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FROM THE CEO

Part of the DNA of the Milken Institute is a belief in the power of capital markets to solve urgent social and economic problems. But in the wake of the 2007-08 financial meltdown, voices have been raised around the world asserting that capital markets are rigged and serve the interests of only a few.

Robert Shiller, recently awarded the Nobel Prize for economics, made a different argument in his 2012 book, *Finance and the Good Society* (excerpted in the *Review*'s Second Quarter 2012 issue). "Finance should not be viewed as inherently or exclusively elitist, or as an engine of economic injustice," he wrote. "Finance, despite its flaws and excesses, is a force that potentially can help us create a better, more prosperous and more equitable society. In fact, finance has been central to the rise of prosperous markets economies in the modern age – indeed, this rise would be unimaginable without it."

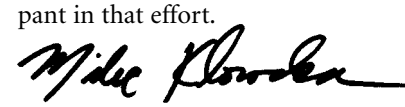
We couldn't agree more – and by no coincidence, an important focus of the Institute's work is exploring ideas and advancing solutions to widen access to capital. That focus can be glimpsed in the range of the Institute's activities, in our convening as well as our research. In the past decade and a half, we've published blueprints for mainstreaming minority businesses by financing "domestic emerging markets," compiled best practices for providing women access to credit and organized Financial Innovation Labs™ on a host of capital access issues. Here are a few examples of our recent work:

• Through our Access to Global Capital initiative, we are working closely with leading multinationals and foreign governments committed to implementing best practices in governance and regulation in order to open up markets and enhance access to global capital.

• Our DC-based Center for Financial Markets is facilitating discussion with international organizations and aid agencies on deepening capital markets in developing economies, with a special focus on integrating the markets in East Africa.

• Last October, the Institute's white paper, *Where Banks Are Few, Payday Lenders Thrive* [see excerpt on page 48], highlighted the abuses of an industry that charges borrowers up to 460 percent interest for payday advances, and provided recommendations for policy makers and mainstream financial institutions to ensure that this market is served at more affordable rates.

In the last half decade, financial markets have recovered dramatically, yet concerns about equity and access remain. In the coming years, one task for policymakers and financial market leaders is to help establish finance as Shiller's force for a better, more prosperous and more equitable society. The Milken Institute will remain an active, engaged participant in that effort.



Michael Klowden, CEO

Obsessively loyal correspondent JG of Passadumkeag, Maine, writes to remind that we allowed the diamond jubilee of the *Milken Institute Review* – the 60th issue – to go uncelebrated. Sorry 'bout that, JG; we were too distracted by Miley Cyrus's contributions to the music scene to give it much thought. But 61 is a pretty cool number, too. According to our resident numerologist, people with the "name number" 61 are good at research but dominating in relationships.

The research part applies to this issue's contents, but not sure about the domination stuff. You'll have to decide.

Larry Fisher, a former business writer for the *New York Times*, explores a technology that is literally sneaking up on us. "When you think about drones," he writes, "you think about death from the sky. But a host of companies are racing to market with unmanned aerial vehicles intended for nonmilitary applications from wildlife tracking to real estate marketing to last-mile package delivery. The size of the market remains a subject of intense speculation. But the technology is flying ahead, far in advance of regulations governing safety and privacy."

Jim Barth, **Priscilla Hamilton** and **Donald Markwardt** of the Milken Institute argue that the sky-high rates paid by the working poor for "payday" loans to tide them over to the next check are symptoms of reversible market failure. "The evidence from pilot programs in which banks do compete directly with payday loan stores suggests that traditional lenders could profit handsomely at far lower interest rates than those charged by the stores," they conclude. "Hence the questions for policymakers: why have banks left ripe fruit to be picked by payday lenders? What could be done to encourage banks to compete for the business?"

Nathan Richardson, a lawyer at Resources for the Future (a DC-based think tank), assuages fears that climate regulation by the EPA will be flat-footed – or worse. "There's every reason to believe that well-designed and, above all, flexible Clean Air Act climate regulation can deliver a lot of emissions cuts for relatively little money and economic disruption," he writes. "There is no other approach to climate policy available today or, given political realities, in the near future, with similar potential."

Yichuan Wang, an economics blogger who is an undergraduate (no misprint) at the University of Michigan, focuses on the underside of China's economic miracle. "Though China has traditionally been marked by regional inequality, the breakneck pace of development has greatly improved living standards across the country and – contrary to received wisdom – has, in recent years, even worked to narrow the gaps," Wang writes. "Yet I would argue that

ongoing unease about inequality is justified: to lock in the gains, the Chinese government needs to take aggressive action to equalize access to social services."

Eric Toder, codirector of the Urban Institute-Brookings Institution Tax Policy Center, plots a tortuous route through the daunting territory of corporate income tax reform. "Tax reform is hardly ever a piece of cake," he writes. "The big question here, though, is why reform of the corporate income levy seems to be an especially daunting project. In my view, the most likely way to break the logjam is to rethink the tax from the basics."

Ed Dolan, an economist who's taught in post-Soviet Estonia and Latvia, ponders why the Baltic states were hit harder by the financial crisis than other European periphery states, but have recovered with alacrity. "Some have chosen to interpret the Baltic experience as a success story for fiscal austerity, as if tax increases and spending cuts were the best cure for economies in a slump," he writes. "I find that hard to support." Dolan's own explanation: a serendipitous mix of location, cultural cohesion and (small) size.

Thomas Healey, a former assistant secretary of the Treasury, describes the other elephant in the room when talk turns to future environmental disasters. "The phrase 'water crisis' has a faraway feel, something that happens on the other side of the world," he writes. "In truth, though, water is in disturbingly short supply in developed countries, too. Think of the western United States and Australia, both of which are in the grips of devastating, decades-old droughts. Unless steps are taken soon to improve the way water is managed, local shortages could cascade into a global catastrophe."

Stan Liebowitz, an economist at the University of Texas' Jindal School of Management, outlines what you need to know about the economics of copyright law. "It has been a matter of debate whether the current law conforms to Constitutional instruction — or more generally, whether the law yields efficient incentives to create and distribute the property in question," he writes. "In fact, the contemporary debate over how best to reconcile the sometimes conflicting goals of copyright regulation is really a modern rendition of a centuries-old argument."

And, of course, there's so much more. In an excerpt from her new book, *The Entrepreneurial State*, Mariana Mazzucato of the University of Sussex blasts the argument that government investment in technology is inherently wasteful. Demographer **Bill Frey** of Brookings offers a glimmer of hope that the trauma of recession is easing, and your humble editor marvels at the ubiquity of cell phones in the world's poorest places. —*Peter Passell*

CHRIS PIZZELLO/INVISION/AP

BY NATHAN RICHARDSON

Listening to veteran environmentalists talk about climate change, you'll often catch a note of despair. Hyper-partisan politics and coal-industry lobbying succeeded in blocking cap-and-trade legislation back in 2010, they say, leaving the United States up a creek without a paddle.

Meanwhile, global containment is stalled – at least in part because the United States isn't providing leadership. Remaining hopes for generating momentum in this country are pinned on the states, some of which, like California, are pursuing relatively ambitious policies in the teeth of national indifference.

Some regulation experts tell a very different, if equally depressing, tale. President Obama's EPA, they say, is attempting an unprecedented power grab by using the venerable Clean Air Act to regulate greenhouse-gas emissions. The irony, they suggest, is that the inefficiency of this allegedly rigid command-and-control approach threatens another Obama administration goal – namely, full recovery from the Great Recession.

Neither view is accurate. Significant climate policy is, in fact, being made today at the federal level, using existing law. But the legal and political limits on executive discretion act as a check on rash, disruptive changes. Moreover, Clean Air Act regulation need not be (indeed, never has been) as rigid as its critics claim.

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But the bang for a buck possible from regulation under the Clean Air Act is very much in doubt. That's why decisions made this year and next – above all, about how much flexibility emitters will have in responding to new mandates and how the country's armada of coal power plants is treated – will be the most significant ones that any president has ever made on climate.

That isn't to suggest that the act could, even in the best of circumstances, serve as the sole vehicle for a satisfactory climate policy over the long haul. Eventually, better means – a carbon tax or a political resurrection of cap-and-trade – will be needed to get the job done efficiently. But in the short term, there's at least an opportunity for substantial and cost-effective emissions containment.

HOW WE GOT HERE

The Clean Air Act, a bipartisan response to public concerns about air pollution, was passed in 1970 and, with the help of subsequent amendments and a lot of rule-making, has served as a cornerstone of American environmental law. It has led to vast improvements in air quality and public health, making it one of the most popular and successful statutes of any kind. Moreover, the broad wording

of the act has allowed the EPA to adapt to evolving scientific understanding of environmental threats and, to some extent, to evolving economic understanding of the advantages of market-based regulation.

To be sure, the law is far from perfect. It is exceedingly complex, incorporating a diverse range of programs aimed at taming different pollutants and emission sources. These programs sometimes do not work smoothly together, and legal uncertainty surrounding them has led to costly and time-consuming litigation over every key initiative under the statute. Equally to the point, it's plain that the EPA has made errors, some of them serious. But benefits to public health – and to the economy – from Clean Air Act regulation have clearly exceeded their costs, often by a wide margin.

The notion of applying the statute's regulatory tools to greenhouse gases is not new. It was first considered at the highest levels in the waning days of the Clinton administration, and was pushed by a handful of environmentalists long before that. The George W. Bush administration jettisoned the idea, arguing that carbon dioxide was not a "pollutant" in the sense envisioned by the statute, and therefore could not be regulated under it. (The Bush EPA did, however, make other valuable contributions to the evolution of Clean Air Act policy, as will become apparent later.)

In 2007, by a 5-4 vote, the Supreme Court rejected the not-a-pollutant argument *Massachusetts v. EPA*, arguably the most significant environmental-law decision of the past two decades. The court ruled that greenhouse gases are, indeed, pollutants for Clean Air Act purposes and that the EPA is thus obligated to determine whether they are a threat to public health or offer a good reason for not doing so. Such an "endangerment finding" would trigger regulation – initially of motor vehicles, but eventually of other sources as well.

Many EPA critics still try to reargue this case outside the courtroom, claiming (correctly) that Congress never envisioned the Clean Air Act being applied to climate change when it was passed, and (incorrectly) that this implies the statute should not be used for the purpose. While it's true Congress didn't foresee the statute being used to address emissions-driven climate change in the 1970s (or even when the act was last amended in 1990), it did expect change: the law does not just allow EPA to consider new environmental threats, but requires it to do so. In any case, *Massachusetts* is settled law, and the Supreme Court has repeatedly refused to reopen it. The Clean Air Act is therefore the nation's climate policy vehicle until Congress constrains or replaces it, or a very differently composed Supreme Court chooses to reverse itself.

The Bush administration made halting steps toward climate regulation before the 2008 election, including a darkly comic episode in which White House officials refused to open an email from the EPA containing proposed regulations. Instead, the administration punted, releasing an "Advance Notice of Proposed Rulemaking" – Washington-speak for "not now, maybe later." After the 2008 election, though, the Obama EPA brought the act to bear on carbon emitters, albeit in measured fashion. It made a formal endangerment finding in late 2009, then moved in 2010 and again in 2012 to sharply increase fuel-economy standards for the country's future fleet of road vehicles.

While vehicle-emissions standards are not the most cost-effective tool – because, among other reasons, better fuel economy encourages people to drive more, partly offsetting the emissions savings – they are broadly popular and will reduce emissions by a significant

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amount. Other rules require new factories and power plants ("stationary sources," in Clean Air Act parlance) to use the best emissions-reducing technology available when they are built, though this requirement is currently under legal challenge in a case that has reached the Supreme Court.

Most recently, EPA proposed rules that would require all new power plants to meet standards that only natural gas plants (or coal plants incorporating unproven and currently very expensive carbon-capture technology) can meet. Thus, if adopted, this rule would effectively ban new coal plants – which seems like a tectonic change until you realize that few new coal plants are being built, or even contemplated. Low natural gas prices and other environmental regulations aimed at reducing the multiple harmful health effects associated with burning coal simply make building new coal plants economically unattractive today.

For the most part, this EPA action happened quietly; while not secret, it received relatively little media coverage. Climate policy efforts in Congress received much more attention. The 2009 cap-and-trade initiative, culminating in the Waxman-Markey bill, which passed the House but failed in the Senate in 2010, is widely viewed as the high-water mark of climate policy in the United States.

With many conservatives demonizing what had begun as a bipartisan effort, cap-and-trade was banished to the political desert. An underreported aspect of the cap-and-trade bill, however, is that it would have stripped much of EPA's authority to regulate greenhouse gases under the Clean Air Act, leaving the EPA discretion only to set standards for vehicles. Since then, there have been sporadic efforts to peel away EPA's authority over climate policy without providing a substitute mechanism, but these are doomed – at least under this president.

WHAT NOW?

Congress's failure to regulate greenhouse emissions or to bar the EPA from regulating them means that the Clean Air Act is the only viable instrument for making federal climate policy. The EPA is not, of course, immune to politics, as it works under the direction of the president. Indeed, EPA rule-making slowed dramatically in 2012, since the White House wanted to avoid controversy in an election year. The agency only resumed public moves in the wake of a June 2013 speech by President Obama in which he specifically committed EPA to the next phase of its climate program: performance standards for existing (rather than new) fossil fuel power plants. Those rules will be fleshed out this summer, with states and EPA working together on final standards over the next two years.

It makes sense to write performance standards for the electric power industry first. Electricity generation accounts for a larger share of U.S. emissions (about 40 percent) than any other sector. Moreover, unlike trans-

portation, where the average vehicle's shelf life is 10 to 20 years, power plants last a very long time. That means that emissions cuts from existing sources are critical if emissions are to decline in the short-to-medium term – which most climate scientists agree is necessary in order to prevent dangerous climate change. Then, too, most analysts believe the lowest-cost significant emissions reduction opportunities lie in the electric power sector.

That means that the coming existing-source standards are not just the keystone of EPA's Clean Air Act agenda, but of the nation's near-term climate policy. The decisions made by the administration – and the states, which will play a major role – will determine whether the country can make substantial progress in cutting carbon emissions, and, if so, at what cost.

It's not an oversimplification to say that this is ultimately a story about coal, and coal alone. There are two reasons: coal is exceptionally dirty in terms of greenhouse emissions, and the United States burns a lot of it. In 2012, coal accounted for about 74 percent of emissions from the power sector, but only 37 percent of electricity generation. There may well be ways to improve efficiency at coal plants through a variety of technical fixes, perhaps enough to achieve a five percent cut in emissions. That's important, but not sufficient to make a serious dent in the country's total emissions. To do more, regulation would have to encourage shifts to cleaner fuel – most notably natural gas – or encourage energy efficiency at the user end.

A major shift away from coal is already underway in the United States. Coal's current 37 percent share in power generation is down from 49 percent just five years ago. A bit of that is due to rapid expansion of wind-generation capacity. But the lion's share is explained by shifts to natural gas – often in plants that can switch back and forth between coal and gas.

That shift has been driven by the sharp decline in gas prices (largely a result of the fracking boom) and by environmental regulations aimed at curbing other pollutants associated with coal, including mercury and smog-generating sulfur and nitrogen oxides. This "coal-gas margin" therefore appears quite fragile: further regulatory pressure would likely lead to additional movement away from coal and toward gas – at least if gas prices do not increase

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significantly – and, to a lesser extent, toward renewable sources like solar and wind power.

In any event, many argue that the cheapest source of emissions cuts from the power sector lie elsewhere, in using electricity more efficiently. The magnitude of the opportunity is a matter of debate, as is the ability of incentives to convince consumers to use technologies that are cost-effective, without further inducement. But surely, some is ripe fruit left to be harvested.

THOSE DEVILISH DETAILS

For regulation to take advantage of the ostensibly low-cost opportunities for emissions reduction – the coal/gas margin and energy efficiency – it must be flexible. Traditional command-and-control regulation (for example, use this fuel or that technology) cannot do the job well. President Obama recognized this, calling specifically for flexible regulation in his speech last June.

EPA's critics are quick to claim that the Clean Air Act is not up to the task, that it is a regulatory dinosaur unable to adapt to new challenges.

As with dinosaurs, however, this reputation is undeserved. While it is possible to find examples of inefficient and ill-designed Clean Air Act programs, the largest and most important have been very successful by most any definition. Benefits have usually greatly exceeded costs, and – particularly since the act was amended in 1990 – programs have been relatively flexible, allowing various forms of trading in which emitters can either cut their own emissions where it is cost-effective or pay others to cut theirs.

The design of greenhouse-gas standards for existing sources is likely to continue this trend, and may in fact prove to be the most flexible Clean Air Act program to date. There are a few reasons for this.

First, the part of the Clean Air Act on which standards depend, Section 111(d), is relatively short and, unlike other parts of the act, leaves much room for interpretation and discretion. It has only very rarely been used, so there is almost no legal precedent, and it is impossible to draw firm conclusions about it.

Courts will ultimately decide what its limits are. However, almost all legal experts agree that there is at least some room for flexible regulation, including regulation of emissions trading. In fact, the best arguments in favor of such an interpretation were made by the Bush EPA in 2005, when it attempted to use that part of the act to create a nationwide cap-and-trade program for mercury emissions. While that effort was rejected by the courts, they ruled on unrelated grounds; the underlying legal case for flexibility is alive and well. EPA will not again attempt to create a nationwide cap-and-trade program, largely for political reasons. But more modest approaches that include some form of trading are likely.

Second, states will play a key role, and individual ones will no doubt diverge in their regulatory approaches. This variation allows the structure of the policy to be sensitive to local conditions and to factor in the impact of actions that the states have already taken, like California's cap-and-trade program or, perhaps, the renewable-performance standards in place in many states.

Third, this part of the act specifically allows consideration of the cost side of the equation. Many other Clean Air Act programs require regulations to target specific environmental goals, regardless of cost. Here, EPA and the states can design regulations that weigh costs against benefits. Reducing costs per unit of emissions reductions, as flexible regulation can do, in effect makes the pie bigger; you can get more emissions cuts for the same cost, or the same emissions cuts at a lower cost.

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Of course, deciding the balance between the gains from flexibility between greater emissions reductions and lower compliance costs is tricky, and will undoubtedly be the source of controversy. But critics' claims that EPA regulation will be excessively costly and cause great damage to the economy simply aren't credible.

Even fears that regulation will impose excessive costs on a few small players, like operators of old, small coal plants, are unlikely to be borne out. The act allows states to consider the "remaining useful life" of plants above and beyond the overall costs of the program. While carve-outs for such special cases are likely to make programs less cost-effective overall, they may be justified as a matter of equity or political expediency.

Flexibility has a dramatic impact on cost-effectiveness. A study by Resources for the Future found that, in a relatively simple trading scheme, allowing trading between coal and gas plants could achieve emissions reductions similar to those a policy targeting coal alone could achieve at about 30 percent lower overall cost, or could manage more than triple the emissions reductions at a similar marginal cost. Moreover, allowing such trading would substantially increase overall environmental benefits once reductions in other pollutants from coal are taken into account. These differences are driven by the ability of a trading program to access the low-cost, high-reward opportunities at the coal-gas margin.

Also, the Natural Resources Defense Council, a nonprofit environmental group, estimates that allowing plants to get credit for energy efficiency programs downstream could achieve a 26 percent reduction in emissions from the power sector by 2020 (relative to 2005 levels), generating $26 billion to $60 billion in benefits, at a cost of just $4 billion. These numbers depend, of course, on the underlying energy efficiency programs – for example, utility subsidies for replacing incandescent bulbs with LEDs. If these programs are deemed to be legally incompatible with the act or are not as effective or cheap as the analysis assumes, then reductions will have to come from elsewhere, and may be more costly.

GETTING FROM HERE TO THERE

Just before climate talks in Copenhagen in 2009, President Obama set a goal of a 17 percent reduction in U.S. emissions by 2020, relative to 2005. Even without significant policy moves, the country has made some progress toward that objective, thanks to lower natural gas prices, energy efficiency gains and slow recovery from the recession. EPA's tighter vehicle fuel economy standards will also make a modest contribution as the fleet turns over. Emissions cuts from existing fossil-fuel power plants could yield most or all of the remaining reductions necessary to meet the 17 percent target – but only if the regulations are flexible enough to drive a lot of fuel-switching or end-user energy efficiency at relatively low cost.

The Clean Air Act therefore should make it possible to achieve the country's short- to medium-term climate-policy goals, even in the absence of new legislation. There will certainly be obstacles: important parts of the act are untested legally and litigation over new rules is certain. But an overabundance of caution on the part of the EPA would lead to inflexible, unambitious programs that achieved little. And while lawsuits will be costly, they are unlikely to delay implementation, since courts rarely stay regulations during litigation.

The states' role here is also crucial. Some of them will likely strengthen their existing climate policies, create new ones, or join existing emissions-trading blocs like the Regional Greenhouse Gas Initiative in the Northeast.

But others – those in the thrall of coal interests or simply inclined to deny climate change – will use litigation and stalling tactics to avoid action. And at this point, it's hard to say how effective they will be in undermining the national climate-change policy.

Looking past 2020, the Clean Air Act will become a less-effective tool. Relatively obvious low-cost opportunities for emissions reduction, like shifting from coal to gas and, possibly, energy-efficiency investments, will be tapped out. Only less obvious opportunities, often opened by new technologies, will remain. Clean Air Act regulators are not well equipped to keep pace with these changes, and the law makes it difficult or impossible to create market-trading programs that bridge sectors and harness the power of markets to identify them. Moving the country away from fossil energy and toward renewables, which will eventually become necessary, will also be difficult or impossible without new policy tools.

Note, moreover, that Clean Air Act programs cannot generate revenue, at least at the federal level, making it impossible to provide funding to clean-energy R&D or subsidies for energy infrastructure like fueling stations for electric vehicles, or to use climate policy to play a role in addressing the nation's larger fiscal issues, as advocates claim a carbon tax could. Over the long term, then, a market-based approach in the form of a carbon tax or cap-and-trade program is the only realistic way to make the transition to a low-carbon environment compatible with ongoing economic growth – though it is worth keeping in mind that interest-group politics would almost certainly guarantee that such a policy would not live up to economists' blackboard ideals.

Indeed, the stalemate over climate legislation has ironically left us with a way to contain greenhouse gases that has some advantages over new law, at least for the time being. For example, if program costs are lower than expected and climate risks more severe, emissions standards could be tightened. Try that with a policy made by 535 legislators who spend more time raising campaign funds than contemplating public policy.

Using the Clean Air Act for climate policy will not destroy the American economy, and if, over time, it destroys the American coal industry, it will not have acted alone.

But back to the present and the near future. Even if it is designed poorly or undermined by litigation, climate regulation under the Clean Air Act cannot be the costly disaster predicted by its critics. Using the Clean Air Act for climate policy will not destroy the American economy, and if, over time, it destroys the American coal industry, it will not have acted alone. Cheap natural gas and environmental regulation that has nothing to do with climate (and that carries large health benefits) have already dealt coal a serious, and possibly mortal, blow.

On the contrary, there's every reason to believe that well-designed and, above all, flexible Clean Air Act climate regulation can deliver a lot of emissions cuts for relatively little money and economic disruption. The president's ambitious emissions goals and his call for flexibility, along with the important role for the states, warrant optimism about smart policy design. There is no other approach to climate policy available today or, given political realities, in the near future, with similar potential.

