who do not experience job loss. He finds that father's displacement indeed does raise children's net worth. This impact is most pronounced for job losses occurring when the child is an adolescent, and is concentrated on vehicles, unsecured debt, and business equity. The impact of father's displacement does not appear to be driven by lower expected bequests, and Shea finds no evidence that father's displacement forced children to become economically mature at a younger age. His results are consistent with anecdotal evidence suggesting that childhood deprivation causes subsequent aversion to debt, and are also consistent with the popular idea that post-Baby Boom generations are more entrepreneurial and independent than previous generations because of their exposure to corporate downsizing and deindustrialization.

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## Public Economics

The NBER's Program on Public Economics met on November 7-8 in Cambridge. Organizer James M. Poterba, NBER and MIT, chose these papers for discussion:

**Austan D. Goolsbee** and **Jonathan Guryan**, NBER and University of Chicago, "The Impact of Internet Subsidies in Public Schools (NBER Working Paper No. 9090)  
Discussant: David Figlio, NBER and University of Florida (*See "Labor Studies" earlier in this section for a summary of this paper.*)

**Holger Sieg** and **Dennis Epple**, NBER and Carnegie Mellon University, and **Richard E. Romano**, University of Florida, "Admission, Tuition, and Financial Aid Policies in the Market for Higher Education"

Discussant: Patrick J. Bayer, Yale University

**Peter A. Diamond**, NBER and MIT, "Optimal Tax Treatment of Private Contributions for Public Goods with and without Warm Glow Preferences"  
Discussant: Louis Kaplow, NBER and Harvard University

**William D. Nordhaus**, NBER and Yale University, "After Kyoto: Alternative Mechanisms to Control Global Warming"  
Discussant: Emmanuel Saez, NBER and University of California, Berkeley

**Esther Duflo**, NBER and MIT, and **Emmanuel Saez**, "The Role of Information and Social Interactions in Retirement Plan Decisions: Evidence from a Randomized

Experiment"

Discussant: Brigitte C. Madrian, NBER and University of Chicago

**Patric H. Hendershott**, NBER and Aberdeen University Business School; **Gwilym Pryce**, University of Glasgow; and **Michael White**, University of Aberdeen, "Household Leverage and the Deductibility of Home Mortgage Interest: Evidence from U.K. House Borrowers" (NBER Working Paper No. 9207)  
Discussant: Todd M. Sinai, NBER and University of Pennsylvania

**Katherine Baicker**, NBER and Dartmouth College, "The Budgetary Repercussions of Capital Convictions"  
Discussant: Arik Levinson, NBER and Georgetown University

**Epple, Romano, and Sieg** present a general equilibrium model of the market for higher education. Their model simultaneously predicts student selection into institutions, financial aid, and educational outcomes. The model gives rise to a strict hierarchy of colleges that differ by the educational quality provided to the students. To evaluate the model, the authors develop an estimation strategy that accounts for the fact that important variables are likely to be measured with error. Using data collected by the National Center for Educational Statistics and aggregate data from Peterson's and the NSF, they find that their model explains observed admission and price policies reasonably well. The findings also suggest that the market for higher education is quite competitive.

The United States relies on tax-favored contributions as well as direct government expenditures for financing some public goods. From the political perspective, this approach shifts some decisionmaking from the legislative process to the decisions of individual donors (and the managers of charitable organizations). From the

economic perspective, this approach can be a useful part of optimal tax and expenditure policy. **Diamond** explores the latter issue, first using a model with standard preferences and then a model with a "warm glow of giving" (Andreoni, 1990). In addition to showing the conditions for the rate of subsidized private provision, Diamond considers the pattern of optimal subsidization across earnings levels. Analysis of optimal taxation with warm glow preferences is sensitive to the choice of preferences that are relevant for a social welfare evaluation. After considering optimal rules with formulations of social welfare which do and do not include warm glow utility, Diamond considers the choice of normative criterion. His paper focuses on private contributions with nonlinear income taxation. Like the earlier literature, this paper assumes that organizing private donations is costless while tax collection has a deadweight burden. Since private charitable fundraising is very far from costless, the paper is an exploration of economic mechanisms, not a direct guide to policy.

**Nordhaus** reviews different ap-

proaches to the political and economic control of global public goods, for example global warming. He compares quantity-oriented control mechanisms, like the Kyoto Protocol, with price-type control mechanisms, such as internationally harmonized carbon taxes. He focuses on such issues as performance under conditions of uncertainty, volatility of the induced carbon prices, the excess burden of taxation and regulation, accounting finagling, and ease of implementation. Nordhaus concludes that, although virtually all discussions about economic global public goods have analyzed quantitative approaches, price-type approaches are likely to be more effective and more efficient.

**Duflo** and **Saez** analyze a randomized experiment to shed light on the role of information and social interactions in employees' decisions to enroll in a Tax Deferred Account (TDA) retirement plan within a large university. The experiment encouraged a random sample of employees in a subset of departments to attend a benefits information fair organized by the university, promising a monetary reward

for attendance. The experiment multiplied by more than five the attendance rate of these treated individuals (relative to the control group), and tripled the attendance rate of untreated individuals within departments where some individuals were treated. TDA enrollment 5 and 11 months after the fair was significantly higher in departments where some individuals were treated than in departments where nobody was treated. However, the effect on TDA enrollment is almost as large for individuals in treated departments who did not receive the encouragement as for those who did. The authors provide three interpretations — differential treatment effects, social network effects, and motivational reward effects — to explain these results.

**Hendershott, Pryce, and White** analyze over 117,000 loans used to finance home purchases originated in the United Kingdom during the 1988-91 and 1995-8 periods. They first estimate whether a household's loan exceeds the £30,000 deductibility ceil-

ing and then construct debt tax penalty variables that explain household LTVs on these loans. The penalty variables depend on the predicted probability of having a loan that exceeds the ceiling, the market mortgage rate, and exogenous household specific tax rates. From these results the authors compute estimates of the impact of removing deductibility on initial LTVs in the United Kingdom and on the weighted average cost of capital for owner-occupied housing. Removal of deductibility is estimated to reduce initial LTVs, which mitigates the rise in the weighted average cost of capital, by about 30 percent, with the reduction varying with household age, loan size (above or below the £30,000 limit), and tax bracket.

Control of public spending and revenues is increasingly being left to states and localities. In order to understand the consequences of such a movement on the distribution of social spending, it is necessary to understand how fiscal distress will

affect state and local budgets. **Baicker** exploits the large and unexpected negative shock to county budgets imposed by the presence of capital crime trials, first to understand the real incidence of the cost of capital convictions, and second to uncover the effects of local fiscal distress on the level and distribution of public spending and revenues. She shows that these trials are quite costly relative to county budgets, and that the costs are borne primarily by increasing taxes (although perhaps in part by decreases in spending on police and highways). The results highlight the vulnerability of county budgets to fiscal shocks: each trial causes an increase in county spending of more than \$2 million, implying an increase of more than \$6 billion in both expenditures and revenues between 1982 and 1997. Using these trials as a source of exogenous variation to examine interjurisdictional spillovers, she finds significant spillovers of both spending and revenues between counties.

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## Asset Pricing

The NBER's Program on Asset Pricing met in Cambridge on November 8. John H. Cochrane, NBER and University of Chicago, and Jonathan Lewellen, NBER and MIT, organized this program:

**John Y. Campbell** and **Tuomo Vuolteenaho**, NBER and Harvard University, "Bad Beta, Good Beta" Discussant: Jay A. Shanken, NBER and Emory University

**Jing-Zhi Huang**, Pennsylvania State University, and **Ming Huang**, Stanford University, "How much of the Corporate-Treasury Yield Spread is Due to Credit Risk? A New Calibration Approach" Discussant: Jun Pan, MIT

**Peter M. DeMarzo** and **Lian Kremer**, Stanford University, and **Ron Kaniel**, University of Texas, Austin, "Diversification as a Public Good: Community Effects in Portfolio Choice" Discussant: Stephen Shore, Harvard University

**Jonathan B. Berk**, NBER and University of California, Berkeley, and **Richard C. Green**, Carnegie Mellon University, "Mutual Fund Flows and Performance in Rational Markets" Discussant: Harrison Hong, Stanford University

**Bernard Dumas**, NBER and INSEAD, and **Pascal Maenhout**, INSEAD, "A Central-Planning Approach to Dynamic Incomplete-Market Equilibrium" Discussant: Deborah J. Lucas, NBER and Northwestern University

**Eli Ofek** and **Matthew Richardson**, New York University, and **Robert F. Whitelaw**, NBER and New York University, "Limited Arbitrage and Short Sales Restrictions: Evidence From the Options Market" Discussant: Owen Lamont, NBER and University of Chicago

**Campbell** and **Vuolteenaho** explain the size and value "anomalies" in stock returns using an economically motivated two-beta model. They break the beta of a stock with the market portfolio into two components, one reflecting news about the market's future cash flows and one reflecting news about the market's discount rates. Intertemporal asset pricing theory suggests that the former should have a higher price of risk; thus beta, like cholesterol, comes in "bad" and "good" varieties. The authors find that value stocks and small stocks have considerably higher cash-flow betas than growth stocks and large stocks, and this can explain their higher average returns. The post-1963 negative Capital Asset Pricing Model alphas of growth stocks are explained by the fact that their betas are predominantly of the good variety.

**Huang** and **Huang** show that credit risk accounts for only a small fraction of the observed corporate-Treasury yield spreads for investment grade bonds of all maturities, with the fraction smaller for bonds of shorter maturities; and that it accounts for a much higher fraction of yield spreads for junk bonds. This conclusion is robust across a wide class of structur-

al models — both existing and new ones — that incorporate many different economic considerations. The authors obtain such consistent results by calibrating each of the models to be consistent with data on historical default loss experience. Different models, which in theory can still generate a very large range of credit risk premiums, predict fairly similar credit risk premiums under empirically reasonable parameter choices, resulting in the robustness of their conclusion.

**DeMarzo**, **Kaniel**, and **Kremer** examine the impact of community interaction on risk sharing, investments, and consumption. They do this using a rational general equilibrium model in which agents care only about their personal consumption. The authors consider a setting in which, because of borrowing constraints, individuals who are endowed with local resources under-participate in financial markets. As a result, individuals "compete" for local resources through their portfolio choices. Even with complete financial markets (in the sense of spanning) and no aggregate risk, agents herd into risky portfolios in all stable equilibria. This yields a Pareto dominated outcome, as agents introduce "community" risk that does

not follow from fundamentals. The authors show that when some agents are behaviorally biased, a unique equilibrium exists in which rational agents choose even *more extreme* portfolios and amplify the behavioral effect. This can rationalize the behavioral bias, because following the behavioral bias is optimal. A similar effect will result if some investors cannot completely diversify their holdings (for control or moral hazard reasons) and are biased towards a certain sector. Finally, the authors show that equilibrium Sharpe ratios can be high, even absent aggregate consumption risk. Also, from a welfare perspective, diversification has "public good" features. This provides a potential justification for policies that subsidize diversified holdings and limit trade in risky securities.

**Berk** and **Green** develop a simple rational model of active portfolio management that provides a natural benchmark against which to evaluate the observed relationship between returns and fund flows. They show that many effects widely regarded as anomalous are consistent with this simple explanation. In the model, investments with active managers do not outperform passive benchmarks because of the competitive market for



capital provision, combined with decreasing returns to scale in active portfolio management. Consequently, past performance cannot be used to predict future returns, or to infer the average skill level of active managers. The lack of persistence in active manager returns does not imply that differential ability across managers is non-existent or unrewarded, that gathering information about performance is socially wasteful, or that chasing performance is pointless. A strong relationship between past performance and the flow of funds exists in this model; indeed, it is the market mechanism that ensures that no predictability in performance exists. Calibrating the model to the fund flows and survivorship rates, the authors find that these features of the data are consistent with the vast majority (80 percent) of active managers having at least enough skill to make back their fees.

**Dumas** and **Maenhout** show that a central planner with two selves, or

two “pseudo welfare functions,” is sufficient to deliver the market equilibrium that prevails among any (finite) number of heterogeneous individual agents acting competitively in an incomplete financial market. Furthermore, the authors are able to demonstrate a recursive formulation of the two-central planner problem. In that formulation, every aspect of the economy can be derived one step at a time, by a process of backward induction, as in dynamic programming.

**Ofek**, **Richardson**, and **Whitelaw** empirically investigate the well-known put-call parity no-arbitrage relation in the presence of short sale restrictions. They use a new and comprehensive sample of options on individual stocks, in combination with a measure of the cost and difficulty of short selling: the spread between the rate a short-seller earns on the proceeds from the sale relative to the normal rate (the rebate rate spread). They find statistically and economically signifi-

cant violations of put-call parity that are strongly related to the rebate rate spread. Stocks with negative rebate rate spreads exhibit prices in the stock market that are up to 7.5 percent greater than those implied in the options market (for the extreme 1 percent tail). Even after accounting for transaction costs in the options markets, these violations persist and their magnitude appears to be related to the general level of valuations in the stock market. Moreover, the extent of violations of put-call parity and the rebate rate spread for individual stocks are significant predictors of future stock returns. For example, cumulative abnormal returns, net of borrowing costs, over a 2½ year sample period can exceed 70 percent. It is difficult to reconcile these results with rational models of investor behavior, and, in fact, they are consistent with the presence of over-optimistic irrational investors in the market for some individual securities.

## Behavioral Finance

The NBER's Working Group on Behavioral Finance met in Cambridge on November 9. Robert J. Shiller, NBER and Yale University, and Richard H. Thaler, NBER and University of Chicago, organized the meeting. The program was:

**Markus K. Brunnermeier**, Princeton University, and **Stefan Nagel**, London Business School, “Arbitrage at its Limits: Hedge Funds and the Technology Bubble”  
Discussant: Cliff Asness, AQR Capital

**Jose Scheinkman** and **Wei Xiong**, Princeton University,

“Overconfidence and Speculative Bubbles”

Discussant: Owen Lamont, NBER and University of Chicago

**Malcolm P. Baker**, Harvard University, and **Jeremy C. Stein**, NBER and Harvard University, “Market Liquidity as a Sentiment Indicator” (NBER Working Paper No. 8816)  
Discussant: Dimitri Vayanos, NBER and MIT

**Massimo Massa**, INSEAD, and **Andrei Simonov**, Stockholm School of Economics, “Behavioral Biases and Investment”

Discussant: Terrance Odean, University of California, Berkeley

**Nicholas Barberis** and **Richard H. Thaler**, NBER and University of Chicago, and **Ming Huang**, Stanford University, “Individual Preferences, Monetary Gambles, and the Equity Premium: The Case for Narrow Framing”  
Discussant: John Y. Campbell, Harvard University

**Malcolm P. Baker** and **Jeffrey Wurgler**, New York University, “A Catering Theory of Dividends”  
Discussant: Sendhil Mullainathan, NBER and MIT

Classical finance theory maintains that rational arbitrageurs would find it optimal to attack price bubbles and thus exert a correcting force on prices. **Brunnermeier** and **Nagel** examine the stock holdings of hedge funds during the time of the technology bubble

on the NASDAQ. Counter to the classical view, they find that hedge fund portfolios were heavily tilted towards (overpriced) technology stocks. This does not seem to be the result of unawareness of the bubble: at an individual stock level, these investments

were well timed. On average, hedge funds started to reduce their exposure in the quarter prior to price peaks of individual technology stocks, and their overall stock holdings in the technology segment outperformed characteristics-matched benchmarks. These find-

ings are consistent with models in which arbitrage is limited, because arbitrageurs face constraints, are unable to temporally coordinate their strategies, and investor sentiment is predictable. The results also suggest that frictions such as short-sales constraints are not sufficient to explain why the presence of sophisticated investors failed to contain the bubble.