BY WILLIAM H. FREY

Still reeling from employment insecurity and a fragile housing market five years after the crash, most Americans want to know when the nightmare will end. Happily, new data from the U.S. Census suggest modest cause for optimism.

According to the latest American Community Survey, some indicators of socioeconomic misery have bottomed out and some seem to be turning around. Take, for example, the poverty rate. While the nominal rate doesn't tell us a lot – the definition of poverty is elusive – changes in the official rate do, and here the numbers have flattened after years of increases. By the same token, the steady declines in income and house values have slowed.

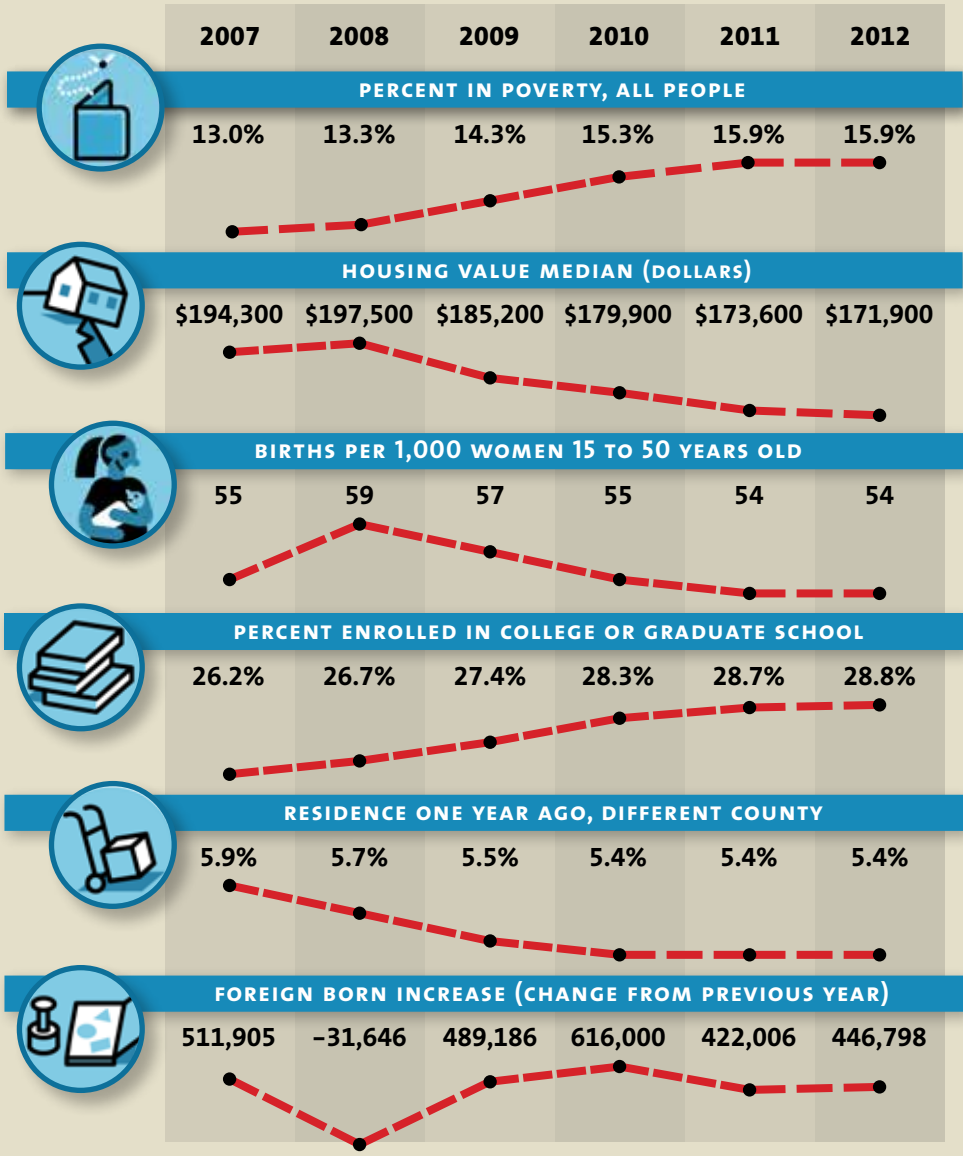
But just as important as these money-related indicators are evidence of a bottoming-out of demographic indicators that reflect perceptions of affluence and security. Fertility rates are holding steady after four years of decline, while the number of people seeking shelter with relatives is no longer growing. And the uptick in school enrollment, seemingly as an alternative to finding a job, has slowed at the same time that the pace of labor force withdrawals has slowed.

Migration, at least across counties and states, is no longer declining. Moreover, in the last year there has been a rise in the foreign-born population, reflecting a draw from Asia despite a continued out-migration to Mexico.

This is definitely a glass less than half full. Poverty among single-parent households is still on the uptick, while homeownership and local mobility are still on a downward path. But there is at least some hope that the aftershocks of the Great Recession are petering out.

BILL FREY is a demographer who serves as senior fellow at both the Milken Institute and the Brookings Institution.

CHANGES IN ECONOMIC AND DEMOGRAPHIC INDICATORS, 2007–12



SOURCE: 2007–2012 American Community Survey and Pew Research Center Estimates for 2009–10

CHI BIRMINGHAM

Corporate Income Tax Reform . . .

Dreaming On

BY ERIC TODER

President Obama and the House Republican leadership agree on little. But on one point, they do seem in accord: the corporate income tax needs to be fixed. Indeed, pretty much no one, inside the Beltway or out, is happy with the current state of affairs.

Chief executives and policy economists alike complain that the high corporate tax rate (35 percent) and the rules for taxing the foreign-source income of U.S. companies discourage investment in the United States and place U.S.-based multinationals at a disadvantage with competitors based overseas. On the other side of the coin, pundits and members of Congress are inclined to react with high dudgeon to the reality that some highly profitable U.S. corporations, including icons of the digital age like Apple and Google, use sophisticated planning techniques to shift reported profits to foreign tax havens.

Politicians of both parties favor closing loopholes – tellingly, with little detail on which ones – to offset the revenue losses from lowering the top corporate tax rate. The latest House Budget Resolution calls for a reduction in the top rate from 35 to 25 percent and changes that would exempt the foreign profits of U.S. corporations from federal tax. President Obama wants a slightly more modest reduction, to a 28 percent rate, and would set a minimum tax on repatriated foreign profits of U.S. multinationals.

But neither side has credibly specified how it would pay for these rate cuts. Obama would scale back some tax breaks – but wouldn't come close to paying for the proposed rate cut. The House Republicans, for their part, have not identified a single preference they would remove.

Tax reform is hardly ever a piece of cake. The big question here, though, is why reform of the corporate income levy seems to be an especially daunting project. In my view, the most likely way to break the logjam is to rethink the tax from the basics.

JUST THE FACTS

The corporate income tax is imposed on the profits of all corporations with permanent business establishments in the United States and on the worldwide profits of U.S.-resident corporations. Profits are defined as revenue less deductions for wages, payments for other inputs like raw materials, interest on debt and depreciation of capital assets. Corporations may not deduct dividends paid to shareholders from taxable income. Thus, since recipients pay income taxes on their dividends – albeit at preferred rates – the total tax burden on corporate profits includes more than just the corporate tax.

"Your Honor, my client would like to be tried offshore."

Without the corporate tax, sheets of the corporations

Almost all profits are taxed at the top federal rate of 35 percent. States impose additional taxes averaging about 6.3 percent, though some are as high as 9 percent. Combining state and federal taxes, and accounting for deductibility of state taxes from federal income, the top average rate is 39.1 percent – the highest corporate tax rate among advanced industrial countries in the OECD.

The Congressional Budget Office projects that the federal corporate income tax will raise about $4.8 trillion over the next decade, which amounts to 12 percent of all federal receipts and slightly over 2 percent of GDP. That's a lot of money: the corporate income tax is the third-largest source of federal receipts. But the revenue is far less than the proceeds from the individual income tax and the payroll taxes that fund Social Security and Medicare.

Actually, corporate receipts used to constitute a much larger share of tax revenue. Between the 1950s and 1980s they plummeted from about 5 percent to less than 2 percent, mostly because of increases in legislated corporate tax preferences, increased debt financing by corporations (interest is deductible from taxable profits) and growth in foreign investments. The Tax Reform Act of 1986 reduced the top corporate rate from 46 to 34 percent (since raised to 35 percent), but increased revenues by curtailing the investment tax credit, lengthening depreciation periods and enacting various accounting changes that delayed deductions. Since the 1980s, receipts

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from the tax have varied with the business cycle, but have averaged about 2 percent of GDP.

Why tax corporations at all? Corporations, whatever the Supreme Court says, are not really people. They are enterprises that employ workers, raise funds from shareholders and creditors, and provide goods and services to consumers. All corporate taxes must ultimately be borne by these stakeholders, in the form of lower investment returns, lower wages or higher prices for goods and services. Why not tax these stakeholders directly?

That is not a purely hypothetical question. Enterprises that account for over half of business receipts and taxable profits in the United States are not taxed as corporations. Their profits are allocated directly to their owners, who include them in the income they report to the IRS on their personal income tax returns. While these business owners, like other individual taxpayers, benefit from a number of preferences in the law, they are taxed on their income in the same way individual workers and investors are.

The share of U.S. businesses that calculate their taxes as part of their owners' personal returns has increased dramatically in the past 30 years. The main factors driving this increase have been the cut in the top individual income tax rates (from 70 percent as recently as 1980 to less than 40 percent today) and tax law changes that enable businesses to benefit from the limited liability status that corporations have without paying corporate income tax.

The two main vehicles that businesses use to achieve this end are subchapter S corporations and limited liability companies. Limits on companies that qualify for S-corporation status have been relaxed over time. And since 1997 Treasury regulations (the so-called check-the-box rules) have made it easy for most companies to choose limited liability company status. Today, only publicly traded companies must still be organized as taxable corporations.

So again: why not tax all businesses this way? The key reason is a practical one. Taxing income from profits at the source eliminates the problem of how to allocate the tax liability for profits among thousands or millions of shareholders who trade stocks frequently within the year. Note, too, that without the corporate tax, shareholders would be able to defer taxable income indefinitely by keeping it on the balance sheets of the corporations – in effect, converting the entire corporate sector into a giant tax shelter.

shareholders would be able to defer taxable income indefinitely by keeping it on the balance — in effect, converting the entire corporate sector into a giant tax shelter.

Nonetheless, there is widespread recognition that the tax is imperfect. It imposes higher overall tax burdens on businesses organized as taxable corporations than on flow-through companies, because corporate shareholders pay tax both at the corporate level and again at the individual level when dividends are paid or when retained earnings contribute to capital gains on sales of stock. The tax favors debt financing over equity because the latter bears both the corporate and individual levels of tax. And it encourages corporations to retain profits (instead of paying dividends) by allowing individuals to defer individual income taxes on the resulting gains until they sell their shares.

IT'S A BIG, BIG WORLD

Most of the revenue from the U.S. corporate income tax comes from large multinational

corporations. Since the 1980s, the world economy has become increasingly globalized, dispersing the assets and employees of typical large multinationals over dozens of countries. Multinationals raise funds for their investments in global capital markets and provide goods and services to consumers throughout the world. And U.S.-based companies must compete with foreign-based ones in both American and foreign markets.

For purposes of taxation, corporate income can be classified by *source* (where the goods and services are produced) or by *residence* (where the corporation is based). The United States taxes the corporate income of all permanent establishments within its borders, whether controlled by U.S. or foreign-based corporations. (An example of the latter would be a Toyota plant in Tennessee.) The United States has no jurisdiction over the income of foreign-based corporations that comes from investments outside the United States.

	U.S.-SOURCE INCOME	FOREIGN-SOURCE INCOME
U.S.-RESIDENT MNCs	Taxable under U.S. corporate income tax	Taxable under U.S. corporate income tax when repatriated with credit for foreign income taxes
FOREIGN-RESIDENT MNCs	Taxable under U.S. corporate income tax	Not subject to U.S. corporate income tax

U.S. companies operating in other countries typically organize these entities as foreign subsidiaries – in tax jargon, controlled foreign corporations. If the local government where the investment is made and the home government where the corporate group is based both taxed the income of controlled foreign corporations, foreign investments would bear a heavier tax than domestic investments and international capital flows would be discouraged. To prevent that, countries (either unilaterally, or through bilateral agreements) use one of two methods to avoid double taxation. Under a *worldwide* system, a country taxes the foreign income of its multinational corporations annually at the home-country's corporate rate, but allows its multinationals to claim a credit for foreign income taxes paid. This subjects all corporate income to at least the home-country tax rate. Under a *territorial* system, a country exempts the foreign-source income of its multinational corporations. This subjects domestic-source income to the home country tax rate and foreign-source income to the tax rates in the jurisdiction in which they are generated.

The current U.S. system is a compromise between the pure worldwide and pure territorial methods. Active income accrued within foreign affiliates of a U.S. company benefits from a provision known as deferral. Under deferral, foreign-source income of U.S. multinational corporations is subject to local income taxes, but incurs no U.S. corporate income tax liability until the income is repatriated in the form of dividends to the U.S. parent company. Upon repatriation, the U.S. parent is taxed on the dividend plus the amount of the associated foreign income tax, but receives a credit for foreign income taxes paid. In general, this means that the income from foreign investments of U.S. corporations is subject to the U.S. tax rate when repatriated as a dividend to the U.S. parent, but, thanks to deferral, there is no current U.S. tax on the income that is retained in the controlled foreign corporation.

It isn't quite that simple. Foreign tax credits are limited in order to prevent U.S. companies from claiming credits in excess of the U.S. corporate tax rate. Other provisions limit erosion of the domestic tax base by taxing certain forms of passive and easily shiftable income of U.S.-controlled foreign corpora-

"When I think of the as yet undreamed-of loopholes that are going to be available to you guys!"

WILLIAM HAMILTON/THE NEW YORKER COLLECTION/WWW.CARTOONBANK.COM

tions in the year they are accrued. That is, passive income such as interest earnings on bank deposits is not eligible for deferral. Other countries impose similar sorts of rules to prevent avoidance.

WHAT'S NOT TO LOVE?

The corporate income tax provides an important backstop for the individual income tax base. And it has the added virtue of being a progressive tax because much of the burden falls on income that is concentrated among the highest-income individuals. But the tax has numerous problems:

• It encourages corporations to use debt instead of equity financing, distorting the allocation of capital and increasing the risks of bankruptcy.

• It favors businesses taxed as flow-through enterprises over taxable corporations. The result is too little investment in the corporate sector relative to sectors like real estate, where flow-through enterprises dominate.

• It contains numerous targeted tax preferences. Some of them, like the research credit, may be justified as a way to encourage activities with broader social benefits. But in general, tax preferences lead to resource misallocation, undermining productivity.

• The high U.S. tax rate favors foreign investment over domestic, and encourages multinational corporations to shift profits to other jurisdictions. Although various tax preferences make the average effective rate on corporate investments lower than the statutory rate, the United States still has a high effective rate compared with the OECD average.

• The U.S. tax on repatriated income encourages U.S. multinationals to keep their funds overseas instead of paying dividends to U.S. shareholders – and, some argue, places U.S. multinationals at a disadvantage compared with foreign-based ones. In recent years, other countries, notably Britain and Japan,

have shifted to territorial systems that exempt profits repatriated by their own multinational corporations.

• The combination of deferral and rules that determine how income and expenses are allocated among countries has enabled many profitable U.S. multinationals to avoid a lot of tax liability. These opportunities are especially large for U.S. companies with intangible income – royalties on patents, for example – that are able to shift reported income to low-tax countries like Ireland or to tax havens like the Cayman Islands or Bermuda. Over the past decade, the reported foreign profits of U.S. multinationals have grown much faster than other measures of their foreign activity (like employment and sales), suggesting that much of this growth comes from aggressive tax planning.

Thus, the tax distorts investment choices, discourages investment in the United States and damages the competitiveness of U.S. multinationals while at the same time allowing some large and profitable U.S. multinationals to pay very little tax on their worldwide income. No wonder most everyone favors reform, at least in the abstract.

BUT WHAT SORT?

One set of proposals would reduce the corporate rate and make up the revenue loss by reducing or eliminating tax preferences like favorable depreciation rules for equipment and for oil and gas drilling. A second set of proposals would switch to a territorial system by removing the tax on repatriated profits of controlled foreign corporations and accompany the tax break with provisions that would reduce tax avoidance through income-shifting to tax havens. In my view, while either approach could improve the efficiency and equity of the tax code, they would both fail to address problems that can only be fixed with more fundamental reforms.

Scrapping tax preferences would, indeed, address an old and familiar problem in tax policy: with time, tax systems become riddled with special tax breaks. This gradual erosion of the tax base is not hard to explain. Many of these tax breaks cost little, taken one by one, but are worth a lot to specific constituencies. Thus, the many who would gain a little bit each by removal of a preference can't overcome the focused interests of the few who would lose a lot if the tax break were eliminated.

By this logic, the only way to enact reform is to take on many special tax preferences at once in order to pay for a big enough cut in rates to garner broader support. That is what happened in 1986, when reform advocates were able to win over an influential group of corporations that found the prospect of a large rate cut more attractive than the loss they would suffer in terms of narrowly targeted benefits.

The problem with repeating the 1986 experience today is that there simply is not enough revenue to be gained by attacking vulnerable tax breaks to pay for the rate cuts that both the House Budget Committee and President Obama are promising. Most of the real money is in two provisions – deferral of active income of controlled foreign corporations and accelerated depreciation of machinery and equipment. But repealing these provisions would raise major substantive and political issues.

Note that the revenue gained by repealing deferral would be much less than the current tax expenditure if the corporate rate were lowered in the bargain. That's because the cost of deferral depends on the difference between the U.S. and foreign rates, not the U.S. rate alone. So if, for example, the United States dropped its rate from 35 to 25 percent, repealing deferral would raise no revenue from tax-

ation of foreign income already subject to a 25 percent (or higher) foreign income tax.

Moreover, repealing deferral would make the United States the only country that taxed its multinationals on a current basis on their worldwide income, placing U.S.-based firms at a major competitive disadvantage with firms based in other countries. For this reason, it is a political nonstarter, with the discussion today focusing on moving in the opposite direction by exempting taxation of foreign-source income.

Repealing accelerated depreciation would raise effective tax rates on new investments in manufacturing equipment in the United States. That would likely generate substantial political resistance. It is counter to the policy of the Obama administration, which has used accelerated deductions as an antirecession policy. And while it would reduce a current bias that favors investment in equipment over structures, it would increase the bias favoring the development of intangible property (deducted immediately), over investment in machinery.

Another concern with the traditional tax reform approach of trading off a lower corporate rate for base-broadening is that it would raise effective tax rates for flow-through enterprises unless also accompanied by a cut in individual income tax rates. And lowering the corporate rate below the individual rate could generate opportunities for high-income individual investors to use corporations as tax shelters. This point highlights the difficulties of reforming the corporate income tax alone without addressing interactions with the individual income tax system.

So, yes, eliminating some tax breaks and using the revenue to pay for reducing the corporate tax rate would be good policy. But it wouldn't pay for the types of rate cuts that politicians are promising.

The other approach would follow the examples of our major trade partners, adopting what is called a territorial tax system, by exempting dividends paid to U.S. corporations by their foreign affiliates. Germany and

"A word to the wise. When the gods speak, they'd better say 'across-the-board tax cut.'"

LEE LORENZ/THE NEW YORKER COLLECTION/WWW.CARTOONBANK.COM

France have had dividend-exemption systems for years. Canada exempts dividends from foreign affiliates based in countries with which they have a tax treaty, and have effectively moved towards universal exemption as their network of treaty partners has expanded. Britain and Japan have also recently enacted dividend-exemption systems, leaving the United State as one of the few holdouts.

"You're kidding. You still pay taxes? It's a nostalgia thing? Right?"

Still, no system is purely territorial in the sense of exempting all foreign-source income from tax. Most countries have rules similar to the U.S. provisions, taxing some forms of passive income of controlled foreign corporations on a current basis. Others have rules to limit income-shifting through restrictions on the use of debt finance (so-called thin-capitalization rules) and rules for allocating fixed costs. Still others impose minimum taxes on income from tax havens.

The tax-writing committees under Representative Dave Camp (R-Mich.) and Senator Max Baucus (D-Mont.) are well aware of these concerns. Any proposal for a territorial system would have to include tighter rules to prevent income-shifting to low-tax countries. It would also have to address the question of how to tax the $2 trillion in profits that are currently parked overseas. Given the widely differing positions of multinational corporations, it would be difficult to develop a consensus in the corporate community, let alone the backing of interest groups that don't want to see corporate tax liability reduced.

It's worth keeping an eye on the prize, though. There would be substantial net economic benefits from a reform that kept the overall tax burden on corporate foreign-source income unchanged while taxing more income on an accrual basis and less when repatriated. The repatriation tax is a very inefficient way of raising money, because it generates little revenue for Washington relative to the costs it imposes on multinational corporations. But the reform would still leave open the question of the ideal effective tax rate to impose on foreign-source income of U.S. multinationals.

BACK TO BASICS

None of these proposals address the fundamental conundrum of the modern corporate tax in a globally integrated economy: without international cooperation, the competition between countries to attract corporate investment, capture a larger share of the reported corporate income and assist their home-based multinational corporations could lead

to a race to the bottom and an erosion of corporate taxes worldwide.

Residence-based taxation would prevent U.S. multinationals from shifting profits to low-tax jurisdictions, because their income would be taxable at the same rate wherever it comes from. But it would place U.S. multinationals at a competitive disadvantage relative to corporations resident in countries that do not tax current foreign-source income. Source-based taxation would equalize the treatment under the U.S. income tax, but would increase the incentives for U.S. multinationals to invest overseas and to report more of their income in low-tax jurisdictions.

Beyond this trade-off, neither the source nor residence definitions have much real economic meaning today. Because of this, where multinational corporations report the source of profits and where they choose to reside is increasingly responsive to tax differentials.

On the sources side, the problem is the increasing share of profits that represent returns on intangible assets, like patents, software and technological skill, as opposed to physical assets, like plants and machinery. Unlike physical capital, which can only be in one place at a time, intangible capital can be deployed in any location without subtracting from its use elsewhere. So if Apple licenses a Chinese company to use its technology to make iPads, that same technology remains available to produce iPads in the United States or anywhere else. And since manufacturing is highly competitive, the lion's share of the profits earned on iPads consists of the return on the intellectual property. But it is unclear just where those profits are earned for purposes of taxation.

Where income is derived from depends on a number of factors, including how a multinational allocates fixed costs like research, general management and interest expenses, where it locates the ownership of intangible assets and what prices it sets for sales of goods and services and licensing of royalty rights within the corporate group. Multinationals can reduce their tax liability without affecting their overall profitability by paying high prices for goods and services they purchase from subsidiaries in low-tax jurisdictions and charging low prices for sales to these subsidiaries.