Motivated by the behavior of internet stock prices in 1998-2000, **Scheinkman** and **Xiong** present a continuous-time equilibrium model of bubbles in which overconfidence generates disagreements among agents regarding asset fundamentals. With short-sale constraints, an asset owner has an option to sell the asset to other over-confident agents who have more optimistic beliefs. This re-sale option has a recursive structure; that is, a buyer of the asset gets the option to resell it. This causes a significant bubble component in asset prices even when small differences of beliefs are sufficient to generate a trade. Agents pay prices that exceed their own valuation of future dividends because they believe that in the future they will find a buyer willing to pay even more. The model generates: prices that are above fundamentals; excessive trading; excess volatility; and predictable returns. However, the analysis shows that while Tobin's tax can substantially reduce speculative trading when transaction costs are small, it has only a limited impact on the size of the bubble or on price volatility. The authors give an example where the price of a subsidiary is larger than its parent firm. Finally, they show how overconfidence can justify the use of corporate strategies that would not be rewarding in a "rational" environment.

**Baker** and **Stein** build a model that

helps to explain why increases in liquidity — such as lower bid-ask spreads, a lower price impact of trade, or higher turnover — predict lower subsequent returns in both firm-level and aggregate data. The model features a class of irrational investors who underreact to the information contained in order flow, thereby boosting liquidity. In the presence of short-sales constraints, high liquidity is a symptom of the fact that the market is dominated by these irrational investors, and hence is overvalued. This theory also can explain how managers might successfully time the market for seasoned equity offerings (SEOs), simply by following a rule of thumb that involves issuing when the SEO market is particularly liquid. The authors find that aggregate measures of equity issuance and share turnover are highly correlated. Still, in a multiple regression, both have incremental predictive power for future equal-weighted market returns.

**Massa** and **Simonov** use a new and unique dataset to investigate how investors react to prior gains/losses and the so called "familiarity" bias. They distinguish between different behavioral theories (loss aversion, house-money effect, mental accounting) and between behavioral and rational hypotheses (pure familiarity and information-based familiarity). They show that, on a yearly horizon, investors react to previous gains/losses according to the house-money effect. There is no evidence of narrow accounting, because investors consider wealth in its entirety, and risk taking in the financial market is affected by gains/losses in overall wealth, as well as by financial and real estate wealth. In terms of individual stock picking, the authors' evidence favors the information-based theory and shows that

familiarity can be considered a proxy for the availability of information, as opposed to a behavioral heuristic.

Many different preference specifications have been proposed as a way of addressing the equity premium. How should we pick between them? **Barberis**, **Thaler**, and **Huang** suggest one possible metric, namely these utility functions' ability to explain *other* evidence on attitudes toward risk. They consider some simple observations about attitudes toward monetary gambles with just two outcomes and show that the vast majority of utility functions used in asset pricing have difficulty explaining these observations. However, utility functions with two features — first-order risk aversion and narrow framing — can explain them easily. The authors argue that, by this metric at least, such utility functions may be very attractive to financial economists: they can generate substantial equity premiums and, at the same time, make sensible predictions about attitudes toward monetary gambles.

**Baker** and **Wurgler** develop a theory in which the decision to pay dividends is driven by investor demand. Managers cater to investors by paying dividends when investors put a stock price premium on payers and not paying when investors prefer nonpayers. To test this prediction, the authors construct four time-series measures of the investor demand for dividend payers. By each measure, nonpayers initiate dividends when demand for payers is high. By some measures, payers omit dividends when demand is low. Further analysis confirms that the results are better explained by the catering theory than by other theories of dividends.

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## Program on Education

The NBER's Program on Education met in Cambridge on November 14. Program Director Caroline M. Hoxby of Harvard University organized the meeting. These papers were discussed:

**Benjamin Scafidi** and **David Sjoquist**, Georgia State University, and **Todd R. Stinebrickner**, University of Western Ontario, "Where Do Teachers Go?"  
Discussant: Richard Murnane, NBER and Harvard University

**Eric A. Hanushek**, NBER and Stanford University; **John F. Kain**, University of Texas at Dallas; and **Steven G. Rivkin**, NBER and Amherst College, "The Impact of Charter Schools on Academic

Achievement"  
Discussant: Miguel Urquiola, Cornell University

**Martin R. West**, Harvard University, and **Ludger Wößmann**, University of Kiel, "Class-Size Effects in School Systems Around the World: Evidence from Between Grade Variation in TIMSS"  
Discussant: Joshua Angrist, NBER and MIT

**Sarah Simmons** and **Sarah Turner**, University of Virginia, "Taking Classes and Taking Care of the Kids: Do Childcare Benefits Increase Collegiate Attainment?"  
Discussant: Cecilia E. Rouse, NBER and Princeton University

**Christopher Avery**, Harvard University; **Mark Glickman**, Boston University; **Caroline Hoxby**; and **Andrew Metrick**, NBER and University of Pennsylvania, "A Revealed Preference Ranking of American Colleges"  
Discussant: Bruce Sacerdote, NBER and Dartmouth College

**Eric Bettinger**, Case Western Reserve University, and **Bridget T. Long**, Harvard University, "The Plight of Underprepared Students in Higher Education: The Role and Effect of Remedial Education"  
Discussant: Brian Jacob, Harvard University

Using new and unique administrative data from Georgia, **Scafidi**, **Sjoquist**, and **Stinebrickner** analyze transitions from full-time elementary and high school teaching. Contrary to public perception, they find that new female teachers are not leaving the teaching profession for high paying jobs in alternative occupations. In their sample of female teachers, only 3.8 percent of elementary school teachers and 5.4 percent of high school teachers who left full-time teaching took a non-education sector job in Georgia that paid more than the state minimum teaching wage. This implies that less than one percent of new female teachers leave full-time teaching for a relatively high paying non-education job in Georgia after the first year of teaching. Other groups of teachers, including males, also have low rates of exits to relatively high paying occupations. Given that these results are in direct contrast to public discussion on the issue, the authors consult the 1994-5 Teacher Followup Survey in an effort to provide some independent validation of their conclusions. While this national survey of teachers does not provide direct evidence on what individuals actually do when they leave

teaching, its circumstantial evidence in the form of motives and anticipated activities is strongly consistent with their results.

Charter schools have become a very popular instrument for reforming public schools because they expand choices, facilitate local innovation, and provide incentives for the regular public schools while remaining under public control. Despite their conceptual appeal, little is known about their performance. **Hanushek**, **Kain**, and **Rivkin** provide a preliminary investigation of the quality of charter schools in Texas. They find that average school quality – measured by gains in student achievement in math and science for elementary students — in the charter sector is not significantly different from that in regular public schools after the initial start-up period. Furthermore, the substantial variation in estimated school quality within the charter sector is quite similar to that of regular public schools. Perhaps most important, parents' decisions to exit a school appear to be much more sensitive to education quality in the charter sector than in regular public schools, consistent with the notion that the introduction of charter schools sub-

stantially reduces the transactions costs of switching schools.

Previous studies of class-size effects have been limited to individual countries, most often the United States. **Wößmann** and **West** use data from the Third International Mathematics and Science Study (TIMSS) to obtain comparable estimates of the effect of class size on student performance for 18 countries. To identify causal class-size effects, the authors compare the relative performance of students in adjacent grades with different average class sizes within the same school, thereby eliminating biases caused by the sorting of students between and within schools. Variation in average class sizes between grades presumably is driven by natural fluctuations in school enrollment, and should be exogenous to student performance. TIMSS actually tested classes in two adjacent grades within each sampled school. The results indicate that smaller classes have a sizable beneficial effect on achievement in Greece and Iceland. However, this cannot be interpreted as a general finding for all school systems because the possibility of even small effects is rejected in six countries. The possibility of *large* ben-

eficial effects is rejected in an additional five countries. Comparing the education systems in these three groups of countries indicates that there are noteworthy class-size effects in countries with relatively low teacher salaries. This suggests an extension of this work to educational production: the performance of poorly-paid, and presumably less capable teachers may deteriorate when they are faced with additional students; that would explain the existence of class-size effects in countries with low teacher salaries. Conversely, highly-paid teachers appear capable of teaching well regardless of class size, at least within the range of variation observed from year to year within the same school.

College participation among non-traditional students – that is, not recent high school graduates, often older and with dependents — has increased markedly in the last two decades, with over half of Pell grants awarded to these “independent” students. Yet the extent to which the availability of financial aid changes the enrollment and attainment of non-traditional students has received little attention in the research literature. For women with children, particularly those in disadvantaged circumstances, direct college costs combined with the need to finance childcare may impede investment in skills that would lead to long-run increases in economic well being. In the academic year beginning in 1988, up to \$1000 in childcare expenditures for families with children was included in the cost of attendance used to determine Pell Grant amounts. For many women with children, this

change led to a substantial increase in Pell grant eligibility. **Simmons** and **Turner** use data from the Current Population Survey and the National Longitudinal Survey of Youth to examine how introducing a childcare cost allowance into the Pell formula in 1988 increased maternal enrollment, attainment, and employment. They find that this program change had a substantial positive impact on enrollment of women with children, but very little effect on attainment or persistence. This finding raises significant questions about how colleges and universities serve these nontraditional students after their initial enrollment.

**Avery, Glickman, Hoxby,** and **Metrick** construct a ranking of U.S. colleges and universities based on students’ revealed preferences. That is, they show which colleges students prefer when they are able to choose among alternatives. Students should be interested in a revealed preference ranking for two reasons: the ranking shows students where their most talented peers are concentrated; and, because the ranking reflects information gathered by many students, it is a more reliable indicator than the observations of any individual student. The authors use data from a survey of 3,240 highly meritorious students that was conducted specifically for this study. Although they account for the potentially confounding effects of tuition, financial aid packages, alumni preferences, and other preferences, these factors turn out not to affect the ranking significantly. The authors develop a statistical model that is a logical extension of the models used for

ranking players in tournaments, such as chess and tennis. When a student makes his matriculation decision among colleges that have admitted him, he chooses which college “wins” in head-to-head competition. The model exploits the information contained in thousands of these “wins” and “losses.” Simultaneously, the authors use information from colleges’ admissions decisions, which implicitly rank students.

Remediation has become an important part of American higher education with over one-third of all students requiring remedial or developmental courses. With the costs of remediation amounting to over \$1 billion each year, many policymakers have become critical of the practice. In contrast, others argue that these courses provide opportunities for underprepared students. Despite the growing debate on remediation and the thousands of underprepared students who enter the nation’s higher education institutions each year, little research exists on the role or effects of remediation on student outcomes. **Bettinger** and **Long** address these critical issues by examining how higher education attempts to assimilate students in need of remediation and prepare them for future college-level work and labor market success. Using a unique dataset of students in Ohio’s public higher education system, they explore the characteristics and features of remedial education, examine participation within the programs, and analyze the effects of remedial education on student outcomes in college.

## Corporate Finance

The NBER's Program on Corporate Finance met in Cambridge on November 15. Program Director Raghuram Rajan, University of Chicago, organized the meeting. These papers were discussed:

**Oliver S. Hart**, NBER and Harvard University, and **Bengt R. Holmstrom**, NBER and MIT, "A Theory of Firm Scope"  
Discussant: Amar Bhidé, Columbia University

**Raymond Fisman**, NBER and Columbia University, and **Inessa Love**, The World Bank, "Patterns of Industrial Development Revisited: The Role of Finance"  
Discussant: Luigi Zingales, NBER and University of Chicago

**James Dow**, London Business School and CEPR; **Gary Gorton**, NBER and University of Pennsylvania; and **Arvind Krishnamurthy**, Northwestern University, "Corporate Finance and the Term Structure of Interest Rates"  
Discussant: Philip Dybvig, Washington University

**Malcolm Baker**, NBER and Harvard University, and **Jeffrey Wurgler**, New York University, "A Catering Theory of Dividends"  
Discussant: Laurie Hodrick, Columbia University (See "Behavioral Finance" earlier in this section for a summary of this paper.)

**Mark Aguiar** and **Gita Gopinath**,

University of Chicago, "Fire-Sale FDI and Liquidity Crises"  
Discussant: Anusha Chari, University of Michigan

**Matthew Rhodes-Kropf**, Columbia University, and **S. Viswanathan**, Duke University, "Market Valuation and Merger Waves"  
Discussant: Augustin Landier, NBER and University of Chicago

**Heitor Almeida**, New York University; **Murillo Campello**, University of Illinois; and **Michael S. Weisbach**, NBER and University of Illinois, "Corporate Demand for Liquidity" (NBER Working Paper No. 9253)  
Discussant: Viral Acharya, London Business School

The existing literature on firms, based on incomplete contracts and property rights, emphasizes that the ownership of assets — and thereby firm boundaries — is determined so as to encourage relationship-specific investments by the appropriate parties. It is generally accepted that this approach applies to owner-managed firms better than to large companies. **Hart** and **Holmstrom** attempt to broaden the scope of the property rights approach by developing a simpler model with three key ingredients: decisions are non-contractible, but transferable through ownership; managers (and possibly workers) enjoy private benefits that are non-transferable; and owners can divert a firm's profit. With these assumptions, firm boundaries matter. Nonintegrated firms fail to account for the external effects that their decisions have on other firms. An integrated firm can internalize such externalities, but it does not put enough weight on the private benefits of managers and workers. The authors explore this trade-off first in a basic model that focuses on the difficulties companies face in cooperating through the market if benefits are unevenly distributed; therefore, they sometimes

may end up merging. They then extend the analysis to study industrial structure in a model with intermediate production. This analysis sheds light on industry consolidation in times of excess capacity.

**Fisman** and **Love** re-examine the role of financial market development in the intersectoral allocation of resources. First, they characterize the assumptions underlying previous work in this area, in particular, that of Rajan and Zingales (1998). The authors find that countries have more highly correlated growth rates across sectors when *both* countries have well-developed financial markets, suggesting that financial markets play an important role in allowing firms to take advantage of global growth opportunities. These results are particularly strong when financial development takes into account both the level and composition of financial development: private banking appears to play a particularly important role in resource allocation. The authors' technique allows them to further distinguish between this "growth opportunities" hypothesis and the related "finance and external dependence" hypothesis, which would imply that countries with similar levels

of financial development should specialize in similar sectors. They do not find evidence in support of this alternative view of finance and development.