Under tax laws in place throughout the OECD, prices of sales within multinational corporations, called transfer prices, are supposed to reflect the prices of comparable arms-length transactions between independent companies – that is, the market price that would prevail if a market existed for the good or service performed. But when a multinational corporation is licensing a unique intangible to its subsidiary, there is often no comparable price, leaving considerable wiggle room in setting the transfer price. Indeed, multinationals have been able to use transfer pricing, debt-equity swaps and other methods to shift increasing amounts of reported income to low-tax jurisdictions.

On the residence side, the problem is that corporate residence has decreasing relevance in today's globalized economy. The largest multinational corporations have production facilities, employees and sales throughout the world and raise funds in capital markets anywhere from New York to London to Hong Kong. Even headquarters functions like central management, finance and R&D are increasingly decentralized. Multinationals may have national identities, but they have truly become citizens of the world.

Major U.S. corporations are not about to shift their legal residences overseas. The United States enacted laws to deter so-called corporate inversions some years ago, after a highly publicized case in which a manufacturer (Helen of Troy cosmetics) changed its

residence to Bermuda. U.S. multinationals that change their residence face a steep tax on their unrealized income. But there are other means to achieve the same end. New companies can choose to be chartered overseas instead of in the United States. U.S. companies can contract out production to foreign-based companies, shifting some of the income to nonresident companies. Mergers and acquisitions can reduce the share of corporate assets that are resident in the United States. And, of course, higher residence-based taxes on U.S.-resident multinational corporations will shift the composition of world output to foreign-based multinationals. While in the short run, major U.S. multinational are not likely to change their corporate residence in response to increased taxes on foreign-source income, in the long run taxes based on corporate residence, like taxes based on corporate source, are not really viable in competitive global markets.

The current system is broken, and simple patches will not go very far to improve efficiency, reduce inequities or even yield a political consensus.

We thus need to consider more radical alternatives. I offer two, with the caveats that neither is fully fleshed out and neither is ready for political prime time.

The first is a move toward global cooperation in taxing income of multinational corporations. This is not an idea as far outside the box as it might seem. Starting with the League of Nations in the 1920s and continuing through the OECD, the international community has developed some general principles for corporate taxation that are widely observed. They include the principles that the home country gets the first bite at taxing cross-border corporate income, that double taxation should be avoided either through a credit or exemption system, and that relief from double taxation should be negotiated through bilateral double-taxation agreements, of which both the United Nations and the OECD have provided templates. They also include the generally accepted principle that arms-length comparable transactions be used to set transfer prices within multinational corporations. The European Union has gone even further in establishing common practices in taxing corporations in member countries.

But the system for allocating income among countries and for preventing income-shifting to tax havens is not working well. The OECD and G20 countries have established the Base Erosion and Profit Shifting Project, and the OECD has issued a preliminary report with some recommendations. Going further, many academic experts have long argued for using some type of formulary apportionment system to allocate income among countries.

Such rules are already used to allocate profits among U.S. states, although not in an entirely consistent fashion. A more recent idea would supplement transfer-pricing rules with ones that allocate income from intangible assets in proportion to the owner's sales among jurisdictions – a so-called destination-based corporate tax. The rationale for this reform is that allocating profit according to sales is less easy to manipulate than current methods of setting the location of corporate profits. The thrust of all these proposals would be to retain the right of separate countries to set their own corporate tax rates, but to reduce the amount of discretion that multinational corporations have to determine the reported source of their income.

A second, more radical approach would scrap the U.S. corporate income tax entirely and replace it with a tax on the accrued income of U.S. shareholders of publicly traded corporations. Under this method, shareholders would be taxed annually on the sum of their dividends and the net change in the value of their shares. The current tax rules for flow-through enterprises would be retained.

treatment for dividends and capital gains.

There are more issues to consider. The tax would affect incentives for companies to go public. There would also be thorny questions about how to treat foreign shareholders, tax-exempt institutions and qualified retirement plans like 401(k)s. Though mostly exempt from the U.S. individual income tax, foreign investors do currently pay corporate income

JOEL PETT/NEW YORK TIMES SYNDICATE

Note the advantages: the U.S. tax system would no longer influence either the residence of corporations or the location of investment by U.S. and foreign-owned multinational corporations. But it would fully tax the income that shareholders accrue within corporations.

The accrued-income approach is, to say the least, a difficult sell. One reason is that a lot of influential people would consider it unfair to pay tax on gains on shares they have not sold. What's more, the public might perceive it as an unjustified break to big corporations, even though their U.S. shareholders would pay tax on their income with no preferential taxes. Congress would thus need to decide whether some tax should be put in place to recapture the lost revenue.

Plainly, neither of these radical reforms amounts to a magic bullet. Like all tax proposals that do not sharply reduce expected revenues, they would create losers as well as winners, and the losers would be bound to resist the change. But the current system is broken, and simple patches will not go very far to improve efficiency, reduce inequities or even yield a political consensus. That's why it's time to think about big solutions to a big problem that is growing ever-harder to ignore. M

China's LATEST Growing Pain

BY YICHUAN WANG

It's hardly news that, apart from the very occasional stumble, the Chinese economy has been setting growth records for decades. From 2002 to 2012 alone, real GDP per capita rose by 146 percent, vaulting China into the league of middle-income nations and making it the second-largest economy in the world. Moreover, though China has traditionally been marked by regional inequality, this breakneck pace has greatly improved living standards across the country and — contrary to received wisdom — has, in recent years, even worked to narrow the gaps among regions. Yet I would argue that ongoing unease about inequality is justified: to lock in the gains, the Chinese government needs to take aggressive action to equalize access to social services.

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Housing, migrant-style

REGIONAL INEQUALITY, FROM MAO TO DENG

In the early years after the Communist revolution, the economy was marked by two parallel divisions – coastal and inland, rural and urban. In 1955, per capita GDP in heavily industrialized provinces like Liaoning and Heilongjiang was more than double that in inland provinces like Hubei and Henan. That was unacceptable to the Chinese leadership, which made it a priority to moderate regional inequality for the sake of political cohesion. To manage that task, Beijing centralized fiscal expenditures and increased both investment and basic services in poor provinces. Doing so involved both substantial revenue-sharing between the national and local governments and transfers of human capital. The famous example of the latter was the provision of "barefoot" doctors, health care workers in the countryside. Though those doctors had only modest training and few drugs to offer, a little went a long way. Their efforts, which included help in improving sanitation and diet, sharply reduced infant mortality and the incidence of epidemics. The payoff: between 1950 and 1965, life expectancy at birth (across China) rose by a spectacular 18 years.

However, many of the programs designed to address regional inequalities were washed away by the waves of economic liberalization in the late 1970s and early 1980s. When agriculture was privatized, village communes lost the financial resources to pay for social services. Liu Yuzhong, a barefoot doctor in the late 1970s (and now a senior staff member at the National Institutes of Health in the United States), recalls that the immediate effect was

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Housing, urban-style

REUTERS/KIM KYUNG-HOON

Although laws barring migration have since been relaxed, farmers moving to the cities are still made second-class citizens by *hukou*.

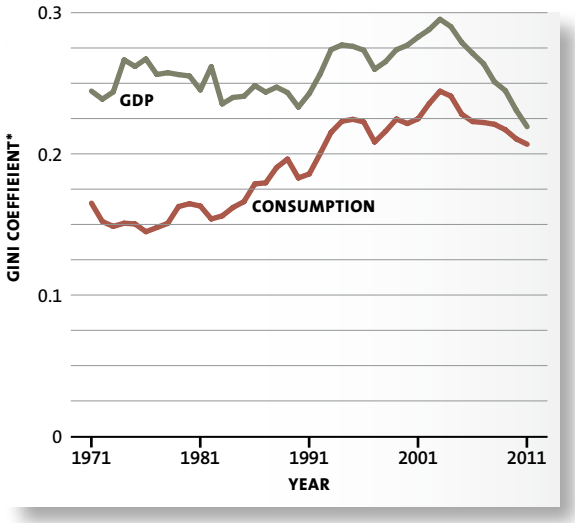
the reemergence of infectious diseases associated with extreme poverty.

Urban areas, by the way, did not entirely escape collateral damage from the changes. As part of the effort in the 1990s to make state-owned enterprises more competitive, many employees lost their government-funded health insurance. Thus, although the 1990s was a period of dramatic growth, the increase in prosperity coincided with the fraying of the none-too-adequate social safety net.

The *hukou* household registration system, a legacy of Chinese feudal social control, exacerbated rural-urban divisions. The *hukou* is akin to a domestic passport, controlling where a person can legally live, work and receive government benefits. It is based on the *hukou* registration of one's parents. Historically, *hukou* was used to tie peasants to the land and to prevent farmers from flooding into the cities – a goal rationalized by post-revolutionary governments as a means of preventing social disorder and the chaos of slums. However, it had the unfortunate consequence of excluding large swaths of Chinese society from getting their share of the fruits of the spectacular economic growth dividend in the 1990s.

The *hukou* system had a particularly severe effect on urban-born young men who had been ordered to the countryside to learn proletarian virtues from the peasants during the

POPULATION-WEIGHTED REGIONAL GINI COEFFICIENTS



*0=perfect regional equality, 1=perfect regional inequality
SOURCE: China Data Online; author's calculations

Cultural Revolution (1966-76). Many of them settled down and started families. But when Deng Xiaoping rose to power in the late 1970s and those exiles were allowed to return home, they found themselves trapped by the *hukou* system that prevented them from bringing their families. This tragedy is the stuff of many a modern television melodrama in China, as well as a vivid reminder of the long shadow of *hukou* in Chinese history.

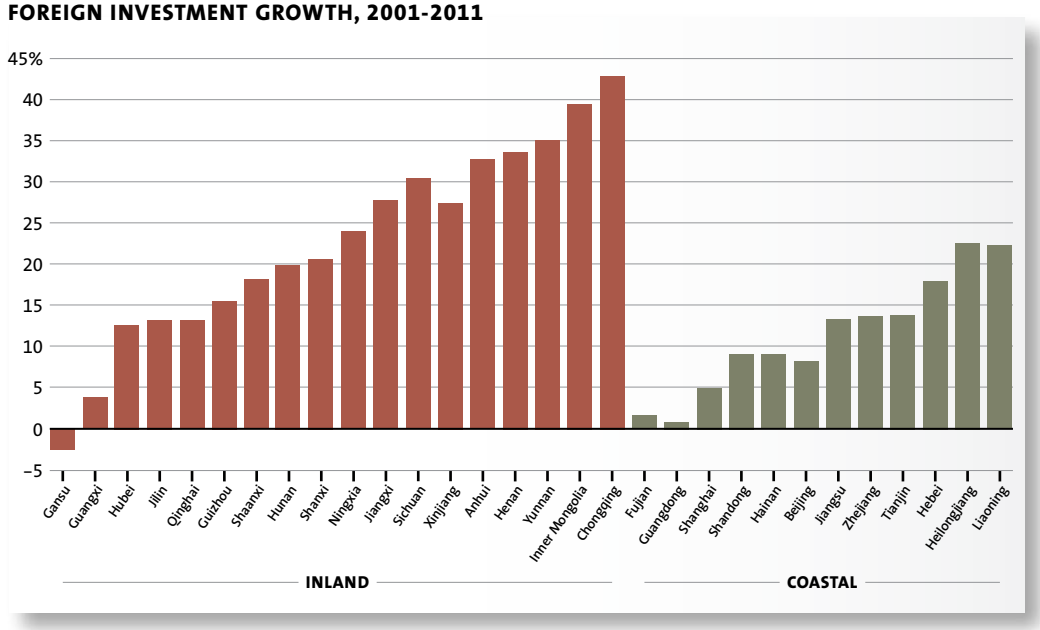
Although laws barring migration have since been relaxed, farmers moving to the cities are still made second-class citizens by *hukou*. They cannot receive housing subsidies, education, health care, state-sector jobs, job training or unemployment insurance in their new locales. The children of migrant workers are especially disadvantaged: even if they go to school in the cities, they must return to the provinces in which they are registered to take the competitive exam for entry to universities. This is a greater handicap than might be imagined, because the prospects of getting into a top school are much better for city residents. Holders of Beijing *hukou*, for example, have an estimated 40-to-1 advantage over the average Chinese test taker for getting into a prestigious university in the capital.

A REVERSAL?

All that said, regional income inequality has been falling in recent years. The coastal provinces did run far ahead in the 1990s, on the strength of export-led private industrialization. But the trend has since been reversed – a reality that may still surprise your average policy wonk because the bulk of studies on Chinese income inequality focused on the earlier post-liberalization period of divergence. What's more, the pace of the narrowing has been brisk: a province with half the average national per capita income in 2001 could expect to grow two percentage points faster annually than the country as a whole across the decade. One way of measuring regional inequality is by comparing population-weighted Gini coefficients for regions as a whole, in effect assuming that every individual within a province has an identical income. By this metric, regional inequality in investment and GDP per capita has never been lower. And although regional inequality in consumption is still elevated from historical levels, it has been falling in the past few years.

There are five main causes for this change. First, central government investment has been increasingly aimed at making the inland provinces more competitive. Since the start of China's official "Go West" development strategy in 2001, Beijing has poured more than 325 billion RMB – in the ballpark of $60 billion in terms of today's purchasing power – into transportation infrastructure in the western provinces. In addition, many new high-speed rail developments, such as the Yichang-Wuhan high-speed line that opened

FOREIGN INVESTMENT GROWTH, 2001-2011



SOURCE: China Data Online; author's calculations

in 2012, serve inland China. These high levels of investment, especially in interior cities like Chongqing and Wuhan, have no doubt helped to spur their rapid growth.

Second, the government has made an effort to close the income gap through more social spending in western and inland areas. From 2004 to 2010, social outlays grew in real value at a rate of 15 percent per year.

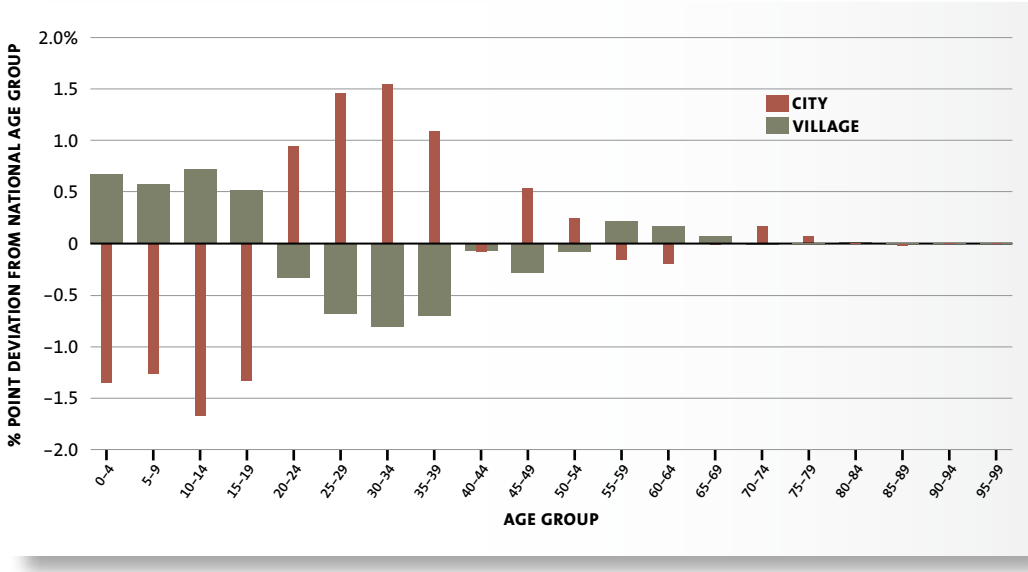
Some of the funds were directed toward a new rural health care insurance system. By 2009, this system was up and running in 95 percent of China's county-level administrative units, and covered two-thirds of the total population. The government is continuing to spend extensively on this program, now with the goal of increasing the average reimbursement rate on health care bills from 30 percent in 2007 to 70 percent or more.

Another important change has been the introduction of a rural pension plan. By the end of 2011, it covered 40 percent of all counties in China. Since many of China's inland provinces are still primarily rural, this represents a large transfer of resources that serves to equalize income and health care.

Third, in addition to beefing up these iconic social programs, the government has channeled a lot of funds toward farm subsidies. The agricultural tax was phased out, beginning in 2004, and direct subsidies for seeds and agricultural machinery were introduced. Price floors were set for wheat and rice and the government stepped in to defend those floors by buying and selling buffer stocks. Expenditures have grown rapidly, reaching $75 billion in 2012, with subsidy payments to grain producers now equaling 7 to 15 percent of their income.

A fourth major driver of the reduction in regional inequality is old-fashioned catch-up growth. Part of the reason China as a whole has been able to sustain such high growth rates is that it is still relatively underdeveloped. Justin Lin, a former World Bank chief economist, has observed that China's relative

AGE DISTRIBUTION RELATIVE TO NATIONAL AVERAGE



SOURCE: China Data Online; author's calculations

backwardness in technology means it can grow through "imitation, import and/or integration of existing technologies and industries." As a result, China is enjoying a period of accelerated growth as it narrows the productivity gap with the West.

But what is true for China relative to the world is also true for Chinese provinces relative to each other. Note, by the way, that this reality has piqued interest from global investors as well as domestic ones. Growth in foreign direct investment in Sichuan, for example, has increased by a factor of nine over the past decade, far more than in Shanghai, Guangzhou and Beijing. This suggests that the interior economy has more going for it than government fiat. Foxconn, the giant Taiwan-based manufacturer, offers a good example of this inland pull. "Henan and Sichuan have always been the largest sources of migrant workers," Louis Woo, a Foxconn spokesman, explained. "That was why we moved to both."

The fifth driver has been domestic migration. Because *hukou* laws have been relaxed to encourage migrants to take low-skilled jobs in construction, manufacturing and services in labor-short cities, there has been an exodus of workers from rural areas. The sheer magnitude of this migration is evident every year during the Spring Festival, when hundreds of millions (yes, hundreds of millions) crowd the rails and the roads to visit their families.

THE ROAD AHEAD

By any objective standard, Beijing has done well in balancing the sometimes-competing objectives of maximizing aggregate economic growth and minimizing regional income disparities. To make further progress in reducing regional disparities, though, it will need to focus on the urbanization of the inland provinces. That is because much of the income gap can be explained as a gap in urbanization.

However, this second wave of urbanization must differ qualitatively from the first. According to the Chinese National Bureau of Statistics, the proportion of Chinese living in cities has risen from around 20 percent in the

early 1980s to 50 percent today. Most of the migrants have been laborers in search of higher wages. As a result, young adults are overrepresented in the population, while children and the elderly are underrepresented. According to the 2009 population survey, the proportion of people in cities under the age of 20 was about two percentage points lower than in the villages – and just the reverse for those between 20 and 39.

The sacrifices implied by this demographic twist have been heavy: millions have been forced to leave their children behind, to be cared for by grandparents. And this division of families is serving as a powerful deterrent to further migration. Thus, if urbanization is going to continue apace, it will need to make room for dependents – both children and the elderly.

To facilitate this transition, provincial governments need to liberalize access to urban social services for migrants and their families. Today, most of those people lack health insurance and old-age pensions that are valid in cities. Moreover, their children generally cannot attend public schools without paying fees.

While it's tempting to narrow regional inequality more directly by means of direct cash transfers to households and rural communities, there are good reasons to expand social service access in cities instead. For one thing, there are economies of scale in urbanization: researchers have shown that large cities are more efficient than less-dense communities in providing social and environmental services.

Consider, for example, health care. While a system of barefoot doctors may have yielded immense social returns in Mao's time, the low-hanging fruit has been picked. And it has proved very difficult – read very expensive – to convince doctors and other highly trained practitioners to move to the countryside to deliver care. The more efficient strategy would be to bring more of these rural residents into the cities and to improve the quality of hospitals and clinics there.

The same holds for education. It is much more costly to build and maintain quality schools – and to hold onto students – in rural environments. Data from the 2010 Chinese population survey show that only half of rural Chinese have more than a middle-school education, whereas the comparable number for urban Chinese is 80 percent. The problems created by inadequate rural education will only grow worse as China gets richer, the composition of GDP evolves toward sophisticated services and the demand for skilled workers rises disproportionately.

Second, using social services to facilitate urbanization in China's interior would allow inland provincial economies to specialize. For broader prosperity, it is critical that each province develop comparative advantages in production – and, in particular, gain a foothold in the sorts of industries needed by a far more affluent economy. But without the large local markets and economies of scale afforded by cities, this process will likely be retarded.

The evidence to date supports this view. From 1980 to 1995, 22 of the 25 broadly defined industrial groupings in China – for example, both finance and construction – became more geographically concentrated. This suggests that there are agglomeration economies in many Chinese industries.

To be sure, there's a conceptual issue here: growth may cause urbanization, rather than vice versa. Or, most likely, causality runs in both directions. But that is hardly a reason to sustain the current institutional bias against urbanization – the constraints imposed by *hukou* and the pressure to stay in rural areas to obtain basic family services.

Then there's the moral dimension. Ongoing urbanization is critical to China's growth

Nursing home, migrant-style

REUTERS/KIM KYUNG-HOON

and social cohesion. But it's hard to argue that the burden of change should be borne disproportionately by migrants and their families. Improving social services for new arrivals to the cities, particularly assistance with housing and schooling, seems an obvious policy choice on ethical as well as practical grounds. It would be a win-win for migrant families and the Chinese state.

A push to urbanization should not be interpreted as abandonment of agriculture. Rather, the strategy is geared toward convincing people to leave the farms in favor of more productive work. It's important not to lose sight of the fact that while reducing regional inequality is important in its own right, the primary goal should be to reduce the inequality of opportunity (and, arguably, outcomes) for people born in each region.

WHO PAYS, HOW MUCH

A back-of-the-envelope calculation shows the expenditures that would be needed to provide social services for migrants and their families in an urbanized interior. A good benchmark for education expenditures in the inland provinces would be Guangdong in 2005, which had a GDP per capita of 20,000 RMB (in year 2000 prices) and a very high urbanization rate (around 60 percent). Today, inland provinces have approximately Guangdong's 2005 level of GDP per capita income, but much lower urbanization rates.

Back in 2005, Guangdong enrolled 18.7 million students in all levels of education, and spent a total of 28 billion RMB – roughly 1,500 RMB per student (again, in year 2000 prices). If the Chinese government were to devote this sum to each of the estimated 61 million children left behind in the countryside, the annual bill would run to around 91.5 billion RMB – around 12 percent of China's 2010 total educational expenditures and a tiny fraction of the country's annual increase in GDP.

Nursing home, urban-style

REUTERS/KIM KYUNG-HOON

The money could come from Beijing. Or local governments could raise the funds through higher business taxes and higher dividends from state-owned enterprises. This could be viewed as a quid quo pro between regional businesses and government, in which companies would benefit from access to a larger, better-educated pool of young workers. Note, too, that the resulting increase in the supply of trained urban workers would reduce the pressure to raise wages in labor-scarce cities – a significant bonus for a Chinese economy that is now facing competition from lower-wage industries in Vietnam and Indonesia.

THE BEGINNING OF THE END OF *HUKOU*?

There's a near-consensus that comprehensive *hukou* reform overnight would be impractical. The resulting pace of migration would exceed the cities' capacity to meet the added demands on services ranging from schools to mass transit, even if the money were available to pay for them. But the best should not be seen as the enemy of the good; a more gradual transition would avoid social turbulence (and the potential for backlash), as well as giving local governments a chance to experiment with delivery methods for social services.

Guangdong has already taken steps toward making this kind of piecemeal reform of *hukou* a reality. Since 2010, the province has allowed migrant workers to enroll their children in schools after five years of residence and to apply for *hukou* registration after seven. While there is a list of requirements for the parents, none involve high educational attainment or specialized skills. Instead, they focus on making sure that parents have paid their taxes and obeyed the law.

Efforts to phase out the impact of *hukou* are also coming from a very different direction. Tongling, a deeply depressed copper mining city in the impoverished rural province of

Anhui, is attempting to convert itself into a manufacturing center by expanding education, health care and housing benefits to migrants. And it's apparently beginning to work: the city's population has been edging up since 2008, even as Anhui's total population fell.

There have been glimmers of reform in higher education as well.

Since 2012, Beijing has permitted high school students with *hukou* registration in other regions to take their examinations in the capital. Many other coastal provinces have followed suit. And since a university education plays a vital role (symbolic as well as real) in the minds of the Chinese, this represents an important step towards integrating rural migrants into urban society.

The national government is apparently marching to the same drummer. In October, the Chinese State Council Development Research Center released a framework proposal for social service expansion and local public finance. It suggested, among other things, that Beijing is prepared to impose a national consumption tax, with the revenues funneled to local governments. The proceeds would pay for a nationally mandated "citizen basic social protection package" – the first step to delinking social services from *hukou* registration nationwide.

There is legitimate concern that the decentralized nature of the Chinese governance system may complicate the process of expanding service provision. Although China has a unitary system of government with final authority over policy concentrated at the top, revenue-raising and the delivery of government services have been decentralized since Mao's time.

The risk here, then, is that provinces will try to pawn off the provision of social services on others, creating a classic race to the bottom.

However, in light of the changing economic environment, this is not likely, because high-quality social services now constitute a powerful attractor for business. Education is one example of this, of course, but transportation and amenities like parks and recreation matter, too. In any event, this potential for a vicious cycle would be reduced if the central government absorbed much of the financial burden during the expansion of social services.

Note, too, that a race to the bottom is not consistent with the history of reform in post-revolutionary China.

The agricultural reforms in the 1970s that allowed households to sell their surpluses on free markets were not imposed from the top. Rather, popular pressure led the central government to give in. The process of market reform in China has long been described as "crossing a river by groping for stones." And so social service reform, like Deng Xiaoping's "Reform and Opening Up" program, three decades earlier, will be based on this kind of decentralized experimentation.

FINISHING THE JOB

Deng famously declared in the 1980s that for a country to become rich, it must let "some people get rich first." That was a stark departure from Maoism, which had focused on reducing inequality, even at the cost of slower growth. However, Deng's declaration had another implication that is often forgotten. He was willing to tolerate rising regional inequality because he strongly believed that allowing the coast to become wealthy first would ultimately provide the best chance for the inland provinces to improve living standards down the road.

His vision has been fulfilled in part, and the means for finishing the task are at hand. The real question now is not whether, but when.

The Drones Are Coming!

BY
LAWRENCE
M. FISHER

When you think about drones, you probably think about death from the sky. But that's about to change. A host of companies, old and new, are racing to market with unmanned aerial vehicles (UAVs) intended for nonmilitary applications from wildlife tracking to real estate marketing to last-mile package delivery. The size of the market for these benign uses remains a subject of intense speculation. But the technology is flying ahead, far in advance of regulations governing safety and privacy.

Weapon-bearing drones like General Atomics' Predator and Reaper generate the headlines. Yet even in the military, a vast majority of UAVs are small, nonlethal craft, used primarily for surveillance, intelligence and reconnaissance. They resemble radio-controlled model airplanes with video cameras – and that, in essence, is what they are. But with the benefit of advanced technologies ranging from infrared sensors to GPS, they become versatile flying robots.

The appeal to existing makers of military drones is obvious: if the civilian market is even a fraction of the size projected by boosters, it offers spectacular opportunities to companies with flexibility and imagination. But civilian products will need to be priced at least an order of magnitude lower than the military craft these manufacturers are accustomed to building, and it's an open question whether any of them could make a profit under such constraints. Indeed, there are good reasons that all of the prime military contractors stopped making small airplanes on a budget decades ago.

At the other end of the spectrum, a flood of start-ups, many of them spawned by the hobbyist community, are approaching this nascent market with a missionary zeal that evokes the early days of flight and the birth of the PC. An Apple Inc. may ultimately emerge from DIYdrones.com – and along with them, of course, a host of flashes-in-the-pan, like Altair, Kaypro and Osborne. But drones come with an image problem; they make many people feel creepy in a way that early airplanes and personal computers never did.

For the time being at least, hobbyist drones literally fly below the radar. The Federal Aviation Administration does not regulate aircraft of less than 55 pounds gross weight that fly below 400 feet, provided they are not used for commercial purposes. Commercial drones exist in a legal no-man's land. But Congress has charged the FAA with creating a general framework for regulating the use of commercial UAVs over United States territory by 2015.

Not surprisingly, anecdotal evidence points to a great deal of illicit testing and "volunteer" work that treads a fine line between commercial and recreational flying. But a drone crash in a populated area or a collision with a passenger aircraft could be catastrophic. As long as the government dodges the issues of who flies which drones and where, this is an accident waiting to happen.

There are other public policy issues to consider here. If unmanned aircraft are used for common tasks like delivering pizzas – as more than one start-up has suggested they will be – the airspace over urban areas will be-

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The BionicOpter Robot Dragonfly

FESTO/REX FEATURES

come a scarce resource and its allocation inevitably a matter of dispute. Likewise, the radio spectrum needed for remote control. For hobbyists, these resources are more-or-less satisfactorily managed on a first-come, first-served basis, but a commercial market will require systematic regulation.

Arguably, the most contentious issue raised by the commercial application of unmanned aircraft is privacy. While citizens willingly share the most intimate details of their lives across social media and casually grant online retailers free use of their personal data, the backlash to revelations about National Security Agency snooping makes it clear they are not comfortable being spied upon. Drone-based surveillance drastically increased the opportunities for peeping – not to mention opening the door wide to anybody with the budget to buy the equipment.

LEGACY OF THE OTHER AMA

Today's hobbyist drone start-ups have an antecedent in Radioplane, which was founded in Southern California in the 1930s by the British actor and model airplane enthusiast Reginald Denny. Radioplane's most lasting contribution to Western culture may have been as the workplace of a young assembly line operative named Norma Jeane Mortenson (Google it). But the company also delivered nearly 15,000 drones to the Army during World War II.

Radioplane was acquired by Northrop in 1952. And Northrop (now Northrop Grumman) still produces drones, as do Boeing and Lockheed Martin. The market-share leader by far, though, AeroVironment Inc., is a comparative unknown whose small hand-launched vehicles account for fully 85 percent of the unmanned aircraft in use today by the U.S.

Puma unmanned aerial vehicle

military. The company, by the way, claims a similar-sized share of the market for industrial fast-charging stations, mostly used for electric forklifts and airport support vehicles. But it is probably best known as the maker of the Gossamer Albatross, the first human-powered aircraft to cross the English Channel.

For most of their nearly 100-year history, remote piloted aircraft were used for the lowest of low-level missions, like target practice. But AeroVironment's Pointer, introduced in the late 1980s, was something different: a tactical reconnaissance vehicle.

The Pointer and its descendants – the Raven, the Wasp and the Puma – represent disruptive innovation. The Raven and its brethren drastically undercut the cost of manned aircraft, which makes their purchase an easy decision. As important, not putting a pilot at risk allows their deployment in situations where a conventional craft simply could not go.

AeroVironment executives say their experience making small drones for the military positions them well to address the civilian market. Steven Gitlin, AV's vice president for marketing strategy, foresees markets for UAVs in public safety, infrastructure monitoring and hazardous waste disposal, among others. "When we developed our initial systems in the 80s, we had in mind these kinds of applications," he said.

Founded in 1971, AeroVironment is hardly a start-up, yet it retains a strong hobbyist ethos. Some engineers proudly wear AMA badges – as in Academy of Model Aeronautics

– alongside their security ID cards, and are keen to show visitors their whimsical creations, like a hummingbird drone, which closely mimics the bird's size, appearance and method of flight. Yet they are serious players: AV's Puma AE is the first hand-launched unmanned aircraft system to be approved by the FAA for commercial missions. The "restricted category" certificate permits operators to fly the Puma for applications like oil-spill monitoring and ocean surveys in the North Slope region of the Arctic. The FAA said that previous military acceptance of the Puma design allowed it to issue the license.

AV's Raven, its most popular model, is sold as a complete system, with three aircraft and two ground stations and varying levels of support, for $100,000 to $200,000. That is a fraction of the $4 million price tag for a Predator, but probably still too much to make it viable for most contemplated commercial applications. While AeroVironment executives are confident they can hit lower price points once they reap economies of scale, hungrier entrepreneurs aren't waiting. Hobbyists can already buy a DGI Phantom quadcopter on amazon.com for just $479, and a raft of startups foresee a market for much more sophisticated small drones costing just a little more.

RUNNING TO STAY IN PLACE

Drones are "a disruptive industry that is going to be disrupted itself," explained Timothy Reuter, president and founder of the DC Area Drone User Group. "You have the traditional suppliers who are used to selling to the government. But at the other end you have a race to the bottom from companies that will disrupt them. Obviously, you don't get the same capability for $500 as for $50,000, but why pay extra when all you need is something small and simple? I honestly believe that folks like the DC drone users are going to incubate the next $100 million companies because it's such a ripe ecosystem now and there's no established player dominating this technology."

San Diego-based 3D Robotics is the highest profile company to emerge from the maker culture. Its founder and chief executive, Chris Anderson, the TED curator and former *Wired* magazine editor, also created the Web site DIYDrones.com. 3D Robotics is producing fixed-wing and multi-rotor helicopter UAV designs using the open source model previously associated with software like Firefox and the Linux operating system. 3D's online store offers kits and parts, plus ready-to-fly models starting at about $600.

While 3D Robotics' origins are in the hobbyist community, it is very much a commercial enterprise; the company has raised $35 million from well-known Silicon Valley venture capital firms and is now operating a factory across the border in Tijuana. It expects to find markets in all the obvious places, along with many that are not. "Drones are going to be one of the biggest sources of big data for the biggest industry in the world, which is agriculture," Anderson said, speaking at "The Atlantic Meets the Pacific 2013" conference sponsored by *The Atlantic* magazine and the University of California at San Diego. "We love agriculture because there are no people there."

He added, "I'm not going to say we've come up with the Macintosh for drones, but we're right on the verge."

Oddly, it is another Apple product, the iPhone, that has inspired the technological innovation driving drone prices down to consumer levels. Inside the iPhone (and all smartphones) are the processors, sensors, accelerometers, GPS and camera technology needed to create a sophisticated autopilot.

Hummingbird drone

COURTESY AEROVIRONMENT, INC., WWW.AVINC.COM

All that's left to do is write the software. And software is cheap – even free, using the open source model. Drones are benefitting from Moore's Law, which famously states that the number of transistors that can be packed in an integrated circuit roughly doubles every two years, driving an inexorable increase in capability and reductions in both price and equipment weight.

"The DIY movement around small UAVs has been able to piggyback smartphone development and build a vehicle around it," said Andreas Raptopoulos, cofounder of Matternet, a Silicon Valley start-up that is designing small networked drones for delivering goods. "A UAV is a vehicle that is 80 to 90 percent software, which allows it to navigate, respecting the laws, and to reach its destination autonomously. Its interface with the physical world has very few moving parts; the rest is a computer with a battery."

The iPhone has inspired the technological innovation driving drone prices down to consumer levels. All that's left to do is write the software.

Matternet's first application will be a system for delivering small, high-value goods – for example, pharmaceuticals – to areas that lack adequate transportation infrastructure like remote villages in sub-Saharan Africa. "In many places in the developing world, the roads do not work," Raptopoulos said. "Our game plan is to set up a number of pilot projects, learn how to transport medical supplies in those environments, and over time learn how to set up businesses in alternative delivery of goods."

Raptopoulos believes the "killer app" for drones will be something not currently done with manned airplanes or helicopters; nor is it likely to originate with incumbent producers. "Will a breakthrough in this industry come from the big players or someone who operates without constraints?" he asked rhetorically. "Historically, it comes from the upstarts. That's Silicon Valley writ large."

The commercial drone industry is already specializing, with newer companies targeting specific pieces of the unmanned aircraft system – the airframe, the autopilot, the software. Some entrepreneurs believe the airplane itself will be increasingly commoditized, with greater value being added by software, instrumentation and the like. This approach would benefit greatly from common standards, so that each application developer does not need to start from scratch. But so far the industry has no Intel, whose 8080 microprocessors gave early PC developers a platform to build upon, and certainly no Microsoft Windows operating system – though many drone developers are using Linux.

Enter Airware, a start-up based in Newport Beach, Calif., that has received backing from the venture capital firms Andreessen Horowitz and Google Ventures. Airware provides an operating system and development platform for UAVs. The business model is to combine hardware, software and application programming interfaces to make it easier for developers to integrate unmanned aircraft technology into their projects. Jonathan Downey, Airware's founder and CEO, brings

serious drone credentials, having worked on Boeing's A160T Hummingbird and Phantom Eye UAV programs.

At Boeing, "I got to see what it's like to be on a large unmanned aircraft program that stretches over 10 years," Downey said. "All of the military aircraft go through this siloed effort; they're all running proprietary software, which is like a black box. On the commercial side, I thought there needed to be a platform, and we would let other people worry about the applications."

Airware is currently supplying hardware and software to beta customers, including Delta Drone, a Paris-based company that designs, produces and sells civilian drones. Early applications are primarily in land management and infrastructure inspection; Delta plans to deploy drones in Kenya by early 2014 to aid in anti-poaching efforts. Commercial drone companies "are more than willing to shift to a common platform," Downey explained." Our goal is to be the Wintel of this space."

COURTESY OF AMAZON.COM

THE REGULATION FACTOR

Just how big that space is remains a matter of conjecture. True believers speak of a market worth tens of billions of dollars annually, but are vague about the composition and the timing. A 2013 market study by the Teal Group, an aerospace industry research firm, estimates that UAV spending will more than double over the next decade from current worldwide expenditures of $5.2 billion annually. But the report concludes that the civil and commercial drone market will represent well under 10 percent of the total for the next five years, largely because of safety and privacy concerns holding back regulatory approval.

The more practically minded drone purveyors concede that the regulatory environment will determine everything. "It's an extremely attractive market opportunity, but it's all gated by the FAA right now," said Gitlin of AeroVironment.

The FAA is playing its cards close to its vest, but states that some 100 United States companies, academic institutions and government organizations are currently developing more than 300 unmanned aircraft designs. In typical government understatement, it notes that "because the industry is in its infancy, forecasts of the number of units are relatively few and have considerable variation." The FAA has plans for six designated UAV test sites and said it had received 25 applications from 24 states to host one, all in high hopes of being the future Drone Valley. Yet based on work by RTCA, a private not-for-profit enterprise that aids the FAA in technology assessment, the agency expects the volume to be relatively small – approximately 15,000 craft by 2020 and 30,000 by 2030.

Advocates say those estimates are far too cautious and point out that the worldwide computer market was once estimated at just a

handful of units. According to a March 2013 report by the Association for Unmanned Vehicle Systems International, the economic impact of the integration of unmanned aircraft systems in the United States will total more than $13.6 billion in the first three years and will grow to more than $82 billion by 2025. Moreover, it will create some 100,000 high-paying jobs in the first decade. But the report concludes that for every year that integration is delayed, the United States stands to lose more than $10 billion in business.

Real dragonfly vs micro vehicle, designed for surveillance

PHILIPPE PSAILA/SCIENCE PHOTO LIBRARY

Some experts find these projections fanciful. "I think they're drinking the Kool-Aid here," said Tom Davis, former chairman of the House Committee on Oversight and Government Reform, and now a private consultant. The civilian market, he said, "is subject to a lot of potential abuse. You could have an Al Qaeda front come in and put up a commercial drone. You've got a whole area that nobody has really thought through. If an entrepreneur gets too far ahead of the regulatory regime, their business model can be knocked down by one incident by one company."

UNMANNED AERIAL POLITICS

Civilian drones do have friends in high places. The cochairmen of the Congressional Unmanned Systems Caucus are Howard P. McKeon, Republican of California, who is also chairman of the House Armed Services Committee, and Henry Cuellar, Democrat of Texas, who serves on the House Appropriations Committee and the House Steering and Policy Committee. According to the caucus Web site, the group sees its role as working "closely with industry to ensure we continue to expand this sector through efficient government regulation and oversight."

Aligned against the industry are a host of nonprofits focused on privacy issues, among them the American Civil Liberties Union and the Electronic Frontier Foundation. But naysayers also include a growing number of cities and counties primarily concerned with safety. Many states and municipalities have legislation pending that would regulate or ban drones altogether, although many of these laws may prove unenforceable. Local governments have no jurisdiction over airspace, which is regulated by the FAA. Meanwhile, the FAA has no responsibility for protecting privacy. Drone boosters point out that local Peeping Tom ordinances already prohibit citizens from spying on their neighbors, with or without aerial assistance.

But privacy advocates say UAVs are different. "People are more concerned about privacy from drones than other technology," said

Parker Higgins, an analyst with the EFF in San Francisco. "License plate readers are everywhere, but we just can't seem to get people worked up about that. A drone in some cases is not very impressive technology, yet people are really concerned."

The EFF, he said, is most concerned about the use of drones by law enforcement without adequate oversight. "Texas, for example, has passed a law that limits commercial use and hobbyist use, but doesn't limit law enforcement use," he said. "From where we're standing, that's just about the worst possible law."

Of course, people may become accustomed to drones, just as they have accepted smartphones that transmit location to the cell network and anyone with access to it. And drone fans say the privacy issue is a red herring. "The ACLU and the EFF have used this as a bully pulpit," said Michael Toscano, president of the Association for Unmanned Vehicle Systems International. "They lost it with cellphones, GPS, the Internet; so this is their opportunity. [But] they're really talking about Big Data. How you collect it is immaterial."

Drone fans say the privacy issue is a red herring. It's really about Big Data. How you collect it is immaterial.

THE NEXT BIG THINGS

One reason that UAV entrepreneurs talk so much about agriculture is that safety and privacy are far less pressing issues flying above an Iowa cornfield than circling midtown Manhattan. There is also a strong business case for using small unmanned aircraft for precision agriculture. Drones equipped with the appropriate cameras and sensors could identify the specific areas of a farm afflicted by pests and apply measured amounts of chemicals only where they are needed. In Japan, unmanned helicopters have been used for crop dusting for more than 20 years, and today UAVs spray 40 percent of the nation's rice crops – apparently without controversy. The University of California at Davis is currently testing the Yamaha RMAX drone on designated vineyards.

Nearly every developed country in the world (as well as some that barely qualify as such) has a drone industry just as keen to tap the civilian market as their U.S. counterparts. In many cases, these companies face a far friendlier political environment. Brazil, a major user of drones for applications like border patrol, has no laws restricting civilian use. Nor do Mexico or New Zealand. In Australia, operators of commercial drones need obtain only an identification certificate, which can be done on the Internet.

"We're shooting ourselves in the foot by going so slow because other countries are shooting ahead," warned Reuter of the DC drones group. "Small companies starting now in Australia will be the big multinationals we'll have to compete against because we're not even allowed to get started until 2015."

But no one inside or outside government expects that deadline to be moved up. Indeed, it's more likely to slip. The infant drone industry will try to advance UAV use gradually, starting with remote applications where unmanned aircraft don't bother anybody. Then, one day perhaps, the sight of a drone above a suburb or city will raise few alarms. As Anderson of 3D Robotics put it, "If our company and others in the DIY Drones community do our jobs, a generation from now won't remember that drones were once military technology."

Where Banks Are Few,

BY JAMES R. BARTH,

Payday Lenders Thrive

PRISCILLA HAMILTON AND DONALD MARKWARDT

At one time or another almost everyone borrows money, even if just a small sum for a short time. It may be for necessities, like buying milk and cereal for the kids, or for pleasure, like financing a weekend at the beach. But how many of us have paid 460 percent interest to use that cash?

The answer may surprise you. Some 12 million American people borrow nearly $50 billion annually through "payday" loans – very-short-term unsecured loans that are often available to working individuals with poor (or nonexistent) credit. The implicit interest can be up to 35 times that charged on typical credit card loans and roughly 80 times the rates on home mortgages and auto loans. On the other side of the ledger, the process is quick and convenient: a person need provide only a driver's license, a Social Security card, proof of income and a bank account number. After writing a postdated check for the loan amount, plus fees and interest, the customer leaves with cash in hand.

What probably won't surprise you is that banks and payday loan stores serve different markets. In California (one state, but probably a representative one), payday stores dominate lending to the working poor, especially those who are Latino or African-American.

It does not necessarily follow, though, that payday borrowers are being exploited, in the sense that lenders must be making monopoly profits. For one thing, the transaction costs of making these short-terms loans are high. For another, one might expect defaults to be relatively high since the loans are not collateralized and borrowers are generally poor.

But the evidence from pilot programs in which banks do compete directly with payday loan stores suggests that traditional lenders could profit handsomely at far lower interest rates than those charged by the stores. Hence the question for policy makers: why have banks left ripe fruit to be picked by payday lenders? Well actually, there's a second question: what could be done to encourage banks to compete for the business?

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WHAT AND WHERE

In the mid-1990s, the payday loan industry consisted of a few hundred lenders nationwide; today, nearly 20,000 stores do business in 32 states. Moreover, a growing number of payday lenders offer loans over the Internet. In fact, Internet payday loans accounted for 38 percent of the total in 2012, up from 13 percent in 2007. The average payday loan is $375 and is typically repaid within two weeks. But the average loan amount varies substantially from state to state, with Tennessee at the low end ($202) and Texas at the high ($533).

Back in 2006, Congress capped the interest that could be charged to members of the military and their dependents at an annual percentage rate of 36 percent. Otherwise, state regulators run the show, with maximum APRs ranging from 196 percent in Minnesota to 574 percent in Mississippi and Wisconsin.

California first authorized payday lending in 1996, and the practice is regulated by the state's Department of Business Oversight. The law allows these lenders to defer the deposit of a customer's personal check for up to 31 days, limits the maximum value of the check to $300 and restricts the maximum fee

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to 15 percent of the check's amount. In addition, payday lenders are barred from lending to customers who have loans outstanding with them – no doubling down. There is no limit, however, on the number of payday loans that a customer may recycle per year.

By year-end 2005, California was home to 2,445 payday loan storefronts. The industry subsequently consolidated, leaving 2,119 stores at year-end 2011. However, the total amount borrowed increased from $2.6 billion to $3.3 billion over the period and individual customers rose from 1.4 million to 1.7 million. The 12.4 million payday loans made in 2011 averaged $263, with an average term of 17 days. The legal maximum fee is equivalent to the aforementioned APR of 460 percent for a two-week loan. While there is no representative data on actual fees charged, the stores we sampled averaged close to the maximum.