**Dow**, **Gorton**, and **Krishnamurthy** present a dynamic equilibrium model of the term structure of interest rates. The short-term interest rate is the price at which investors supply funds to the corporate sector. However, the authors assume that firms are run by managers whose interests conflict with those of their shareholders. Managers are empire-builders who prefer to invest all free cash flow rather than distributing it to shareholders. Shareholders are aware of this problem, but it is costly for them to intervene to increase earnings payouts. Firms with more cash invest more. Aggregate investment and the short-term interest rate are highest at business cycle peaks, when corporate cash flow is high, but the term spread is lowest at these times. Procyclical movements in interest rates are driven primarily by changes in corporate earnings rather than by shocks to the expected marginal rate of transformation. The pricing kernel derived under this free-cash-flow friction mimics one in which investors are "debt-holders" on the

productive sector. They bear downside risk, but do not share equally on the upside. This aspect of the model sheds light on empirical regularities concerning the pricing of risky securities.

In placing capital market imperfections at the center of emerging market crises, the theoretical literature has associated a liquidity crisis with low foreign investment and the exit of investors from the crisis economy. However, a liquidity crisis is equally consistent with an inflow of foreign capital in the form of mergers and acquisitions (M&A). To support this hypothesis, **Aguilar** and **Gopinath** use a firm-level dataset to show that foreign acquisitions *increased* by 88 percent in East Asia between 1996 and 1998, while intra-national merger activity declined. Firm liquidity plays a significant and sizeable role in explaining both the increase in foreign acquisitions and the decline in the price of acquisitions during the crisis. This effect is most prominent in the tradable sectors and represents a significant departure from the pattern of M&A observed both before and after the crisis. Quantitatively, the observed decline in liquidity can explain nearly 30 percent of the increase in foreign acquisition activity in the tradable sectors. The authors argue that the nature of M&A activity during the crisis contradicts productivity-based explanations of the East Asian crisis.

Does valuation affect takeovers? The data suggests that periods of merger activity are correlated with high market valuations and that firms use stock in acquisitions during these peri-

ods. If bidders are simply overvalued then targets should not accept the offers. However, **Rhodes-Kropf** and **Viswanathan** show that private information on both sides can lead rationally to a correlation between stock merger activity and market valuation. They assume that bidding firms have private information about the synergistic value of the target. All firms have a market price that may be over or under the true value of their firm as a stand alone entity. The target's and bidding firm's private information tells them whether they are over- or under-valued, but not why (whether it is market - sector - or firm-specific misvaluation). Thus, target firms cannot distinguish whether high bids are synergies, relative target under-valuation, or bidder over-valuation. A rational target is unwilling to accept a takeover bid with expected value less than the true value of the firm. Consequently, the target uses all available information in an attempt to filter out the misvaluation from the bids. The rational target on average correctly filters but underestimates the market-wide effect when the market is overvalued and overestimates the effect when the market is undervalued. Thus, the target rationally assesses high synergies when the market is overvalued or it is relatively undervalued and accepts more bids leading to merger waves. Furthermore, the market learns more from watching the takeover market and slowly readjusts prices until they realign with fundamental value. Thus, a simple fully rational model can explain a number of empirical puzzles.

**Almeida, Campello, and Weisbach** propose a theory of corporate liquidity demand and provide new evidence on corporate cash policies. Firms have access to valuable investment opportunities, but potentially cannot fund them with the use of external finance. Firms that are not financially constrained can undertake all positive NPV projects regardless of their cash position, so their cash positions are irrelevant. In contrast, firms facing financial constraints have an optimal cash position determined by the value of today's investments relative to the expected value of future investments. The model predicts that constrained firms will save a positive fraction of incremental cash flows, while unconstrained firms will not. The authors also consider the impact of Jensen (1986) style overinvestment on the model's equilibrium, and derive conditions under which overinvestment affects corporate cash policies. They test the model's implications on a large sample of publicly-traded manufacturing firms over the 1981-2000 period, and find that firms classified as financially constrained save a positive fraction of their cash flows, while firms classified as unconstrained do not. Moreover, constrained firms save a higher fraction of cash inflows during recessions. These results are robust to the use of alternative proxies for financial constraints, and to several changes in the empirical specification. There is also weak evidence consistent with an agency-based model of corporate liquidity.

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## Higher Education

The NBER's Working Group on Higher Education met in Cambridge on November 15. Director Charles T. Clotfelter of Duke University organized the meeting. These papers were discussed:

**John M. de Figueiredo**, NBER and MIT, and **Brian S. Silverman**, University of Toronto, "Academic Earmarks and the Returns to Lobbying" (NBER Working Paper No. 9064)

Discussant: Irwin Feller, Pennsylvania State University

**Michael Rothschild**, NBER and Princeton University, "What Makes American Public Universities Great?"

Discussant: Paul Courant, University of Michigan

**Ronald G. Ehrenberg**, NBER and Cornell University, and **George H. Jakubson** and **Michael J. Rizzo**,

Cornell University, "Who Bears the Growing Cost of Science at Universities?"

Discussant: Paula Stephen, NBER and Georgia State University

**Michael Robinson**, Mount Holyoke College, and **James Monks**, University of Richmond, "Making SAT Scores Optional in Selective College Admissions: A Case Study" Discussant: David Zimmerman, Williams College

**De Figueiredo** and **Silverman** statistically estimate the returns to lobbying by universities for educational earmarks (which now represent 10 percent of federal funding of university research). The returns to lobbying approximate zero for universities not represented by a member of the Senate Appropriations Committee (SAC) or House Appropriations Committee (HAC). However, the average lobbying university with representation on the SAC receives an average return on one dollar of lobbying of \$11-\$17; lobbying universities with representation on the HAC receive \$20-\$36 for each dollar spent. Moreover, lobbying universities with SAC or HAC representation appear to set the marginal benefit of lobbying equal to its marginal cost, although the vast majority of universities with representation on the HAC and SAC do not lobby and thus do not take advantage of their representation in Congress. On average, an estimated 45 percent of universities choose the optimal level of lobbying.

**Rothschild's** paper had three parts: 1) speculation about explanations of the strength of U.S. higher

public education. He identified the following factors: wealth; competition; political acceptance of the differing roles of different public facilities; and diversity of revenue sources. 2) An attempt to explain stylized facts about the relationship between ability, price, cost, and wealth in U.S. higher education with a neoclassical (competitive) model. And 3) a discussion of how to think about the efficiency of sorting and matching in education. Abstract examples illustrate that the technology of teaching can make tracking efficient in some cases and inefficient in others.

**Ehrenberg, Rizzo** and **Jakubson** address the impact of the growing cost of scientific research at universities. What is not well known is that an increasing share of these growing costs are financed out of internal university funds rather than external funds. After providing some data on these costs, including information on the magnitudes of start-up costs in various disciplines, the authors present econometric evidence on the impact of the growing internal costs of science on student/faculty ratios, faculty salaries, and tuition levels at public and private universities. They use data for

over 200 universities spanning the period 1972 to 1998. They find that student/faculty ratios, especially at public research universities, are modestly higher today than they would have been if the increase in university expenditures for research had not occurred. They also show that most universities are not earning large sums from commercialization of their faculty members' research.

Despite heightened scrutiny of the use of standardized tests in college admissions, there has been little public empirical analysis of the effects of an optional SAT score submission policy on college admissions. **Robinson** and **Monks** examine the results of the decision by Mount Holyoke College to make SAT scores optional in the admissions process. They find that students who "under-performed" on the SAT relative to their high school GPA were more likely to withhold their scores; the admissions office rated applicants who withheld their scores more highly than they otherwise would have been rated; and, matriculants who withheld their scores had a lower average GPA than those who submitted their standardized test results.

## International Trade and Investment

The NBER's Program on International Trade and Investment met at the Bureau's California office on December 6-7. Program Director Robert C. Feenstra, University of California, Davis, organized this meeting. The following papers were discussed:

**Gordon H. Hanson**, NBER and University of California, San Diego; **Raymond J. Mataloni, Jr.**, U.S. Bureau of Economic Analysis; and **Matthew J. Slaughter**, NBER and Dartmouth College, "Vertical Specialization in Multinational Firms"

**Deborah L. Swenson**, NBER and University of California, Davis, "Overseas Assembly and Country Sourcing Choices"

**Lee G. Branstetter** and **Raymond Fisman**, NBER and Columbia University, and **Fritz Foley**, University of Michigan, "Will Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U.S. Firm-Level Panel Data"

**Mihir A. Desai**, NBER and Harvard Business School; **Fritz Foley**, University of Michigan; and **James R. Hines, Jr.**, NBER and University of Michigan, "International Joint Ventures and the Boundaries of the Firm" (NBER Working Paper No. 9115)

**Zadia Feliciano** and **Robert E. Lipsey**, NBER and Queens College, "Foreign Entry into U.S.

Manufacturing by Takeovers and the Creation of New Firms"

**Kevin H. O'Rourke**, NBER and Trinity College, and **Jeffrey G. Williamson**, NBER and Harvard University, "From Malthus to Ohlin: Trade, Growth and Distribution Since 1500" (NBER Working Paper No. 8955)

**Brian Copeland**, University of British Columbia, and **Scott Taylor**, NBER and University of Wisconsin, "Trade, Tragedy, and the Commons"

**Gilles Duranton**, London School of Economics, and **Diego Puga**, NBER and University of Toronto, "Microfoundations of Urban Agglomeration Economies"

In recent decades, the growth of overall world trade has been driven largely by the growth of trade in intermediate inputs. This input trade results in part from multinational firms choosing to outsource input processing to their foreign affiliates, thereby creating global production networks in which each actor is vertically specialized. **Hanson**, **Mataloni**, and **Slaughter** use firm-level data on U.S. multinationals to examine trade in intermediate inputs between parent firms and their foreign affiliates. They estimate affiliate demand for imported inputs as a function of host-country trade costs, factor prices, and other variables. They find that affiliate demand for imported inputs for further processing decreases in direct proportion to host-country tariffs, host-country wages for less-skilled labor (both in absolute terms and relative to wages for more-skilled labor), and host-country corporate income tax rates. Consistent with recent theory, these results suggest that vertical specialization within multinational firms rises as trade barriers between countries fall and as factor-price differences between countries widen.

The fragmentation of production has resulted in an increasing degree of vertical specialization across countries. **Swenson** studies one venue that has facilitated growth in U.S. vertical specialization, examining how the cross-country pattern of U.S. overseas assembly responds to changes in country and competitor costs. A number of interesting regularities emerge. Changes in sourcing are influenced not only by changes in import values, but also by a high degree of country entry to and exit from the program. Both developed and developing countries face exit pressures when their own costs rise, or their competitor's costs decline. For those countries that are selected to provide assembly, the value of assembly imports also is influenced by own and competitor costs. In all cases, the estimated cost sensitivity for developing countries is larger than it is for the richer nations of the OECD.

**Branstetter**, **Fisman**, and **Foley** examine the response of U.S. multinational firms to a series of reforms of intellectual property rights (IPR) regimes undertaken by 12 countries over 1982-99. Their results indicate that changes in the IPR regime pro-

duce 8.5 percent increases on average in royalty payment flows to parent firms and 22.8 percent increases for firms that hold more patents than the median firm prior to the reforms. The affiliates of parent companies that had a large number of U.S. patents before reforms experienced larger increases in employment, sales, and profitability than other firms around the time of policy changes. Since there is no evidence of an increase in royalties paid by unaffiliated foreigners, multinationals seem to respond to the IPR regime changes by exploiting their technologies inside the firm. The data on international patent filings suggests that some component of the increased royalty flows represents the transfer of new technologies to the host country; the increased flows do not merely reflect an increase in the price of the flows or greater rent extraction.

**Desai**, **Foley**, and **Hines** analyze what determines partial ownership of the foreign affiliates of U.S. multinational firms and, in particular, why partial ownership has declined markedly over the last 20 years. Whole ownership appears most common when firms: coordinate integrated produc-



tion activities across different locations; transfer technology; and benefit from worldwide tax planning. Since operations and ownership levels are determined jointly, the authors use the liberalization of ownership restrictions by host countries and the imposition of joint venture tax penalties in the U.S. Tax Reform Act of 1986 as a measure of ownership levels. Firms responded to these regulatory and tax changes by expanding the volume of their intrafirm trade as well as the extent of whole ownership; 4 percent greater subsequent sole ownership of affiliates is associated with 3 percent higher intrafirm trade volumes. The implied complementarity of whole ownership and intrafirm trade suggests that reduced costs of coordinating global operations, together with regulatory and tax changes, gave rise to the sharply declining propensity of American firms to organize their foreign operations as joint ventures over the last two decades. The forces of globalization appear to have increased the desire of multinationals to structure many transactions inside firms rather than through exchanges involving other parties.

Using U.S. Bureau of Economic Analysis data for individual foreign acquisitions and new establishments in the United States from 1988 to 1998,

and aggregate data for 1980 to 1998, **Feliciano** and **Lipsey** find that acquisitions and establishment of new firms tend to occur in periods of high U.S. growth and take place mainly in industries in which the investing country has some comparative advantage in exporting. New establishments are largely in industries of U.S. comparative disadvantage, and the relation of U.S. comparative advantage to takeovers is negative, but never significant. High U.S. stock prices, industry profitability, and industry growth discourage takeovers. High U.S. interest rates and high investing country growth and currency values encourage takeovers. Direct investments in acquisitions and new establishments thus tend to flow in the same direction as trade. They originate in countries with comparative advantages in particular industries and flow to industries of U.S. comparative disadvantage.

A recent endogenous growth literature has focused on the transition from a Malthusian world, where real wages were linked to factor endowments, to one where modern growth has broken that link. **O'Rourke** and **Williamson** present evidence on another, related phenomenon: the dramatic reversal in distributional trends — from a steep secular fall to a steep secular rise in wage-land rent ratios — which occurred

some time early in the 19<sup>th</sup> century. What explains this reversal? While it may seem logical to locate the causes in the Industrial Revolutionary forces emphasized by endogenous growth theorists, the authors show that something else mattered just as much: the opening up of the European economy to international trade.

**Copeland** and **Taylor** investigate the conditions under which the market integration of resource-rich countries into the global trading system leads to greater or lesser conservation of natural resources. The authors present a model of common property resources where the strength of property rights varies endogenously with world market conditions. They find that some countries will never be able to develop control over access to their renewable resources, but others will, and increases in resource prices work towards solving the tragedy of the commons. The paper divides the set of resource-rich countries into three categories according to their ability to graduate to tighter resource management, and links these categories to country characteristics, such as resource growth rates, technologies, and the expected lifetime of agents. The authors also consider extensions to allow for political economy elements and government corruption.