Compare that APR to current rates on car loans (about 6.4 percent), credit card loans (13 to 25 percent) and subprime mortgages (5.5 percent) in California. Of course, the lenders' risks are different as well: mortgage and auto loans are secured (that is, the lender can seize the property if the borrower defaults), while credit-card and payday loans are unsecured.

The $30 charged on a $200 two-week loan may not seem especially onerous for the typical borrower. But borrowers with six or more loans each year generate over half of all payday store revenues in California. Nationwide, most borrowers are indebted to payday lenders for five months out of the year and typically shell out $800 for what amounts to a $300 revolving loan.

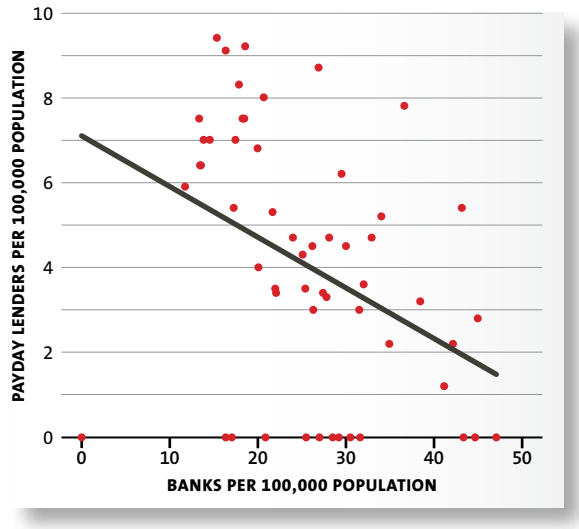
CALIFORNIA'S FINANCIAL LANDSCAPE

California accounts for about 7 percent of all the bank branches and slightly more than 10 percent of all the payday stores nationwide. A much more interesting picture emerges at the county level. The state has only one county with no banks, but 14 counties with no payday lending stores. At the other end of the spectrum, Los Angeles County has the most banks and payday lenders, with 2,120 and 521, respectively. The situation is quite different on a per capita basis: in every county but one, the number of banks per capita is greater than the number of payday lender stores per capita.

We collected demographic and personal finance data by county to see how they correlate with the location decisions of banks and payday lenders. The first thing to note is the strong negative relationship between the number of bank branches and the number of payday lender stores, adjusted for population.

It's possible this is simply the consequence of market forces – that banks and payday lenders locate where their own customers live. Or it could mean that banks are unwilling to take on the challenge of expanding into new demographic segments, in spite of the potential for profit. Either way, though, it puts residents of counties with relatively few banks at

MORE BANKS = FEWER PAYDAY STORES



SOURCES: FDIC, U.S. Census, and Milken Institute

a disadvantage in borrowing. This is especially disturbing because it is likely to reduce social and economic mobility: less-banked counties are home to relatively more poor and minority households, while the populations of more-banked counties have both more education and higher incomes.

WHAT COULD – AND SHOULD – BE DONE

One relatively uncontroversial reform would focus on transparency. Borrowers ought to know more than how much they get from the payday lender today and how much will be deducted from their bank account in two weeks. The interest cost of using a credit card to finance $300 of debt is roughly $2.50 for two weeks and $15 for three months. By contrast, fees for a $300 payday loan are $45 for two weeks and $270 for three months. More emphasis on disclosure might lead to greater caution on the part of potential payday loan customers.

But transparency is no panacea. If the local payday lender is the only game in town and the kids are hungry, borrowers will pay what they must.

Payday lenders say that the high APRs they charge are warranted by the nature of short-term lending – the paperwork, the low volume of loans per store, etc. – as well as by the high-risk profile of low-income borrowers. Other financial institutions, they argue, have been unwilling to extend unsecured loans to borrowers with poor or no credit. And the ability to borrow at 460 percent is better than not being able to borrow at all.

Recent evidence suggests, however, that banks and other financial institutions could, in fact, provide alternative loan products that meet the needs of those now relegated to payday borrowers at lower APRs. The FDIC's Small-Dollar Loan Pilot Program has yielded important insights into how banks can offer affordable small-dollar loans (SDLs) without losing money in the process.

Under the pilot program concluded in 2009, banks made loans of up to $1,000 at APRs of less than one-tenth those charged by payday loan stores. Banks typically did not check borrowers' credit scores, and those that did still typically accepted borrowers on the lower end of the subprime range. Even so, SDL charge-off rates were comparable to (or less than) losses on other unsecured forms of credit such as credit cards. Note, moreover, that banks featuring basic financial education in the lending process reaped further benefits by cutting SDL loss rates in half.

The success of the banks' SDLs has been largely attributed to lengthening the loan term beyond the two-week paycheck window. Along with reducing transaction costs associated with multiple two-week loans, longer terms gave borrowers the time to bounce back from financial emergencies (like layoffs) and reduced regular payments to more manageable sums.

For consumers, the benefits of SDLs over payday loans are obvious. It goes without saying, though, that banks won't stay in this line of business unless, one way or another, SDLs prove to be profitable. In the FDIC pilot, a majority of banks reported that SDLs helped to cross-sell other financial services and to establish enduring, profitable customer relationships. Given the low volume of SDLs that banks extended in the programs' beginning stages, however, the profitability of SDLs as a stand-alone product line was largely untested.

Happily, this is an arena in which fresh thinking and digital technology can make a big difference. Start-ups like ZestFinance, created by Google's former chief investment officer and head of engineering, are employing big

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Payday lenders say that the ability to borrow at 460 percent is better than not being able to borrow at all.

data analytics to improve on traditional underwriting models based on FICO scores.

Another newcomer, Progreso Financiero, employs a proprietary scoring system for making small loans to underserved Hispanics. Progreso's loans follow the pattern that emerged in the FDIC pilot program – larger loans than payday offerings with terms of many months rather than days and, of course, more affordable APRs. Moreover, the company has shown that the business model works at substantial scale: it originated more than 100,000 loans in 2012.

LendUp, an online firm, makes loans available 24/7, charging very high rates for very small, very short-term loans. But it offers the flexibility of loans for up to six months at rates similar to credit cards, once a customer has demonstrated creditworthiness by paying back shorter-term loans. It also offers free financial education online to encourage sound decision-making.

Both Progreso and LendUp participated in a 2010 pilot program to expand access to affordable credit in California. And both are supporting a replacement program with guidelines similar to the FDIC initiative. Sheila Bair, the former head of the FDIC, envisions SDLs becoming a staple bank product. Indeed, as banks face increasing criticism for becoming dependent on "gotcha" fees on regular consumer accounts, the time may be right to develop viable credit services for the unbanked that help to repair the industry's image. M

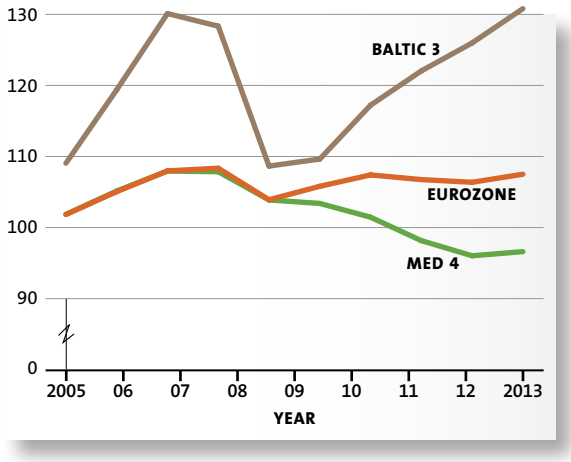
The Baltics Show the Way Back

BY ED DOLAN

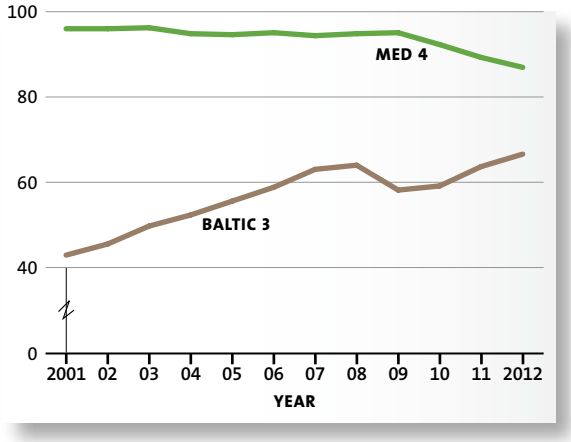
Much of the economic news dribbling out of Europe in recent months has been bad, and much of that has come from its southern periphery. Greece, Italy, Spain and Portugal are still wallowing in deep slumps. Unemployment remains in double digits, and the rate of joblessness among young workers is catastrophically high.

Europe has another periphery far to the north, however, and here the news is very different. The three small countries at the eastern end of the Baltic Sea — Estonia, Latvia and Lithuania — were initially clobbered by the global crisis, but are now showing the rest of Europe the way back. Output and living standards are up, unemployment is down and GDP has almost recovered to precrisis levels.

REAL GDP (2004=100)



REAL GDP PER CAPITA (EU AVERAGE=100)



SOURCE: Eurostat

What has made the difference? Perhaps more important, are there insights to be gleaned from the Baltic experience that are relevant to the larger ailing economies of Europe?

NUMBERS PLEASE

Two charts show just how striking the difference in recovery has been between the small Baltic states (which I'll call the Baltic 3) and four troubled economies on Europe's southern edge (which I'll call the Med 4, even though Portugal doesn't actually touch the Mediterranean). Start with GDP – total output in each group, adjusted for inflation.

A few things stand out. First, in the years before the global crisis, growth in the Med 4 was about average for the euro area, but the Baltic 3 experienced a remarkable boom. Although the Baltic countries were not formally in the euro area at that time, it is still the relevant comparison group, since all three had firmly pegged their exchange rates to the euro. Estonia formally joined the Eurozone in 2011; Latvia is joining in January 2014, and Lithuania hopes to join in 2015.

Second, although all of these countries took a hit in 2009, the dip in GDP in the Med 4 was relatively mild and in line with other euro area countries. In the Baltics, by contrast, the crisis wiped out three-quarters of the gains made during the preceding boom.

Third, the Baltic 3 recovered strongly after 2010, in contrast to the euro area as a whole, which slipped back into a mild recession. The slump in Med 4 members was far more severe: by 2013, their recession was in its fifth year. Forecasts call for a slight upturn in 2014, but whether the recovery grows legs remains to be seen.

Now compare the real GDP per capita in each region with that for the European Union as a whole. The Baltic 3 don't shine as brightly in this context since their living standards are still well below those in the Med 4. At the time they joined the EU in 2004, the Baltic 3 were its poorest members. (Bulgaria and Romania, which joined later, are poorer still.) Even Greece, the poorest of the Med 4, has a higher GDP per capita than Estonia, the most prosperous of the Baltic 3.

On the other hand, the Baltic 3 have

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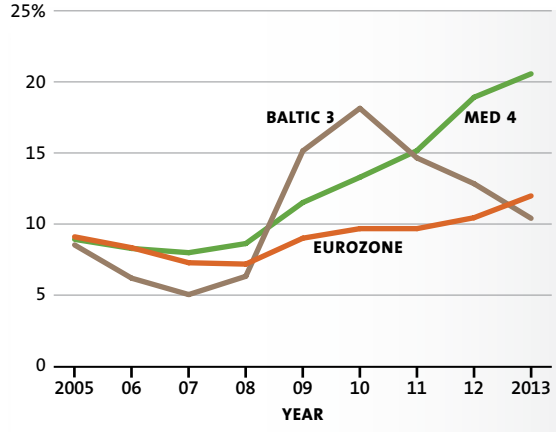
sharply narrowed the gap with the rest of Europe. Although their total GDP has not quite recovered its precrisis peak, their standard of living is higher now relative to the rest of Europe than in the precrisis years.

Meanwhile, the Med 4 are stagnating. Their aggregate performance, of course, reflects in part the free fall of the Greek and Portuguese economies, where real GDP per capita has slipped to about 75 percent of the EU average. But even Italy, where per capita GDP was 20 percent above the EU average a dozen years ago, is now below the average. Much the same can be said for Spain, which also briefly made it above the EU average during its real-estate-fueled boom of the mid-2000s.

One more chart. Unemployment soared everywhere in Europe when the bubble burst, and at first, the impact on the Baltic region was the most severe. By 2010, however, jobs had begun to recover, and by mid-2013, joblessness had dropped below the EU average.

UNEMPLOYMENT RATES



SOURCE: Eurostat

The picture is quite different for the Med 4. There, unemployment lagged the decline in output, thanks to regulations that make layoffs very costly to employers; however, unemployment has kept right on rising. The numbers for youth unemployment are even more distressing. In Greece and Spain, the figures exceed 50 percent; in Italy and Portugal, close to 40 percent. By contrast, youth unemployment in Estonia in mid-2013 was just 15 percent, and was only a little higher in Latvia and Lithuania.

THE BALTIC ROLLER COASTER

The introduction of the euro at the beginning of the century was the most ambitious step yet in the integration of Europe, which began after World War II. The idea is appealing on its face. A common currency makes trade and travel among member states easier, just as a shared dollar does in the United States. And, provided the currency union is stable, it eliminates one source of risk in investing in another country. In political and psychological terms, it reinforces the notion that Europe is one – a reality much on the mind of the Eurozone's founders.

Unfortunately, though, currency areas also have drawbacks that were inadequately addressed in planning for the Eurozone. The big one is that members lose the ability to use monetary policy independently to smooth the business cycle and manage external shocks – say an increase in oil prices. In the Eurozone, monetary policy is made by the European Central Bank on a one-size-fits-all basis.

Although the Baltic 3 all retained their national currencies when they first joined the European Union, their decision to peg their exchange rates to the euro put them in much the same economic position as full euro members. By law, the central banks of Estonia, Lithuania and Latvia have to give first priority to maintaining the currency peg. That has meant abandoning the ability to influence interest rates, inflation and the quantity of money in circulation.

The loss of independent monetary policy leaves fiscal policy as the main tool for smoothing the business cycle. Subject to general rules set by treaty, Eurozone members can adjust taxes and government spending to stimulate or restrain demand.

Admission to the EU (as distinct from the currency union) in 2004 put the combination of fixed exchange rates and discretionary fiscal policy under severe strain in the Baltic states. With per capita GDP just over 40 percent of the EU average, membership opened huge opportunities for growth. Investment flooded in, partly in the form of official EU development funds, partly through loans from the Scandinavian banks that dominate their money markets and partly through private direct investment. As unemployment declined, wages rose. And rising wages increased demand for consumer goods and real

estate. By no coincidence, inflation rose steadily – it was over 10 percent by 2008. The impact on housing was even more pronounced, with price increases exceeding 30 percent in some years.

Other countries that joined the EU in 2004 felt the impact of the same forces. However, the ones that allowed their exchange rates to float against the euro – notably, Poland and the Czech Republic – responded to the money slosh very differently. They allowed their currencies to appreciate steadily as money poured in. And the appreciation prevented the overheating of their economies during the mid-2000s. Then, when the crisis came, depreciation of the Polish and Czech currencies cushioned the impact on output and employment by making their products more competitive in global markets.

In principle, even without flexible exchange rates, the governments of the Baltic countries could have tempered the unsustainable boom with the wise use of fiscal policy. But the budget rules imposed as a condition of EU membership had little bite in the Baltics.

Those rules required only that EU members limit their annual budget deficits to less than 3 percent of GDP and their total government debt to 60 percent of GDP. But with tax revenues booming as their economies expanded, budget deficits fell below one percent of GDP in Latvia and Lithuania, while Estonia actually ran a small surplus. And since they were burdened with essentially no government debt at the time of their independence from the Soviet Union, they never got close to the 60 percent limit.

What the EU rules did not mandate (and Baltic governments did not pursue) were *countercyclical* fiscal policies – policies that moderate spending and/or raise taxes during booms, while going the other direction in response to recession. More precisely, the Baltic states failed to track their budgets' structural balances, the surpluses or deficits they would have experienced if their economies were operating at full capacity.

During the years of rapid growth in the mid-2000s, the Baltic 3 should have taken measures to achieve structural surpluses. Unfortunately, the extra tax revenue brought in by the boom masked the fact that structural balances remained substantially in deficit throughout the region. That was true even in Estonia, with its budget surpluses. Thus, rather than leaning against overheating, the fiscal policies of all the Baltic governments were adding fuel to the fire. Far from being countercyclical, their policies were actually *pro-cyclical*. Playing by the rules – the misguided rules embodied in the EU treaties – set them up for a bigger-than-average fall when the financial crisis hit.

THE BALTICS

The Med 4 countries also experienced the malign effects of fixed exchange rates and pro-cyclical fiscal policy, but not to the same degree. Except in Greece, budget deficits did not grow markedly in the period leading up to 2008. That helped to limit the extent of overheating, and as a result, made the immediate impact of the crash less severe. Why, then, are the Baltic 3 recovering, while the Med 4 lag?

LOCATION MATTERS

Ask people in the Baltics what natural economic advantages they enjoy, and they'll mention their location at a strategic crossroads between North and South, East and West. Geography endows them with many of the healthiest EU economies as trading partners. To the north, there's Scandinavia, whose economies have outperformed the EU average since the global crisis. To the south, there's Poland, the only EU member to avoid a recession entirely, and Germany, the largest and strongest EU economy.

In contrast, much of the intra-EU trade of the Med 4 is with one another and with another underperforming member, France. Germany is the only major trading partner that the Med 4 countries share with the Baltic 3.

East-West trade is also important to the Baltic economies. Economic links with Russia are nowhere more apparent than in Latvia, which is geographically at the center of the Baltic 3. First, there are strong ties of culture and language imposed on Latvia during the long Soviet occupation: nearly half of the population of Riga, Latvia's capital, is of Russian origin. For people in the business community, whether of Russian or Latvian ethnicity, proficiency in at least three languages (Latvian, Russian and English) is a given.

Language is only part of the story, however. Latvians often emphasize that they understand not only the speech of their Russian business partners, but also their ways of thinking and negotiating – ways that can be quite foreign to Western Europeans.

Strong transportation links are a second plus. The first time I heard Latvians brag about their excellent rail system, I was taken aback since the Baltics lack good connections with the rest of the EU. A long-discussed project to build a high-speed line from Tallinn through Latvia and Lithuania and into Poland and Germany seems to be going nowhere.

The freight rail connections from Riga eastward are a different matter, however. Not only is the line in good condition, but, as a legacy of the Soviet period, it retains the wider Russian rail gauge. Rail traffic can go straight from the port of Riga to Moscow and beyond. And "beyond" can be a long way: from Riga through Russia by rail has been the cheapest and most reliable routing for tens of thousands of tons of American supplies for war and reconstruction in Afghanistan.

Third, Latvia is the preferred financial gateway to the EU for many Russian companies. Although Cyprus has received more attention as a venue for Russian offshore banking, Latvia is far closer to Moscow. And many Russians like the assurance of being able to do business in their own language in any branch of a Latvian or Nordic bank in Riga.

To be sure, Russia's economic relations with the Baltics are not without strains. Latvia and Lithuania resent their dependence on gas from Russia, for which they pay prices well above current global averages. (Estonia, by way of exception, is proud to be the most energy-independent country in the EU, thanks to its abundant deposits of oil shale.)

Furthermore, trade with Russia is always vulnerable to political disruption. In one incident, the 2007 relocation of a World War II

memorial to the Soviet cause in Tallinn led to economic retaliation against Estonia in the form of of rail service disruption and cyber attacks. More recently, Lithuania used its turn in the rotating EU presidency to push for stronger linkages between the EU and Ukraine. Russia retaliated by banning imports of Lithuanian dairy products on the flimsy pretense of health concerns.

Such incidents aside, however, increasing Baltic integration with Western Europe has not displaced trade and financial ties with Russia and other former Soviet republics to the east, but rather has facilitated them.

LABOR MARKETS MATTER, TOO

Baltic entrepreneurs complain that it's difficult to find qualified workers. The causes: emigration to more affluent EU members, an education system ill-designed to serve a business economy and low birth rates – a worrisome factor in the long run if it isn't reversed. But to an outsider, the contrast with Spain and Greece is striking. What Baltic employers see as an acute labor shortage is also a sign of economic growth and healthy diversification into enterprises needed to catch up with Western Europe.

The most important differences in labor markets between northern and southern Europe lie in the institutions that determine how easily workers can move in and out of jobs. A labor market with high mobility allows an economy to adapt better both to temporary shocks (like the financial crisis) and to trends like changing patterns of trade and diverging productivity. In times of change, there is a tension between the desire to protect incumbent workers from job loss and the need to move workers of all ages, including those just entering the labor force, into jobs where they are most productive.

Two aspects of labor market rigidity are of special importance in Europe. One is legal protection against dismissals, both individual and collective, that give employers an incentive to employ fewer workers in the first place.

The freight rail connections from Riga eastward retain the wider Russian rail gauge. Rail traffic can go straight from the port of Riga to Moscow and beyond.

The other: limitations on hiring temporary workers. Taken together, they've created a dual labor market in much of Europe, where some workers have well-paid jobs from which they cannot be dismissed, while others, especially new graduates, are either unemployed or stuck in dead-end temporary jobs.

Which brings us back to the aforementioned contrast: on the whole, labor markets

are much less rigid in the Baltic countries than in southern Europe. One measure of the flexibility gap is a set of employment protection indicators compiled by the OECD. On a scale where lower numbers indicate more flexibility, the Baltics score 0.97 for protection against dismissals compared with an average of 1.27 for the Med 4. (Note, however, that labor markets in both regions are less flexible

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than in countries that follow the so-called Anglo-Saxon model, including the United States, Britain and Canada, which average 0.22 on the OECD scale.)

The numbers for regulation of temporary work are similar. The Baltics score 1.21, compared with 1.39 for the Med 4 – but both are more rigid than the Anglo-Saxon group.

What's more, anecdotal evidence suggests that the contrasts on the ground are greater than those implied by the OECD numbers, which don't reflect how strictly (or laxly) regulations are enforced. Nor do they reflect differences in unions' inclination to defend the letter of the law or, for that matter, workers' willingness to invoke legal protections against layoffs and dismissals.

The World Economic Forum provides a different ranking based on perceptions of how efficiently labor markets actually operate. The forum's numbers suggest that the differences in labor-market efficiency between the Baltic 3 and the Med 4 are significant. The average ranking of the Baltic 3 is 31st out of 148 countries surveyed. Estonia is 12th, suggesting that it has one of the most efficient labor markets in the world.

In contrast, the average efficiency ranking for the labor markets of the Med 4 is 126th, with none of the Med 4 in the top 100! Italy's ranking, at 137th out of 148 countries, is downright dismal. Small wonder, then, that the Baltic 3 have unemployment rates just half those in the Med 4.

ROOM FOR IMPROVEMENT

The top two complaints about doing business in the Baltics are corruption and bureaucracy – both of which are holdovers from the region's Soviet past. The Corruption Perceptions Index compiled by Transparency International gives the Baltic states an average ranking of 44 out of 178 countries, which is actually a bit better than the Med 4, with an average ranking of 57. Those averages, however, hide wide variations within each region. Spain is less corrupt than any Baltic country, while Portugal is in a virtual tie with Estonia, the cleanest of its group. What drags down the Med 4 average are the corruption rankings for Italy (72) and Greece (94).

All three Baltic nations score well on the World Bank's Ease of Doing Business index, with an average ranking of 21 out of 170 countries. That puts them collectively in a tie with Germany and ahead of Switzerland (29), France (38), the Netherlands (28) and all of the EU's southern and eastern peripheries. But Estonia and Latvia show contrasting weakness on the World Bank's Ease of Start-

ing a Business subindex, ranking 61 and 57, respectively. That puts them ahead of Italy (90) and Spain (142!), but far behind most of northern Europe. And it reflects the burden of bureaucracy in post-Soviet states that haven't fully reformed their regulatory practices.

Interestingly, difficulties with corruption and bureaucracy apparently haven't slowed the emergence of new businesses very much. Latvia, for example, enjoyed four times the rate of start-ups as Spain, which is admittedly depressed. One American ex-pat entrepreneur who now lives permanently in Riga explained this paradox to me by noting that the Soviet experience taught Latvians how to cope with adversity.

THE BALTIC ADVANTAGE

The economic success of the Baltic 3 can't be attributed to a single factor, giving ideologues room to impose their own interpretations. Some have chosen to interpret the Baltic experience as a success story for fiscal austerity, as if tax increases and spending cuts were the best cure for economies in a slump.

I find that interpretation hard to support. Keynes argued – and no one since has really dented the argument – that pro-cyclical austerity during a downturn is part of the problem, not the solution. We can declare the disease of perverse fiscal policy cured only when we see that a country is able to maintain fiscal discipline during its next expansion.

There are early signs that the Baltic 3 are doing better during the current expansion than during the previous one, but it is really too soon to be sure. We have even less indication as to how well the Med 4 will manage their budgets during the next expansion since their economic cycles are, at best, just now reaching the perigee.

Part of the reason for a more rapid rebound in the Baltics, as we've noted, lies in their luck to be living in a good neighborhood. An even more important factor, in my view, is the fact that their market economies are younger and more flexible. Baltic labor and product markets adapt more rapidly to change than those in southern Europe.

Governments in both the Baltic 3 and Med 4 have made some of the same policy mistakes. But the bad habits are not deeply entrenched in the Baltics and should prove easier to break. Also, institutions that protect the interests of established workers and firms are not as strong in the Baltic region, making it easier for workers to change jobs or to enter the market for the first time, and for new businesses to emerge to replace those that fail.

The Baltic market economies are younger and more flexible. Baltic labor and product markets adapt more rapidly to change than those in southern Europe.

Finally, there is the simple reality that the Baltic economies are small. The Portuguese economy, the smallest of the Med 4, is six times larger than that of Lithuania, the largest of the Baltic 3. Italy's economy is 100 times larger than Estonia's.

In recent conversations, corporate executives and entrepreneurs in Latvia mentioned size as a factor in economic success again and again. A few noted that small size has a downside, in that small economies are more exposed to external shocks from their giant neighbors. Much more often, however, they equated small size with the unity and flexibility needed to respond to emerging opportunities. For the moment, anyway, small is beautiful.

FIRST

CLIMATE NOW

WATER

BY THOMAS J. HEALEY

If you doubt that the world is on the brink of life-altering shortages of fresh water, consider this example. In Yemen, 25 million people face the specter of a whole country running bone dry. Already, water supplies in this arid environment are so low that households are permitted to run their taps for only brief periods once or twice a week. The rest of the time they must rely on trucks that roam their neighborhoods, selling water like heating oil or vegetables. Streams and natural aquifers are dwindling by the day, and the water table in the capital, Sana, has dropped below sustainable levels. In rural areas, where access to clean water is most severely limited, the water crisis is morphing into a public health crisis: dengue fever, diarrhea and cholera have spread at alarming rates.

Not surprisingly, water is increasingly a source of deadly conflict among ethnic groups in Yemen, which zealously protect the meager supplies they control. And the phenomenon hardly respects borders. Indeed, tensions over the ownership and use of water are exacerbating international tensions – notably in flashpoints like southern Asia.

To be sure, the phrase "water crisis" has a faraway feel, something that happens on the other side of the world – in places like Yemen.

THOMAS HEALEY, a former assistant secretary of the Treasury and partner at Goldman Sachs, is a senior fellow at the Kennedy School of Government at Harvard University.

In truth, though, water is in disturbingly short supply in developed countries, too. Think of the western United States and Australia, both of which are in the grips of devastating decades-old droughts. Unless steps are taken soon to improve the way water is managed, local shortages could cascade into a global catastrophe, reducing food supplies and undermining the health of billions.

WATER, WATER EVERYWHERE...

How can we be short of water when there's so much? The great bulk, of course, is salty. But vast quantities of fresh water are inaccessible because they are locked in glaciers, icecaps

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and permanent snow cover, or are remote from human settlement. Only 0.007 percent of it is both sweet and readily accessible.

Stark signs of the global water scarcity abound. As the result of rapid, ill-planned economic development, there isn't enough water in China today to satisfy the demands for drinking, sanitation, irrigation and industrial uses like cooling power plants. Some 60 percent of China's cities are seriously short of water; water tables around Beijing and other major northern metros have dropped so low that existing wells are unable to tap them.

In Brazil and South Africa, households and businesses suffer frequent brownouts because there isn't enough water to drive the turbines of hydroelectric plants at full capacity. Arguably most ominous, the glaciers of the Himalayas and Tibetan Plateau, which cover parts of five countries and provide the melt each spring that swells the great rivers of the region, are imperiled. Almost one-fifth of the Indian Himalayas' ice coverage has disappeared since 1960. And computer models predict that glaciated areas across the Himalayas will shrink by another two-fifths over the next half century.

Americans will certainly not be spared from serious shortages. Tim Barnett, a geophysicist with the Scripps Institution of Oceanography, estimates that Lake Mead, the great reservoir formed by the Hoover Dam that supplies water to millions of desert farmers and residents in Nevada and Arizona, could be dry by 2021.

WHY NOW?

As the world's population more than doubled over the past half century (to 6.7 billion), water use roughly tripled. Population growth is clearly slowing and may peak as early as 2050 at eight billion, rather than topping 10 billion in 2100, as the United Nations projected two years ago. But even in the most optimistic projections, most of the growth will be concentrated in countries that are already water-starved and can ill afford to develop new sources.

In any event, the demand for food – in particular, for animal products produced with grain – is bound to rise more rapidly than the population, putting disproportionate pressure on water supplies. Already, farmers account for more than 70 percent of water use (compared with less than a fifth by industry and a tenth for household use).

Another disaster in the making is inextricably linked to water scarcity: global warming. Climate models are not sufficiently fine-tuned

to predict the precise impact of atmospheric warming on complex (and delicate) hydrological systems. We know with near certainty, though, that the resulting changes in weather patterns will alter rainfall, river flows and freshwater reserves significantly. Some areas of the world will grow wetter as a result of climate change, increasing the prospect of flooding; others will become dryer and serve as possible flashpoints for drought, crop failure and widespread famine. It's also safe to conclude that those areas of the world where water is already scarce, like the densely populated countries cradling the Himalayas, are going to be subject to the most traumatic changes.

Even if global warming doesn't reduce average rainfall, it will put tremendous pressure on water management by intensifying drought-flood cycles. On the one hand, reservoirs don't have the storage capacity to get people through prolonged droughts. On the other, megastorms overwhelm flood control systems. Moreover, global warming is forcing glaciers around the world to recede at an alarming rate. This increases the prospect of more extreme drought-flood episodes since snow and ice have served through the ages as natural regulators, storing water in high-precipitation winters and releasing it in low-precipitation summers.

DECAYING INFRASTRUCTURE

For 1.1 billion people around the globe – most of them in poor countries – the issue of water scarcity is dwarfed by the issue of water safety. At the root of the problem of securing access to potable water is inadequate infrastructure for storage, treatment and distribution. Even in countries with well-developed distribution and sanitation infrastructures, deteriorating systems waste staggering amounts. Britain, for example, squanders almost 200 million gallons of water a day because of aging water mains and frequent raw sewage overflows from antiquated treatment systems. In the United States, hundreds of thousands of miles of underground water pipes laid generations ago are in disrepair and will require an investment of $250 billion to $500 billion over the next 20 years to be brought up to standard.

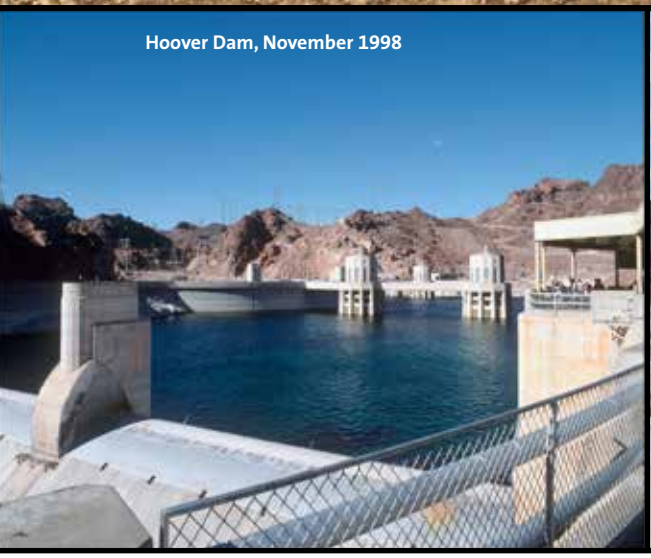
The problem is most acute in countries that are rapidly urbanizing – and lack the capital and technical capacity to build large-scale infrastructure to bring clean water to population centers. And when these facilities are built, governments too often lack the money to maintain them. In New Delhi, fully a third of the city's water supply is lost to cracked and aging pipes.

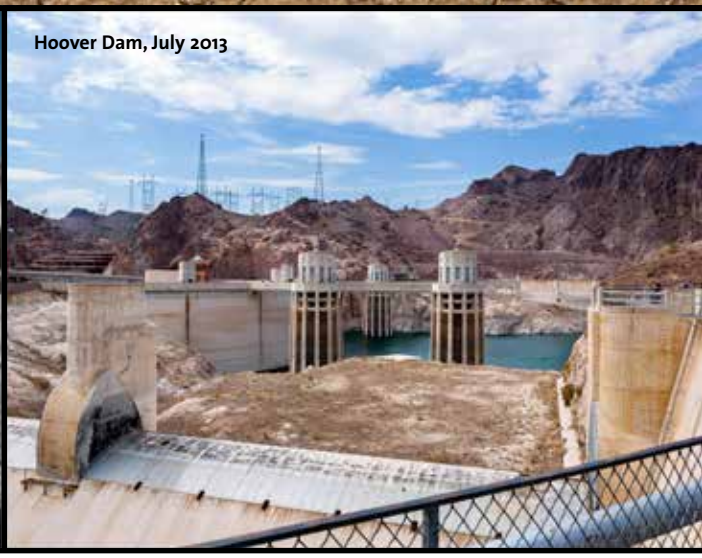
Aging infrastructure is becoming a public health hazard even in some places that have the financial resources (if not the foresight) to keep up infrastructure. According to the EPA, more than 3.5 million people became ill from microorganisms and toxins released by faulty sewage systems in the United States in 2006.

One hopeful sign in the United States: financially struggling local governments are turning to the private sector for help in repairing decaying water systems. Globally, cooperation between the public and private sectors, as well as between national and regional authorities, could play the same role.

WATER POLLUTION AS A GLOBAL THREAT

Even sound distribution and treatment infrastructure, however, is no guarantee of safe water. Too often, watersheds become polluted with industrial chemicals, pesticides, microbes and heavy metal salts leeched from soil by agricultural runoff. Some two million tons of human and industrial waste are dumped


Hoover Dam, November 1998


Hoover Dam, July 2013

daily, and a portion of it threatens aquifers and surface-water sources. Indeed, nearly 80 percent of the world's population lives near rivers in which pollution is a clear and present danger to both human and aquatic life.

Startlingly, rivers in the developed world are experiencing some of the highest threat levels, at least in part because of strategic missteps. "We know it is far more cost-effective to protect these water systems in the first place," said Charles Vorosmarty of the City University of New York. "The current emphasis on treating the symptoms rather than the underlying causes makes little sense from a water security standpoint, a biodiversity standpoint or even an economic standpoint."

The metaphoric rubber hits the road where potable water and sanitation converge. Without adequate supplies of water for waste disposal, cross-contamination of drinking and bathing water by untreated sewage can occur. According to the Water Supply and Sanitation Collaborative Council, a multinational donor, lack of sanitation is the world's biggest cause of infection; 88 percent of cases of diarrhea worldwide are attributable to inadequate isolation of potable water and sanitation systems.

CONFLICT TRIGGER

Dwindling or disappearing reserves of freshwater are creating flashpoints both between nations and within them, raising strategic security concerns. Maude Barlow, the chair of the nonprofit Food and Water Watch advocacy group, estimates that 200-plus rivers and 300 groundwater basins and aquifers are shared by two or more countries. Examples abound:

- Israel, Jordan and Palestine all rely on the Jordan River, which is controlled by Israel.
- Turkey's plans to build dams on the Euphrates River brought it to the brink of war with Syria in 1998.
- The Brahmaputra River has been a constant source of friction between China and India.
- Flooding along the Ganges River caused by melting glaciers in the Himalayas is precipitating the contentious migration of displaced citizens of Bangladesh to India.

IS IT FIXABLE?

Even a cursory look suggests that the water crisis is in part a crisis of management: those who control access have inadequate incentives to use it in ways that reflect its highest value.

And because agriculture is by far the world's biggest consumer of water, it provides the most fertile opportunities for low-cost gains. Indeed, modest investments in more efficient irrigation practices could yield vast savings. For example, more than half the irrigated agricultural land in the United States is served via gravity-flow systems, which result in water loss of up to 50 percent through evaporation, inefficient water delivery to the crop-root zone and runoff at the edge of fields.

But there is clearly some low-hanging fruit to be gathered in other environments, too. Capital-starved countries, for example, can engage low-cost technologies like rainwater-harvesting systems, which capture water from roofs and store it in underground tanks. And repairing aging urban distribution systems could postpone the day when rapidly growing cities are forced to compete with farmers for limited supplies. In wealthier countries, improved water management could mean far more ambitious investments to offset greater weather volatility – for example, mass storage facilities that could be filled when water is episodically plentiful and tapped when it wanes.

Technology could also provide effective, longer-term solutions for managing scarcity. Australia, which recently suffered the worst drought in its history, is a case in point. The government has launched a five-year $1.3 billion project in northern Victoria state (home to Australia's capital, Melbourne) to refurbish the region's century-old irrigation system with computer-controlled channels that are expected to curtail waste, currently as high as 30 percent.

Note a constant, if implicit, theme here: coming to grips with growing water scarcity will require changes in the government's role – in some cases increasing intervention, in others decreasing it in order to allow private markets to determine allocation. For one thing, water markets are riddled with "externalities": my use of water raises the cost of water to you.

And in many cases, those affected are hundreds or thousands of miles away.

Efficiency gains will thus require greater cooperation across political jurisdictions and greater regulation within jurisdictions. In many places, for example, there is no regulation of the use of aquifers: anybody is welcome to tap into a common underground source. In many places, for that matter, aquifers are poorly mapped and little is known about their sustainable supply capacity.

Cross-border regulation can be maddeningly difficult, but the prize is often worth it. The Indus Waters Treaty was signed in 1960 between India and Pakistan with the goal of adjudicating conflicts over the allocation of water between two deeply hostile nations. Since then, the joint Indus River Commission has provided an effective mechanism for consultation and conflict resolution. The key here seems to be taking cross-border disputes out of the abstract nationalist context and focusing on practical resolutions that fit the needs of the direct stakeholders on both sides.

But the cases for deregulation and/or privatization can be equally compelling. Water is all too often priced according to its historic cost. Thus, farmers in the California and Arizona desert, who pay almost nothing for water, find it profitable to grow low-value animal fodder as well as "monsoon" crops like rice that are best left to Vietnam and Thailand. In a better world, water prices would be determined by supply and demand, leaving it to the market to decide what crops are grown where and with what sort of water-conserving technologies.

Of course, market-based reforms produce losers as well as winners, at best complicating the politics of change, at worst preventing it entirely. But there are ways around the problem. For example, rather than charging more to farmers as a means of changing their behavior to reflect the market value of water, one can approach the same outcome by making it both legal and easy for farmers to sell their rights to the water to the highest bidders. That's an injustice in some people's view (why should the windfall go to the farmers?), but is surely better for society than the status quo stalemate, in which the farmers waste much of their bounty.

By the same token, one can tinker a bit with price incentives to produce relatively efficient outcomes that seem fair and generate less political pushback. In water-starved Las Vegas, for example, officials were eager to create market-based incentives for encouraging conservation. But to give those with modest incomes a break, they increased prices for low-volume users by just 17 percent, while raising prices for greater use by some 30 percent.

OUT OF MIND...

Managing water deficits requires political will and policy flexibility – no small challenge. Indeed, the challenge may not be possible to meet without greater public awareness of both the stakes and the implications of alternative policy approaches. Getting from here to there is plainly an uphill battle because most people in the developed world have no experience with the risks of shortages in terms of health and economic dislocation.

Public debate with the intensity of what is now taking place around global warming will be needed to give the crisis the sense of urgency required to produce the momentum for action. What's needed, I suspect, is an initiative for water akin to that of the Intergovernmental Panel on Climate Change, one that is science-based and highly credible. After all, as with climate change, the alternatives to broad-based reform are unthinkable: if the world continues to treat water as a costless resource, there will be big trouble ahead.

Copyright: Hope v Reality

By Stan Liebowitz

The basis for American copyright laws is laid out in the Constitution: "To promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

Happily, the founders' reasoning conforms nicely to the economic analysis of the underlying issue. But it has been a matter of debate whether the current law conforms to this constitutional instruction – or more generally, whether the law creates economically efficient incentives to create and distribute the property in question. In fact, the contemporary debate over how best to reconcile the sometimes conflicting goals of copyright regulation is really a modern rendition of a centuries-old argument. Here's a primer on how to think about the question.

WHAT DOES COPYRIGHT PROTECT?

Copyright is intended to protect the expression of ideas, not the ideas themselves. It does this by allowing the owner to determine who is allowed to make copies of the work being protected. Copyright was originally applied to books. But as technology changed, protection was broadened to cover creative works ranging from recorded music to film to visual art. There are often layers of rights – in a movie, for example, the screenplay, the book or magazine article it's based on and background music may be separately protected. Untangling these layers of rights provides employment for an army of lawyers.

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Unlike patents, copyright is supposed to protect an author only from someone avoiding the costs of creation by copying the author's work. Copyright does not bar independent creation of similar or even identical work.

To illustrate this narrow range of protection, consider the copyright that allows J.K. Rowling to prevent her stories from being printed, translated or turned into movies without her permission. It does not allow her to bar others from publishing fiction about, for example, boarding schools that teach magic, even if they are piggybacking on the same customers.

In principle, then, it should be fairly easy to determine whether a work infringes on others' copyrights. If you publish a 200-page story that is word-for-word identical to mine, that's surely an infringement because there is an essentially zero probability that you could independently create an identical work. Indeed, it is virtually impossible to create even a single identical paragraph without copying. On the other hand, if you create a very similar story, but devise your own plot and

characters and write each paragraph yourself, you're not infringing.

That said, there are some hard cases to judge. The main tune in a song may have less variety than that found in a typical paragraph. Two almost identical tunes might be independently created, and copyright infringement cases for songs often revolve around the issue of whether the writer of the second song heard the first song.

Parodies of works are allowed under copyright, although there can be a fine line between a parody and a copy (or derivative work). A cause célèbre among critics of copyright was a book published a few years ago called *The Wind Done Gone*. It borrowed the characters from *Gone With the Wind*, but retold the story from the perspective of the slaves. Margaret Mitchell's estate accused the author of infringement, but the courts eventually ruled that the newer work was a parody, not a copyright infringement. The publicity over the court case, it's worth noting, was probably good for sales of both books.

Fan fiction, where fans of, say, *Star Trek* create works using characters from the original but provide original plot lines, is usually considered a derivative work. Derivative works are often considered infringements of copyright, although many copyright owners seem willing to overlook the transgressions because they believe the derivative work serves their own interests by keeping the fans happy.

In light of the narrow nature of the legal protection, I believe it is a mistake to say that copyright provides a monopoly, as the term is used in economics. The "monopoly" it provides is no different than the monopoly everybody has on his or her own talents, or the monopoly that any firm has on its own branded products.

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A CAPSULE HISTORY

The U.S. Congress passed copyright legislation just three years after the adoption of the Constitution. The initial term was 14 years, followed by another 14 years if the copyright was renewed. But copyright was only for American authors. For most of the 19th century, the United States was something of a rogue in this regard, failing to extend protection to foreigners. (Ironically, this failure gave foreign books printed in the United States a leg up in the American market, since without the need to compensate the author they were less costly to publish.)

Foreign authors could close the loophole by finding an American "coauthor" to write a preface, thereby protecting the entire book. But sharing the credit was more than some authors could stomach: Rudyard Kipling (among others) refused to make this sort of arrangement, while T. H. Huxley acceded.

Canada applied tit-for-tat, denying copyrights to Americans. Mark Twain beat the Canadian system by spending several weeks in Montreal before publication of *The Prince and the Pauper*, thereby gaining temporary Canadian residency.

Arnold Plant, an early 20th-century economist, examined the state of United States publishing during the late 19th century, concluding that some British authors made more money in the United States without copyright than they did in Britain with copyright. His argument: being first in the market provided a sufficient time cushion to allow most of the benefits of copyright to go the creator of unprotected work. But his case was weaker than it looked since the American market was already considerably larger than the British

market, implying that parity in sales was still indicative of weaker protection.

Early 20th-century U.S. copyright law provided 28 years of protection, followed by another 28 on renewal. This has gradually been extended. In 1976, the term was increased to 50 years *after the death of the author*, and in 1998 it was increased to 70 years after the death of the author. (Works created under contract – "works for hire" – have different copyright lengths since there is no "life" upon which to base the duration.) The 1998 extension, by the way, triggered an academic and legal backlash that I'll detail later.

The scope of copyright has kept up, imperfectly, with new technologies. The owner of a copyrighted sound recording of a musical composition is paid each time the recording is played on the radio. But owners of copyright on the performance of the song on those same sound recordings are not paid when the record is played on the radio (United States law is unusual in this regard). Thus, if the radio plays a recording of Rod Stewart singing a Gershwin song, Gershwin is paid but Stewart is not. If the same recording is streamed over the Internet, however, both the owner of the composition (Gershwin) and the owner of the sound recording (Stewart) are paid.

There is no logical distinction between these cases. In large part they reflect the varying political clout of the stakeholders when the rules were set. And that's no way to run a copyright system.

LIMITS ON COPYRIGHT PROTECTION

The most important limitation to copyright protection is a concept known as "fair use," which provides defenses to infringement claims. Originally a common law concept, it was codified in the 1976 copyright law. Simplifying a bit, fair use applies if:

- Only a small amount of the work is copied.
- The use is educational and/or nonprofit.
- The work is nonfiction.
- The market for the original work is hardly damaged by the copying.