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## Market Microstructure

The NBER's Working Group on Market Microstructure met in Cambridge on December 6. Bruce Lehmann, NBER and University of California, San Diego; Andrew Lo, NBER and MIT; Matthew Spiegel, Yale University; and Avaniidhar Subrahmanyam, University of California, Los Angeles, organized this program:

**Bruno Biais** and **Christophe Bisière**, Toulouse University, and **Chester S. Spatt**, Carnegie Mellon University, "Imperfect Competition in Financial Markets: ISLAND vs. NASDAQ"  
Discussant: Stewart Mayhew, University of Georgia

**Sugato Chakravarty**, Purdue University; **Venkatesh Panchapagesan**, Washington University; and **Robert A. Wood**, University of Memphis, "Has Decimalization Hurt Institutional Investors? An Investigation into Trading Costs and Order Routing Practices of Buy-Side Institutions"  
Discussant: Tarun Chordia, Emory University

**Kee H. Chung**, SUNY; **Chairat Chuwonganant**, Purdue University; and **D. Timothy McCormick**, NASDAQ, "Order Preferecing and Market Quality on NASDAQ Before and After Decimalization"  
Discussant: Michael Barclay, NBER and University of Rochester

**Burton Hollifield** and **Robert A. Miller**, Carnegie Mellon University; **Patrik Sandas**, University of Pennsylvania; and **Joshua Slive**, HEC Montreal, "Liquidity Supply and Demand in Limit Order Markets"  
Discussant: Ohad Kadan, Washington University

**Magueye Dia**, Oxford University, and **Sébastien Pouget**, Georgia State University, "Sunshine Trading in West Africa: Liquidity and Price Formation of Infrequently Traded Stocks"  
Discussant: Barbara Ostdiek, Rice University

The Internet technology reduces the cost of transmitting and exchanging information. Electronic Communications Networks (ECNs) — including Island, Archipelago, and Redi — exploit this opportunity, enabling investors to place quotes at very little cost, and compete with incumbent stock exchanges. Does this quasi-free entry situation lead to competitive liquidity supply? **Biais**, **Bisière**, and **Spatt** analyze trades and order book dynamics on the Nasdaq and Island. The Nasdaq Touch — the best price quote available through the NASDAQ market makers' network for a given security at a point in time — frequently is undercut by Island limit orders, using the finer tick size prevailing on that ECN. Before decimalization, the coarse tick size constrained Nasdaq spreads, and undercutting Island limit order traders earned oligopoly rents. After decimalization, the hypothesis that liquidity suppliers do not earn rents cannot be rejected.

**Chakravarty**, **Panchapagesan**, and **Wood** examine the effect of decimalization on institutional investors. Using proprietary data, they find that decimalization has not increased trading costs for institutions. In fact, they find an average decrease of 13 basis points, or roughly \$224 million a

month, in savings of institutional trading costs after moving to decimal trading. As to institutional order-routing practices, the smaller and easier-to-fill orders more often are routed to electronic brokers, while the larger and more-difficult-to-fill orders are sent to traditional brokers. The trading costs of orders routed to electronic and independent research brokers increase, while the costs of trading with full service and soft dollar brokers go down. Interestingly, the authors find less usage of soft dollar brokers, suggesting that decimalization may have altered the incentives of this multi-billion dollar industry. These results survive extensive partitioning of the data and differ in spirit from those reported around the transition of the minimum tick size from eighths to sixteenths. The results are also surprising in light of an oft-repeated complaint among professional traders: that liquidity is hard and expensive to find in a post-decimal trading milieu.

No hard evidence exists on the extent and determinants of order preferencing and its impact on dealer competition and execution quality. **Chung**, **Chuwonganant**, and **McCormick** show that the bid-ask spread (dealer quote aggressiveness) is positively

(negatively) related to the proportion of internalized trades during both the pre- and post- decimalization periods. Although decimal pricing led to lower order preferencing on NASDAQ, the proportion of preferenced trades after decimalization is much higher than what some prior studies had predicted. The authors find that the price impact of preferenced trades is smaller than that of unpreferenced trades and that preferenced orders receive greater (smaller) size (price) improvements than unpreferenced trades.

**Hollifield**, **Miller**, **Sandas**, and **Slive** model a trader's decision to supply liquidity by submitting limit orders, or demand liquidity by submitting market orders, in a limit-order market. The best quotes and the execution probabilities and picking-off risks of limit orders determine the price of immediacy. The price of immediacy and the trader's willingness to pay for it determine the trader's optimal order submission; the trader's willingness to pay for immediacy depends on the trader's valuation for the stock. The authors estimate the execution probabilities and the picking-off risks using a sample from the Vancouver Stock Exchange to compute the price of immediacy. The price of immediacy changes with

market conditions — a trader's optimal order submission changes with market conditions. The authors combine the price of immediacy with the actual order submissions to estimate the unobserved arrival rates of traders and the distribution of the traders' valuations. High realized stock volatility increases the arrival rate of traders and increases the number of value traders arriving — liquidity supply is more competitive after periods of high volatility. An increase in the spread decreases the arrival rate of traders and

decreases the number of value traders arriving — liquidity supply is less competitive when the spread widens.

**Dia and Pouget** study liquidity and price formation in the West-African Bourse. They provide evidence consistent with investors using the preopening period to implement sunshine trading, and prices revealing information before trading actually occurs. They argue that market participants implement order-placement strategies bound to enhance market liquidity. They also underline the role of the preopening

period as a powerful tool for disseminating information regarding both liquidity needs and stock valuation. The authors interpret the empirical results in the framework of a simple theoretical model. For some parameters' value, at equilibrium, market non-anonymity and repeated interaction enable investors to coordinate on trading strategies, improving market quality as it is observed in the West-African Bourse. These findings have implications for global portfolio management and for the design of financial markets.

## Productivity

The NBER's Program on Productivity met in Cambridge on December 6. Bronwyn H. Hall, NBER and University of California, Berkeley, organized this program:

**Bee Yan Aw-Roberts**, Pennsylvania State University; **Mark J. Roberts**, NBER and Pennsylvania State University; and **Tor Winston**, U.S. Department of Justice, "Export Market Participation, Investments in R and D and Worker Training, and the Evolution of Firm Productivity" Discussant: Amil Petrin, NBER and University of Chicago

**Hajime Katayama**, Pennsylvania State University; **Shihua Lu**, Charles River Associates; and **James R. Tybout**, NBER and Pennsylvania State University; "Why Plant-Level Productivity Studies Are Often Misleading, and an Alternative Approach to Inference" Discussant: Marc Melitz, Harvard University

**Barbara M. Fraumeni** and **Sumiye Okubo**, Bureau of Economic Analysis, "R and D in the National Income and Product Accounts: A First Look at Its Effects on GDP" Discussant: Bronwyn H. Hall

**Saul Lach**, NBER and Hebrew University, Jerusalem, and **Mark Schankerman**, London School of Economics, "Incentives, Academic Research, and Licensing" Discussant: Arvids Ziedonis, University of Michigan

**James D. Adams**, NBER and University of Florida; **Grant C. Black** and **Paula E. Stephan**, Georgia State University; and **Roger Clemmons**, University of Florida, "Patterns of Research Collaboration in U.S. Universities, 1981-99" Discussant: Manuel Trajtenberg, NBER and Tel Aviv University

**Aw, Roberts, and Winston** use data for firms in the Taiwanese electronics industry in 1986, 1991, and 1996 to investigate a firm's decision to invest in two sources of knowledge: participation in the export market and investments in R and D and/or worker training. They also assess the effects of these investments on the firm's future total factor productivity. They find that past experience in exporting increases the likelihood that a firm currently exports, but that past experience in R and D and/or worker training does not have lasting effects on a firm's investment decisions. These results are consistent with the belief that exporting is less costly for firms that have

already incurred some necessary sunk costs. In addition, the results indicate that larger firms and more productive firms are more likely to participate in each activity. The findings also suggest that, on average, firms that export but do not invest in R and D and/or worker training have significantly higher future productivity than firms that do not participate in either activity. In addition, firms that export *and* invest in R and D and/or worker training have significantly higher future productivity than firms that only export. These findings are consistent with the hypothesis that export experience is an important source of productivity growth for Taiwanese firms and that

firm investments in R and D and worker training facilitate their ability to benefit from their exposure to the export market.