None of these rules are hard and fast. For example, in the Betamax case (*Sony v. Universal City Studios*, 1984), the Supreme Court held that making a videotape of a broadcast television program was fair use. The first three conditions hardly applied. But because

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these programs were supported by advertising and the advertising was contained in the videotape copy, it was unlikely that the market for broadcasting would be damaged, implying that the last condition was likely to be met.

Fast-forward 30 years, and assumptions of no financial damage seem much weaker since modern recorders can strip out commercials. Currently, Dish TV, which makes no secret of the fact that its Hopper DVR can remove commercials, is being sued for copyright infringement. Nevertheless, the Betamax fair-use precedent will be difficult to overturn.

Another restriction on copyright is the compulsory license. Such a license compels a copyright holder to make the work available to all users as long as the user meets certain conditions (for example, pays a stated fee).

Have you ever wondered why Pandora, the Internet streaming service, does not allow you to pick an individual song, but only a performer, composer or genre? This limitation is due to a compulsory license that Pandora wants to use. When Internet streams are controlled by the listener, the stream is categorized as "interactive" and the copyright rates (for sound recordings) are set by private negotiations between the parties. When Internet streams are classified as noninteractive or semi-interactive, the streaming entity can pay the compulsory license copyright fee (for the sound recordings), which is currently considerably less than the market payments for interactive streams. Pandora cannot let users cross a line on the control of streaming content or it would be classified as an "interactive" service and oblige the company to pay the higher royalty.

AN ECONOMIC ANALYSIS OF COPYRIGHT

Start with a light dusting of jargon. When a typical good is consumed – say, an apple or a box of tissues – it becomes unavailable to others. But with creative works like books, consumption may be "non-rivalrous." That is, my

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reading of *A Tale of Two Cities* does not preclude anyone else from reading it. Nothing is used up when you "consume" the work; while a physical book may become more worn, the story it contains is not affected.

Another economic characteristic labeled "non-excludability" is often (though incorrectly) linked to non-rivalrous consumption. There are some items, like national defense, for which it is essentially impossible to exclude individuals living in the country from benefiting from the safety it provides. But intrinsically non-excludable items are far and few between.

It was claimed by no less an authority than Paul Samuelson, a towering figure in the history of economic thought, that television broadcasts were non-excludable. This was true for a while in the United States, but only because of the way over-the-air broadcasting was regulated. It was not an economic characteristic of television broadcasts per se. For example, television broadcasts were excludable in Britain for several decades after World War II. Specialized vehicles with electronic sensors roamed the streets to catch unauthorized television viewing by households that did not pay a user fee to the BBC.

In general, with sufficient resources brought to bear, unauthorized consumption of intellectual products can largely be prevented, just as theft and shoplifting can largely be prevented. Thus, non-excludability is normally a function of legal protection and the failure to invest in protective systems (like signal scrambling for cable TV) rather than a fundamental characteristic of copyrighted products.

But back to non-rivalrous consumption, which is a characteristic of copyrighted goods. To achieve economic efficiency – maximizing the net value to society – once the book, song, play or movie is created, everyone who values it more than the cost of reproduction should be allowed to consume it. By this logic, in a world in which the reproduction costs are close to zero, as is largely the case with digital goods distributed over the Internet, all potential users should be allowed to consume it.

But if there were no charge to consume the product, where would the money come from to pay for its creation in the first place? This conflict between the efficiency of a low price to encourage consumption and a higher price to provide the incentive to create is known as the efficiency tradeoff in the production of non-rivalrous goods like copyrighted and patented goods.

One theoretical solution – "perfect" price discrimination – is to charge each consumer just slightly less than the maximum he is willing to pay. There are a couple of problems, though. First, all of the surplus from the market exchange would go to the seller rather than the buyers, which may seem unfair if you are a consumer. Arguably more important, sellers would need to be mind readers to set prices perfectly. Inevitably, sellers would err, overestimating the value to some potential consumers and driving them from the market.

Because a price of zero provides no revenues to producers and because perfect price discrimination is only a theoretical fantasy, neither approach to maximizing value is practical. A third approach – really another fantasy – would be to have the government pay to create copyrighted works. Were the government to pay creators just enough to persuade them to produce works that consumers would collectively value more than the cost, and then give away the creation, the inefficiency would disappear. But there are problems.

First, it would take a crystal ball to know which efforts should be financed. Second, the funds to pay creators would have to come from somewhere, and taxes create their own inefficiencies. So government funding would

trade one type of inefficiency for another. Third, it seems dangerous to put the government in charge of creativity since censorship and bias are likely to arise in its choices.

Most of the time, then, we use a rough-and-ready market-based approach, allowing the copyright owner to pick the price. That gives creators an incentive to create works for which revenues (or personal satisfaction) appear likely to cover the cost of creation. Consumers, for their part, get to consume the product if it's worth it to them at the price. Eventually, the copyright expires and anyone can consume the product for the cost of reproduction.

That still leaves the duration of copyrights to be decided – a decision that evokes the now-familiar tension between incentives for creation and benefits of low prices to consumers. Long-duration copyrights favor creative activities; shorter durations favor consumers.

Implicit in the debate over copyright duration is the assumption that one duration fits all. Yet that seems implausible on its face. An ideal copyright law would provide just enough protection to induce production – a point understood for a long time. In 1841, the historian-politician Thomas Macaulay argued:

> It is good that authors should be remunerated; and the least exceptionable way of remunerating them is by a monopoly. Yet monopoly is an evil. For the sake of the good we must submit to the evil; but the evil ought not to last a day longer than is necessary for the purpose of securing the good.

I have argued that an "efficient" copyright system along Macaulay's line would be unfair because it would funnel all the net value to consumers. It's unclear, after all, why we should squeeze creative occupations protected by copyright in this way, but allow other markets to direct much of their surplus to other categories of producers – for example, to athletes, movie stars and entrepreneurs.

THE PROBLEM WITH EFFICIENCY

Our market-based economy does not always – or, for that matter, very often – aim at maximizing economic efficiency over other societal goals. Yet that's the perspective of economic analyses of copyright policy. And it can lead to some uncomfortable implications.

For example, copyright critics following in Arnold Plant's footsteps argue that some creators do not need copyrights to induce them to create. After all, there are all sorts of motives for creation other than money – for example, fame, not to mention the delight in creation. For that matter, some artists may do their best work while starving.

Let's take that last point seriously. What if artists do better work when poor than when rich? What would an efficient copyright system look like under these circumstances? Economics provides a simple answer. In this hypothetical world, giving artists money would be like polluting the air – a negative externality borne by society rather than the buyers and sellers. The solution: tax artists to keep them poor, just as we tax air pollution to make polluters change their behavior.

Let's go one step further. What if making slaves out of artists increased their production even more? What if it were unambiguously clear that their enslavement would generate more gains to others than losses to the artists? That's efficiency – and, plainly, it's not what we would want.

Skeptical of extreme hypotheticals as debating points? Take the very real case of the British-based multinational ARM Holdings, which designs the microprocessors found in most smartphones and tablets. ARM does not produce the chips; its output consists solely of their designs, which are perfect examples of non-rivalrous goods. What would an efficiency-focused analysis have to say about the optimal copyright length for this company?

The analogous logic to determine optimal copyright length would say that ARM should be allowed to generate all the revenue that allows it to cover costs, and not a penny more. Of course, we don't treat these firms this way. Is it really fair to treat copyright industries as sui generis cases where economic efficiency is paramount?

THE NEVER-ENDING DEBATE

Eldred v. Ashcroft (2002), a challenge to the 1998 copyright extension, worked its way to the Supreme Court. Critics of the extension to 70 years after the author's death claimed that it eviscerated the constitutional "limited term" requirement. Certainly, 120 years of protection for an author who writes a work 50 years before death is a long time. But the number is still finite and the term is still of "limited" duration. It's thus surprising that the case made it to the Supreme Court and that the challenge was supported by even two of the justices.

What the case had going for it were groups of influential legal academics and economists, which submitted "friend of the court" briefs. The economists, among them several Nobel Prize winners, argued that the extended duration made copyright too long. Few new works, they concluded, would be brought forth by the extension because the revenues generated by the extra 20 years of copyright life would be too small to increase current output.

They're right that the "present value" of revenues discounted so far into the future would lead to small increases in expected revenues. But the assertion that a small increase in revenues would have only a small impact on current production might or might not be true; it depends on how elastic the supply of new works is with respect to increases in expected revenues.

Moreover, the group failed to acknowledge that, by the same reasoning, the present value of the benefits of increased future consumption if copyright expired in 90 years, say, instead of 110, was also small. In truth, there is not remotely enough information for anyone to claim to know the ideal copyright duration.

Further muddying the waters was a secondary issue that offered a stronger case to

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critics of the law: the increase in copyright length was made retroactive to works that had already been created. Since the overriding economic purpose of greater copyright duration is to increase the incentives for creativity, the economic argument for increasing duration for works that have already been created simply does not exist.

Of course, the big copyright debate in the last decade has been about the impact of piracy on the sales of copyrighted goods – especially in the context of digital downloads. Almost every claim in this debate is in dispute, with much of the dialogue amounting to nothing short of pure disinformation.

With almost a decade and a half of experience, however, we can now say that the music industry, both domestic and abroad, has experienced an unprecedented decline in revenues – more than 60 percent after inflation. Moreover, most studies conclude that piracy has led to most of the decline.

By the same token, sales of recorded movies have fallen considerably in the last seven years (perhaps not coincidentally, after BitTorrent made movie piracy practical). Every rigorous study of movie piracy that I have seen has concluded that piracy had an impact, but the magnitude of the hit to the movie industry has not been pinned down.

The dispute about what, if anything, should be done about piracy has been particularly nasty in part because the home-electronics industry benefits indirectly from piracy.

It shouldn't be surprising that self-interest drives the debate. But part of the opposition to antipiracy regulation comes from people who seem to view copyright as little more than extortion. One of the things that we learned from Hollywood's recent confrontation with the digital hardware and software interests is that Google and Wikipedia can scare the living daylights out of politicians if they get their users riled up.

Stay tuned. M

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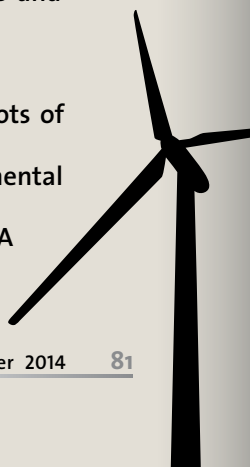
THE ENTREPRENEURIAL STATE

BY MARIANA MAZZUCATO

The idea of intervening in the marketplace to jump-start nonmilitary technological innovation slips in and out of favor, having probably reached the height of fashion in the 1970s and 1980s as policymakers struggled with threats (real or perceived) ranging from the Arab oil embargoes to Japan Inc. But mainstream economists have long been skeptical, and their views hardened in the wake of the ill-conceived push for "energy independence."

Less is more, the free market mantra goes. Direct intervention – picking winners, in the parlance of the Reagan era – is an invitation to waste and corruption as regulators and elected officials cozy up to their favorite interest groups. Free markets are far from perfect, they acknowledge, but market outcomes are more likely to serve the public interest than, say, the decisions of the House Appropriations Committee. When market failures can be identified and measured, the goal of policy should be to get the prices right – for example, to internalize the external costs of pollution, global warming, traffic congestion, etc. through market-friendly taxes or cap-and-trade schemes.

But that near-consensus is breaking down because economists (and lots of other folks) are frustrated by the lack of progress in solving daunting environmental problems. Since Congress won't tax greenhouse gas emissions, maybe the EPA



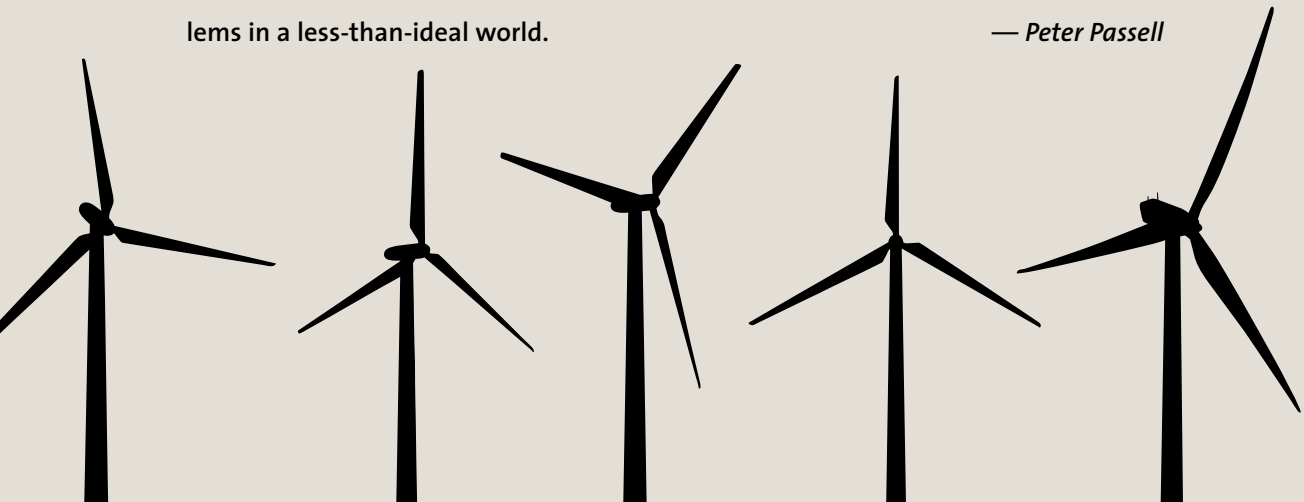
is right to limit them by decree (see page 5) ... Since the risks of investing in unproven green technologies are so high, maybe efficiency would be served by investing more government money in the most promising candidates ... Since consumers hardly notice the impact on their monthly bills, maybe utilities should be required to help out by purchasing more energy from green sources ...

Mariana Mazzucato, an economist who is the R.M. Phillips Professor of Science and Technology at the University of Sussex and the author of *The Entrepreneurial State – Debunking Public vs. Private Sector Myths*,* is long past the "maybe" stage. Indeed, I'm not sure she would lay claim to the adjective "mainstream" that most economists find so comforting. But she most definitely has an ear for the zeitgeist in questioning the ability of the private sector to innovate without a lot of help from government.

Her riff in *The Entrepreneurial State* on the sources of Apple's success – on why Steve Jobs would never have made his first million if governments had not spent billions on research in digital technology – led a *Financial Times* reviewer (Martin Wolf) to label her analysis "brilliant." Here, we excerpt the chapter blasting opposition to massive subsidies for wind power and solar photovoltaic panels.

I'm not convinced by her sweeping endorsement of the visible hand – in each case, the costs need to be weighed against benefits (another economist's mantra). But her thought-provoking book certainly deserves the attention it's getting, if only to force policy wonks to think more clearly about less-than-ideal solutions to problems in a less-than-ideal world.

— Peter Passell

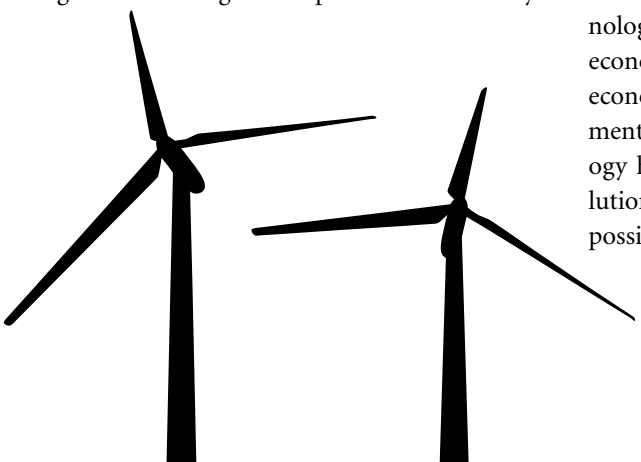


We are like any international company: we deal with government. With the Chinese government, German government, U.S. government, with many international governments. And of course we get support from government in the form of research and development grants and government subsidies to grow. I think almost every U.S. solar company obtained a grant from U.S. government as well, and German companies get subsidies from the German government. Because this is a very young industry which requires government support.

— Shi Zhengrong, Founder, Suntech Power

While a host of countries are making the investment in the development, manufacture and diffusion of a "green industrial revolution," sowing the seeds of change for such a major economic and social shift is not without its challenges. Here, I delve into the interaction of policy and development using examples of how effective innovation policies can be, and how the state plays a vital role in promoting radical new technologies – not merely by inventing new tax incentives, but by getting (and staying) involved in every aspect of the wind and solar power business.

Behind many wind and solar firms, and their core technologies, was the visible hand of the state that also contributed to the emergence of the Internet, biotech, nanotech and other radical technology sectors. In particular, government agencies provided the early-stage, high-risk funding and created an institutional environment to foster green energy. Ironically, much of the push came from the United States, but much of the benefit of state investment was seized by other countries, including Germany, Denmark and China.



It's not always clear how to connect the dots between dominant firms and their technologies, and the efforts of governments around the world. But it is clear that no leading clean-technology firm emerged from a pure "market genesis" – that is, with the state playing no role at all.

In the last few decades wind turbines and solar panels have been two of the most rapidly deployed renewable-energy technologies on the planet, spawning industries in many regions of the world. In 2008, $194 billion was directed at emerging clean-energy technologies in an effort to provide badly needed economic stimulus to counteract the global economic crisis. An unofficial global agreement was reached: the time for clean technology had come (again). A green-energy revolution seemed to be within the realm of possibilities.

The demand for wind power contracted in 2010, however, in large part as a result of the unfolding financial crisis in the United States (now the second-largest wind power market). But solar markets nearly doubled between 2009 and 2010, surpassing wind power for the first time. Together, wind and solar power represented a $164 billion global market in 2011, compared to just $7 billion in 2000.

While the U.S. and China possess the largest quantity of wind capacity deployed worldwide, Denmark is home to the largest manufacturer of wind turbines, Vestas. Manufacturers also emerged during the 1980s in the U.S., but all disappeared as a consequence of acquisition or bankruptcy. Germany's weather is less than ideal for solar power, yet it remains the world leader of deployed solar photovoltaic capacity. Meanwhile, China has emerged as the world's largest producer of solar panels, out-competing U.S., Japanese and European rivals that led in prior decades. A big question, then, is how the U.S. became a leading market for green energy, but failed to produce a leading manufacturer of equipment, and conversely, how China could spawn a big manufacturing sector in the absence (until recently) of a domestic market.

To be sure, several factors contributed to the decline of the pioneering U.S. companies. Falling fossil fuel prices in the 1990s did not help. Nor did the terms of purchase contracts for wind power negotiated in the 1980s, which exposed developers to major revenue reductions for the electricity they sold in the subsequent decade. In the case of Kenetech, once the bright star of wind energy, warranty losses incurred from their newest turbine model were substantial, and other firms were vulnerable to the uncertainty emerging from the decision to liberalize energy-generation markets.

But it's important to note that what differentiates these nations has nothing to do with

their classic comparative advantages as producers of wind turbines or solar PV panels; nor does it have anything to do with a natural abundance of wind or sun. Historically, the development of wind and solar power has reflected differences in government policies meant to foster these power sources.

TAKEOFF – AND HARD LANDING

The first "wind rush" (1980-85) had the energy crises of the 1970s as a backdrop. A number of countries actively invested in utility-scale wind turbines as a way to mitigate dependence on fossil fuels in electricity gen-

Nearshore wind farm, Lower Saxony, Germany

eration. In the 1970s, Denmark, Germany and the United States all initiated massive wind energy R&D projects. The goal was typically to build one-megawatt and larger machines, creating designs that could be commercialized and exploited by existing large firms typically involved in aerospace technology or agricultural machinery.

The U.S. outspent Germany and Denmark on wind energy R&D. But despite enlisting NASA to lead the program, a viable commercial design failed to emerge. Germany's attempt met a similar fate. Only Denmark succeeded in transforming government-funded R&D into commercial success, giving it a valuable advantage during the wind industry's formative years.

Linda Kamp of Delft University and Kristian Nielsen of Aarhus University see the point of divergence between nations in the decision of the Danes to develop technology based on an existing wind turbine called the Gedser, which was a reliable three-bladed horizontal-axis machine. Testing of the Gedser had been financed in its early days by the Danish ratepayer-owned SEAS utility and the trade association of Danish utilities.

Later, the governments of Denmark and

the U.S. provided millions to test the design as part of efforts to develop wind turbines for modern energy grids. But despite the promise of the Gedser, the U.S. and Germany pursued lighter-weight and aerodynamically efficient (though often unreliable) designs based on prototypes originally conceived around the Second World War in Germany and the U.S.

Denmark's push into wind turbines included state-sponsored prototype development, which brought in large manufacturers to gain experience with the technology and to create a functional supply chain. Companies including Bonus and Vestas were able to purchase patents generated by the Danish research program and smaller-scale wind turbine pioneers, giving them control over the collective knowledge and the requisite profit incentives to invest their own capital. They then applied their experience producing farm equipment to produce robust machines on a larger scale.

Denmark's R&D activities overlapped with investment tax credits offered to wind turbine buyers. The tax credits helped launch a domestic market for wind energy, while parallel financial incentives provided by both California and the U.S. government created export opportunities for Danish producers.

"Big government" R&D in the U.S. and Germany was largely dismissed as a failure because reliable wind turbine designs that could be successfully commercialized were not produced as an immediate consequence of the effort. That condemnation misses the point, though: obviously, if governments are willing to take the big risks that business will not take, the ventures are bound to fail sometimes. But if they do not take risks, they will not succeed at all.

That particular failure, however, gave the Reagan Administration an excuse to write off government R&D initiatives as the inevitable result of trying to "pick winners" – a phrase often used by conservatives to justify the rejection of government intervention in the clean technology sector.

This view ignores some inconvenient facts about clean energy R&D. First many large, private companies with track records in technology – among them, Lockheed Martin, General Electric and the MAN Group – were partners in that failure. Each acted as a contractor under the U.S. or German programs. Second, wind turbine technology was not well understood, and scaling turbine designs successfully required more time than expected. In effect, the government and business community underestimated the challenge at hand, though critics focus on the failure of government and not of private finance. Third, it makes little sense to conclude that the initiative wasn't worth the investment without including the benefits of the spillover effects. These projects established networks of learning among utilities, government, the business community and universities that would later prove valuable.

Unlike the U.S., which drastically slashed funding for wind turbine development, Germany did not give up on publicly funded R&D despite initial missteps. Indeed, it expanded on the research, as well as paying for a demonstration program that allowed for controlled testing of German designs. Germany also promoted multiple development paths, funding turbines of different sizes – in contrast to the U.S. program that biased R&D in favor of huge machines. Denmark's program was less expensive and more successful than either. That's attributable in part to the entry of the farm equipment manufacturer Vestas, which, unlike aerospace companies that emphasized light weight, understood the need for rugged design.

While the U.S. struggled to maintain a dominant manufacturing presence, it succeeded in establishing a big market for wind turbines – pushing, not merely nudging, one

COURTESY OF VESTAS WIND SYSTEMS A/S

Denmark's farm equipment manufacturer Vestas, which, unlike aerospace companies that emphasized light weight, understood the need for rugged design.

into existence. The favorable conditions for wind energy fostered by the U.S. government and California by means of stimulus expenditures and subsidies were not just opportunities for American companies. They also attracted Vestas, which became the turbine supplier of choice for the Zond Corporation, a California-based wind-energy developer. With few proven wind turbine models available to choose from, Zond ordered more than 1,000 turbines from Vestas, almost single-handedly financing the early growth of Vestas' turbine business.