Applied economists often wish to measure the effects of policy changes (such as trade liberalization) or managerial decisions (for example, how much to spend on R and D) on plant-level productivity patterns. But plant-level data on physical quantities of output, capital, and intermediate inputs are usually unavailable. Therefore, when constructing productivity measures, most analysts proxy these variables with real sales revenues, depreciated capital spending, and real input expenditures. The first objective of **Katayama**,

**Lu, and Tybout** is to show that the resultant productivity indexes have little to do with technical efficiency, product quality, or contributions to social welfare. Nonetheless, they are likely to be correlated with policy shocks and managerial decisions in misleading ways. The authors' second objective is to develop an alternative approach to inference. Applying their methodology to panel data on Colombian pulp and paper plants, the authors then study the relation between their welfare-based measures and conventional productivity measures. They find that conventional productivity measures are correlated positively with producer surplus because they depend positively on mark-ups. But the conventional measures are not related closely to product quality measures and they are nearly orthogonal to consumer surplus measures; from a social welfare standpoint, they are poor characterizations of producer performance. Finally, the authors show that conventional productivity measures imply firms that import their intermediate inputs tend to do worse, while their welfare-based measures suggest they do not.

According to the estimates of **Fraumeni and Okubo**, R and D is a significant contributor to economic growth. Over the 40-year period studied, 1961-2000, returns to R and D capital accounted for 10 percent of growth in real GDP. Treating R and D as an investment raises the national

savings rate by 2 percentage points, from 19 to 21 percent. Their paper is a preliminary and exploratory examination of the role of R and D in the U.S. economy. It extends the National Income and Product Accounts (NIPA) framework by treating R and D as an investment and imputing a net return to general government capital. Capitalizing R and D investment has a small positive effect on the rate of growth of GDP. There is a significant effect on the distribution of consumption and investment on the product-side and the distribution of property-type income and labor income on the income-side. Most importantly, the partial R and D satellite account developed in this paper increases our understanding of the sources of economic growth.

**Lach and Schankerman** study how economic incentives affect university research and licensing outcomes. Using data on inventions, license income, and scientists' royalty shares for 103 U.S. universities, they examine how the cash flow rights from university inventions affect the quantity and value of university inventions. Controlling for other determinants, including university size, quality, and research funding, they find that universities with higher royalty shares produce *fewer* inventions with *higher* average value. Overall, total income from licensing university inventions increases with the royalty share. These incentive effects are much stronger in private than in public universities.

**Adams, Black, Clemmons, and Stephan** explore recent time trends as well as cross-sectional patterns in the size of scientific teams, and in collaboration between scientific institutions. The data derive from 2.4 million scientific papers written in 110 leading U.S. universities over the period 1981-99. The authors' measure of team size is the number of authors on a scientific paper. By this measure, the size of scientific teams increases by 50 percent over the 19-year period. Much of the increase takes place during 1991-5, when the Internet was commercialized rapidly. Cross-sectional patterns indicate that sciences that are intensive in instruments or research assistants employ larger teams, as do top departments that receive large amounts of federal R and D and employ faculty who have received prestigious prizes and awards. There is also evidence of rapid growth in institutional collaboration, especially international collaboration. Since these two factors determine the location of team members, the authors conclude that geographic dispersion of scientific teams has increased over time. Finally collaboration in its different dimensions generally contributes positively to papers and citations received. Since collaboration implies an increase in the division of labor, these results are consistent with the notion that the division of labor increases scientific productivity, consistent with Smith's famous dictum of 1776.

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## Bureau Books

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### Managing Currency Crises in Emerging Markets

*Managing Currency Crises in Emerging Markets*, edited by Michael P. Dooley and Jeffrey A. Frankel, is available from the University of Chicago Press for \$68.00. The twelve papers, comments, and discussions in this volume analyze currency crises in terms of three phases identified in the book's introduction: the initial attempt to defend the currency; the IMF rescue program; and the impact of the crisis and rescue program on the real economy. This volume serves as a companion to *Preventing Currency Crises in Emerging Markets*, a thorough and thought-provoking assessment of recent crises.

Dooley is a Research Associate in the NBER's Program on International Finance and Macroeconomics, which Frankel directs, and a professor of economics at the University of California, Santa Clara. Frankel is the James W. Harpel Professor of Capital Formation and Growth at the John F. Kennedy School of Government at Harvard University.

### Economic and Financial Crises in Emerging Market Economies

*Economic and Financial Crises in Emerging Market Economies*, edited by Martin S. Feldstein, is available from the University of Chicago Press for \$70.00. This NBER Conference Volume draws together the views of senior officials, business leaders, and academic economists. It includes six non-technical papers, each written by a distinguished economist who is a specialist, on the following issues: exchange rate regimes, financial policies, industrial country policies, IMF stabilization programs, IMF structural programs, and creditor relations. The result presents in one volume both the exceptional "briefing" papers and the personal responses of many of the major players and policymakers who have dealt with these difficult problems.

Feldstein is President of the National Bureau of Economic Research and the George F. Baker Professor of Economics at Harvard University.

### Scanner Data and Price Indexes

*Scanner Data and Price Indexes*, NBER Studies in Income and Wealth, Volume 64, edited by Robert C. Feenstra and Matthew D. Shapiro, is available from the University of Chicago Press for \$75.00.

Every time you buy a can of soup, or a new television set, its bar code is scanned to record the price and other information. These "scanner data" offer a number of attractive features for economists and statisticians, because they are collected continuously, are available quickly, and record prices for all items sold, not just a statistical sample. But scanner data also present a number of difficulties for current statistical systems.

This volume assesses both the promise and the challenges of using scanner data to produce economic statistics. Three papers present the results of work in progress at statistical agencies in the United States, United Kingdom, and Canada, including a project at the U.S. Bureau of Labor Statistics to investigate the feasibility of incorporating scanner data into the monthly Consumer Price Index. Other papers demonstrate the enormous potential of using scanner data to test economic theories and estimate the parameters of economic models, and provide solutions for some of the problems that arise when using scanner data, including dealing with missing data.

Feenstra and Shapiro are Research Associates in the NBER's Program in Productivity. Feenstra is a Professor of Economics at the University of California, Davis. Shapiro is a Professor of Economics at the University of Michigan.

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### NBER Working Papers

Paper	Author(s)	Title
9229	James W. Hughes Michael J. Moore Edward A. Snyder	"Napsterizing" Pharmaceuticals: Access, Innovation, and Consumer Welfare
9230	Marc D. Weidenmier Richard C.K. Burdekin	Suppressing Asset Price Inflation: The Confederate Experience, 1861-1865
9231	Charles H. Mullin Ping Wang	The Timing of Childbearing among Heterogeneous Women in Dynamic General Equilibrium
9232	Robert A. Pollak	Gary Becker's Contributions to Family and Household Economics
9233	Christopher M. Meissner	A New World Order: Explaining the Emergence of the Classical Gold Standard
9234	Raquel Fernández Alessandra Fogli Claudia Olivetti	Marrying Your Mom: Preference Transmission and Women's Labor and Education Choices
9235	Laurence Ball	Short-Run Money Demand
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