When the tax subsidy program in California was allowed to expire at the end of 1985, Zond refused to pay for its last shipments of wind turbines, which had been delayed. To survive, Vestas abandoned its farm machinery business and quickly re-emerged as a world leader in wind turbine production. Note that without the forbearance of the Danish government in allowing Vestas to restructure, the company might well have disappeared.

Of the handful of new companies emerging to capitalize on the call to bring wind energy to America, U.S. Windpower (later renamed Kenetech) become an early leader. Founded in Massachusetts, it had derived knowledge of wind technology from research at the University of Massachusetts (Amherst), a public university with an active wind power program funded in part by the U.S. Department of Energy. The company subsequently moved to California, lured by state tax breaks and regulators' mandate to California's electricity utilities to promote renewable energy.

Kenetech was one of the few U.S.-based wind turbine manufacturers to have grown from a seed stage to an initial public offering. But the wind turbine business is risky; the company went bankrupt in 1996 due to major warranty losses incurred following the release of its state-of-the-art (but technically flawed) variable-speed wind turbine.

Unlike Vestas, though, Kenetech did not enjoy the forbearance of government lenders or private investors; about 1,000 people lost their jobs when the company couldn't meet its financial obligations. Zond subsequently purchased Kenetech's variable-speed wind turbine technology and developed wind turbines with the assistance of the DoE. Zond was, in turn, acquired by Enron in 1997, and when Enron collapsed in scandal, GE purchased Zond's technologies to become one of the world's largest wind turbine suppliers.

From that point forward, the powerful combination of government incentives for wind power at the federal and state levels, along with the resources of a big corporation, paved the way. Though threatened worldwide by Chinese competition, GE still dominates the U.S. market.

The technologies developed with substantial contributions from the U.S. Government thus played an important (if easily forgotten) role in the development of wind technology. The basic science of wind power was advanced by the DoE through initiatives at both its national labs and universities. Understanding the aerodynamics of turbine blades was of particular importance, given that wind turbine operating environments are unlike those of planes or helicopters. Computer modeling boosted the reliability and efficiency of turbine designs, and collaboration with private industry yielded improved designs with better "capacity factors" – the ratio of actual power production to theoretical production capacity. Advanced mapping of wind resources by the government also provided wind-power developers with accurate siting information.

When Washington abandoned subsidies for wind power development in the mid-1980s and slashed the DoE's R&D budget in a backlash against attempts to promote energy innovation,

The efficiency of turbines more than tripled in the three decades following the 1970s, while operating availability reached nearly 100 percent and expected life spans reached 30 years. Accordingly, the cost of wind energy fell from approximately 30-50 cents per kilowatt-hour in the 1970s to as little as 3 cents/kWh in the 2000s.

The importance of government support is seen most starkly through the consequences of its withdrawal. When Washington abandoned subsidies for wind power development in the mid-1980s and slashed the DoE's R&D budget in a backlash against attempts to promote energy innovation, the domestic market stagnated and momentum for the industry shifted to Europe – more accurately, to Germany.

In 1989, Germany's Federal Ministry of Education and Research launched an initiative to bring on line 100 megawatts of wind-power capacity. To this end, the government created a "feed-in tariff" program, which mandated the payment of above-market wholesale prices for wind power sold to electric utilities, along with providing a 70 percent tax credit to small pro-

ducers. Germany also set aside national and state funding of approximately $2.2 billion to support continued wind energy R&D. The combination made Germany the hottest market for wind-power development in the world.

The country's long-term approach to wind energy development gained momentum in the 1990s and continues today, enabling the emergence of strong manufacturers that facilitate stable annual growth in deployed wind capacity. The 20-year investment horizons provided by government incentives are twice as long as those in the U.S., reducing market uncertainty and boosting investor confidence.

the domestic market stagnated and momentum for the industry shifted to Germany.

China was a relative latecomer to wind-power technology, despite having pushed investment in renewable energy in the 1980s as a technical solution for rural electric infrastructure development. China's partially state-owned Goldwind, a major wind turbine manufacturer, was established in 1998, and initially licensed German technology. Goldwind's turbine business benefited from aggressive Chinese domestic content rules, which since 2003 have required 70 percent local content in all wind turbines sold in China. This effectively shut the door to foreign competition, even as China's manufacturers strengthened their domestic supply chain.

Chinese wind-power producers also received 25-year fixed-price contracts, reducing uncertainty in demand. Wind projects had access to low-cost financing, and after 2005 the government began to fund R&D projects with grants and favorable loan terms. China is seeking 1,000 gigawatts of installed wind power capacity by 2050 – equal to the country's *total* generation capacity in 2010. China surpassed the United States as the world's biggest wind energy market in 2010. And thanks to the favorable treatment of domestic turbine manufacturers, China has also eroded the global market shares of other producers.

SOLAR'S ROCKY ROAD

The policy shifts driving the California wind market in the 1980s provided the catalyst for a global market for solar PV panels to emerge. Bell Labs had invented the first crystalline-silicon (c-Si) solar PV cell back in 1954 while the lab complex was still a part of the AT&T regulated telephone monopoly. The first major opportunities for solar PV technology were created by the DoD and NASA, which purchased solar cells made by U.S.-based Hoffman Electronics to power space satellites.

While the space race made the government a cost-be-damned customer for early solar manufacturers, the transition of solar PV technology to terra firma was facilitated in part by the cost and performance advantage it had in markets for remote power applications – signal lighting on offshore oil rigs, corrosion protection for salt-water oil drilling, remote communication towers. In most cases, however, government regulation, not cost, forced the application: the choice of solar PV/battery power for oil rigs, for example, was in part a consequence of the EPA's ban on the disposal of spent batteries in the ocean.

Note the familiar theme here: government initiatives have helped to establish solar PV firms and markets around the world. Many examples of innovative emerging firms can be found in the U.S., where First Solar, Solyndra, SunPower and Evergreen Solar each developed state-of-the-art c-Si or thin-film solar technologies.

Arrays of solar panels at a photovoltaic power plant in Hami, northwest China

First Solar emerged out of efforts to commercialize cadmium telluride (CdTe) thin-film solar PV panels and became a major U.S.-based CdTe thin-film producer. The company now dominates the U.S. market for thin-film panels. Thanks to superior technology and low-cost manufacturing, the business has generated more than $2 billion in annual revenue since 2009.

First Solar's patents have extensive links to prior DoE research. Development of the company's CdTe technology was a collaboration of founder Harold MacMaster with the University of Toledo's state-funded solar research facilities and the federal government's National Renewable Energy Laboratory (NREL).

First Solar's partnership with the NREL dates back to 1991, when the company was still known as Solar Cells. The collaboration resulted in the development of high-rate vapor transport deposition, a superior means of manufacturing glass CdTe thin-film panels, which First Solar began to produce in 2003.

Solyndra was a technological leader in solar panels, built on federal research conducted on copper indium gallium (di)selenide (CIGS) solar PV. The technique of depositing CIGS onto tubular glass gave Solyndra's panels a unique look; more important, it enabled them to capture direct and reflected light without add-on tracking systems. Additionally, Solyndra's panels had a unique interlocking system that made them easy to install, reducing their cost relative to other technologies.

The list goes on. SunPower manufactures high performance c-Si solar PV panels with technology that owes much to government aid. The company's success links back to DoE research patents related to solar PV shingle panels, which take on the look of roofing shingles. Established in 1985 by Dr. Richard Swanson, SunPower had early R&D support

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from the DoE and the Electric Power Research Institute (the utility industry's research arm) while developing technology at Stanford University.

This is not to say that government intervention in solar power always pays off. Evergreen Solar was a spinoff of the now-defunct Mobil Solar. It was started when a group of scientists defected from Mobil to develop a rival vision of string-ribbon wafer technology, forming thin films from molten silicon by exploiting the phenomenon of surface tension. Evergreen attracted $60 million in Massachusetts subsidies – the most ever offered to a single company – in return for a promise to create manufacturing jobs in the state. But the company was subsequently lured to China, which offered favorable loan terms from publicly owned banks to build a new plant. In obtaining this financing, Evergreen agreed to share its innovative technology with its partner, Jiawei Solarchina.

Evergreen completed a $42 million IPO in 2000. Taxpayer support from Massachusetts thus helped to generate a big payday for VCs and top executives, but failed to create the promised benefits for the U.S., and even transferred advanced technology to China.

Suntech of China was a global market share leader in c-Si solar PV manufacturing in 2011. Suntech has benefited from imports of PV manufacturing equipment from bankrupt U.S. companies and the acquisition of Japan's MSK Corporation, the abundant and willing public finance of government-directed Chinese banks and the booming government-driven market for solar PV in Europe. Suntech Founder Zhengrong Shi studied solar PV and spent 13 years in Australia, working for Pacific Solar, a joint venture between the University of New South Wales and an Australian utility company, before returning to China.

Shi had been lured by the city of Wuxi, which offered him $6 million to set up solar PV manufacturing there in 2000. Suntech's Pluto c-Si technology is a derivative of PERL c-Si technology developed at the state-supported University of New South Wales. Its products are quickly approaching the performance levels of rivals like U.S.-based SunPower.

Suntech, like most Chinese solar PV manufacturers, depends on exports to grow. It generates a substantial share of its revenues in Europe, where (as noted earlier) markets are driven by strong feed-in tariffs and other policies that cost billions of euros to European taxpayers and electricity customers. It also benefited from support in China, which granted the company a preferential 15 percent tax rate, millions in grants, and a $7 billion line of credit from the China Development Bank. (All told, as of 2010, the bank had made $47 billion in loans to Chinese solar companies on favorable terms.) These huge sums have made the difference for Chinese solar PV manufacturers, providing the resources to grow rapidly and to weather shifts in demand for their exports.

There's an interesting hitch here – one that illuminates the differences in government support for green energy in China and the United States. After defaulting on a bond payment in March of 2013, Suntech divided its assets between Wuxi Suntech, now expected to be taken over by state-owned Wuxi Guolian, and Suntech Power, whose equity investors will be subordinate to the public banks that have been carrying the firm.

The relatively orderly outcome of Suntech's bankruptcy stands in stark contrast with that of U.S.-based Solyndra. Solyndra was overwhelmingly funded by private interests, while Suntech was funded by public interests. The two firms committed the same mistakes, scaling up too rapidly and depending too much

on volatile export demand. Yet Solyndra has disappeared from the world, while Suntech survives. Suntech's fate is not to be decided by its investors, whose first priority is to get their money back, and then some.

Solyndra's failure highlights the "parasitic" innovation system that the U.S. has created for itself, where private financial interests rarely commit the first dollar but always have the last word. Perhaps done differently and with an eye to the value of economic development beyond short-term financial performance, Solyndra would have grown to employ thousands and to generate revenue on the magnitude of GE. Suntech's fate, on the other hand, will be decided by the state, which made the larger investments in the firm, and which proceeded into the company's bankruptcy with a much broader perspective on Suntech's potential role in the Chinese economy.

In a better system, the government could have weighed the cost of letting Solyndra fail against the potential benefits of giving it another chance. It might even have considered firing the executives responsible for its financial decline – as the Chinese government did with Suntech.

American policymakers will continue to spend their time imagining success until they recognize that innovation unfolds as part of a global process, not an individual or even organizational process. Clean technology is already teaching us that changing the world requires coordination and investment from multiple states. Otherwise R&D, support for manufacturing, and support for market creation and function remain dead ends while the Earth literally suffocates on the industries we built a century ago.

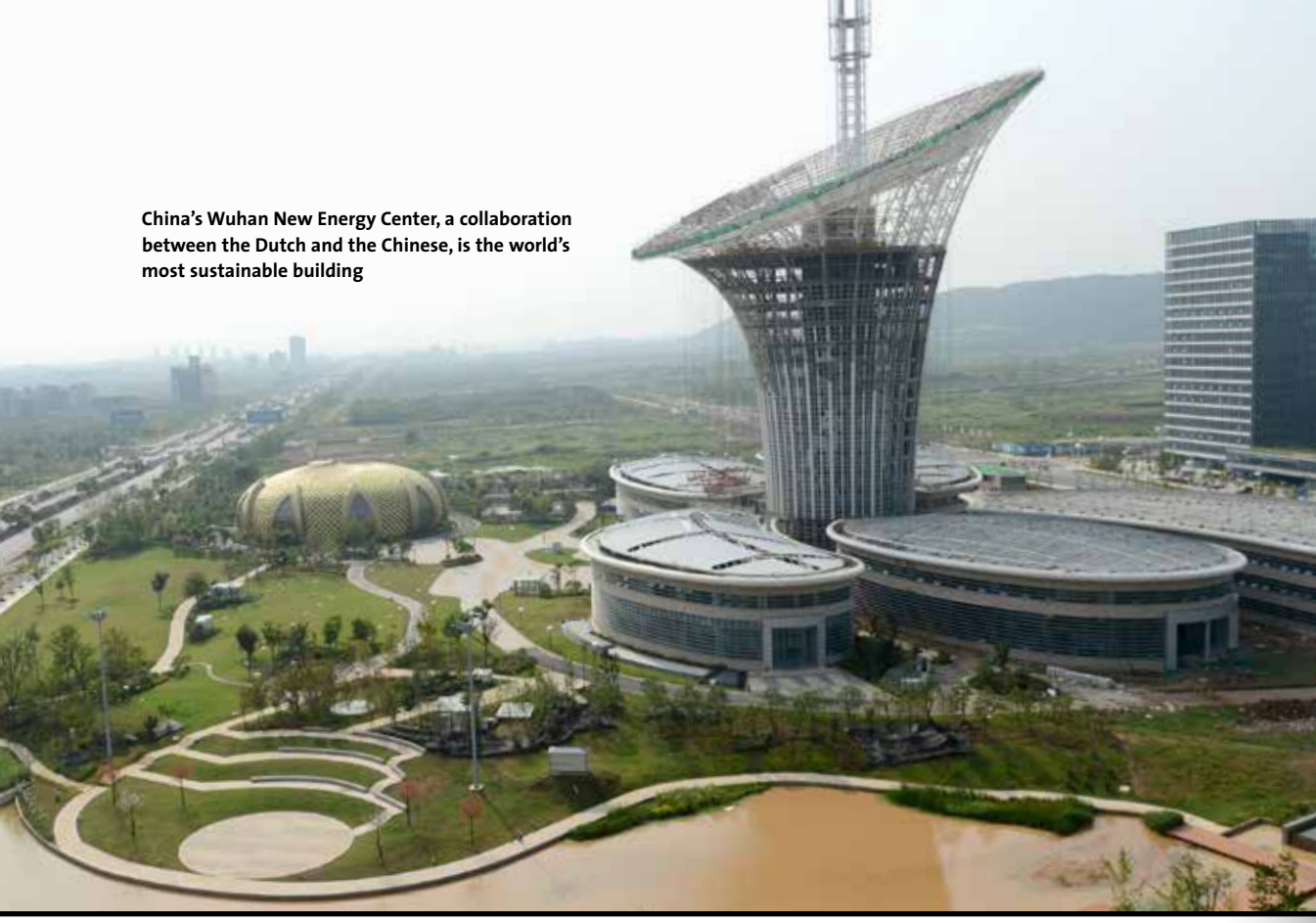
THINK GLOBALLY, ACT GLOBALLY

I argued above that the state of California's mandated use of renewable energy explains in part the early success of Vestas, a Danish company that is the world's largest wind turbine manufacturer. In similar fashion, the growth of U.S. and Chinese solar-panel makers has depended on Germany's leadership. Germany made solar PV competitive with traditional power sources by revising its feed-in tariffs policy to provide better pricing for solar PV. At the same time, Germany established a "100,000 roofs program" to encourage residential and commercial investment in the technology. The action kicked the solar PV industry into high gear, and Germany expanded its solar capacity from just 62 MWs in 2000 to over 24 GW in 2011. This is equivalent to completing 24 nuclear power plants in about 10 years.

Germany's policies have been both a blessing and a curse. On the one hand, Germany's growing market supported the emergence of domestic manufacturers such as Q Cells. But it also provided growth opportunities for competing firms from the U.S., China and elsewhere.

These countries have not followed Germany's lead in establishing strong residential and business demand for solar PV. And excess capacity created in part by the "start-and-stop" government policies toward demand for solar power is currently crippling solar companies around the world. Q Cells, once a German champion, went bankrupt and is now the property of Korea's Hanwha Group.

Meanwhile, the rise of China as a government-supported center for solar PV manufacturing has had serious fallout on the industry as a whole, prompting trade wars with both the United States and Europe. But while U.S. and European companies find themselves unable to compete, the U.S. government, for its part, has reacted with calls to end support for clean technology development; if anything, the lesson here should be that



China's Wuhan New Energy Center, a collaboration between the Dutch and the Chinese, is the world's most sustainable building

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American policymakers will continue to spend their time imagining success until they recognize that innovation unfolds as part of a global process, not an individual or even organizational process.

more support, not less, is needed.

The trade conflict only serves to strengthen the myth that industrial development occurs through invisible market forces that cannot be created or controlled by government. With the government acting as referee in the dispute, China's public support for clean technology industry development is framed as "cheating." At the same time, multiple countries are attempting to capture the global market for clean technology with similar policies that include direct and indirect support for firms – in other words, if China is cheating, the other countries are, as well.

Plummeting solar PV prices are supposed to be a good thing, eventually positioning solar panels to compete favorably with fossil fuels. But in this case, falling prices (and shrinking profit margins) frustrate many and ignore the shortcomings of industrial policy in countries like the U.S., which we could describe as lacking an adequate supply of "patient capital" conducive to innovation and growth, as well as a long-term vision for energy transition. What is separating China from its international peers is its courage to commit to renewable energy and innovation in the short and long runs.

Some argue there is a risk that the rapid growth of Chinese wind and solar companies will stifle innovation. The charge: Chinese companies are reducing costs and grabbing market share using older technologies, which prevents newer ones from penetrating world markets. If this is proven to be the case, governments should heed the signal that more needs to be done to ensure that critical energy innovations can establish themselves in markets that are becoming crowded with competing technologies.

But these complaints take no notice of the fact that there are advantages to the current c-Si technology, such as the availability of abundant raw materials for manufacturing. Other technologies rely on rare earths, which are in limited supply and environmentally problematic to extract. Furthermore, these complaints ignore the reality that U.S. innovations produced by companies like Innovalight and 1366 Technologies can be incorporated into Chinese panels. (1366 Technologies developed very low-cost multi-crystalline silicon manufacturing equipment with $4 million in aid from the U.S. government's new ARPA-E program.) In any case, at some point convergence towards a dominant design is needed before mass diffusion of solar power can be achieved.

THE VISIBLE HAND

There is nothing accidental about clean technology development or the formation of markets for renewable energy. There are no "genius" firms or entrepreneurs acting independently. Rather, clean-tech firms are leveraging technologies and cashing in on the prior investments of an active public sector.

While the performance of countries has varied tremendously over the decades, Germany has provided a glimpse of the value of long-term support, China has demonstrated that a rapid scale-up of manufacturing and deployment is possible, and the United States has shown the value of R&D – but also the folly of permitting uncertainty, shifting political priorities and speculative finance to set the clean technology development agenda.

The challenge moving forward is to fund a long-term policy framework that sustains momentum in the clean energy sector that been erected over the last decade. Without long-term commitments, it is likely that clean technology will become a missed opportunity for many nations. Such a framework would include demand-side policies to promote increased use of solar and wind energy, as well as supply-side policies that promote manufacture of the technologies with "patient" capital.

The challenges of developing clean technologies go far beyond establishing public-sector energy innovation hubs, such as ARPA-E. Governments need to reduce the risk of commercializing innovations while establishing and managing the risks of competing in diversified, volatile, global energy markets. When difficulty has arisen in the past, such as when the wind power market faltered following retraction of U.S. support for renewables in the late 1980s, the tendency has been to focus on how government investment is flawed and to ignore the ways in which business contributed to that failure.

Worse, some interpret growing pains as proof that an innovative technology will never be able to compete with incumbent technology and should be shelved. This would go against the historical record, which suggests that all successful energy technologies have needed lengthy development and long-term government support. What matters more is that the effort continues as if the future of the planet depended on it – because it does.

THE ENVELOPE PLEASE

With our expertise in regional economics, it's no wonder that the Institute's annual Best Performing Cities index gets so much attention from the media – not to mention from the top-ranked metros taking a victory lap and from those down the list that want to ascend in next year's list. Unlike surveys that focus on quality-of-life metrics, our index is built around measures of jobs, wages and technology performance. All told, 379 metros across the United States are ranked. This year's index, released in December, was a tale of technology and energy. The top five metros – Austin, Provo, San Francisco, San Jose and Salt Lake City – are all thriving tech centers. Meanwhile, 9 of the other top 25 were thrust into the spotlight by the shale oil and gas boom.

Curious where your hometown ranks? You'll find everything you ever wanted to know at our custom data site, www.best-cities.org.

HOWDY, PARTNER

"Partnering for Cures is the meeting I *choose* to attend each year," kvelled one of participants at the fifth annual event, held in New York in November. "It's where innovators come together to collaborate to find cures – smarter and quicker." This year's "P4C" brought nearly 1,000 leaders from across sectors in medical research, and not just to hear expert panels that included Francis Collins (Director of the National Institutes of Health), Ariti Prabhakar (Director of the Defense Advanced Research Projects Agency) and Tom Frieden (Director of the Centers for Disease Control). More than 800 one-on-one partnering meetings were arranged across the three days of the conference, allowing entrepreneurs with potential life-extending ideas to meet with venture capitalists looking for ways to do well by doing good.

NEW FORMAT, NEW FOCUS

The Milken Institute is California born and bred, and one of the hallmarks of our home state is openness to innovation. For more than a decade, our California Center has held annual meetings to bring together leaders from across the Golden State to focus on its most pressing issues and to chart practical solutions. In years past, attendees typically exceeded 500, with most sessions open to the media. But last November, we tried something different. A considerably smaller group met at the Institute's headquarters in Santa Monica for sessions designed to give participants a chance to candidly discuss issues ranging from the quality of the business environment (and how to make it friendlier) to the responsiveness of Sacramento to the state's needs. Gov. Jerry Brown keynoted the California Summit, reminding attendees that "our wealth is in the minds of our people."

COURTESY OF THE MILKEN INSTITUTE

The Summit's breakout session on government effectiveness

Thirst for knowledge

So, which is more important to poor countries: cell phones or clean water? Judging by the 10 randomly chosen nations below, cell phones win hands down. Indeed, the explosive proliferation of wireless service in places where most people live near subsistence and almost nothing else works well is one of the more astonishing phenomena of the globalizing economy.

But back to the clean water. This strange "revealed preference" vaguely makes sense in countries with low population densities like Afghanistan, Bolivia and Mongolia, where communications can sometimes be a matter of life and death – and a lack of septic tanks sometimes isn't. But a more plausible explanation for the fabulous growth of telecom (and failure of sanitation) in very poor countries has little to do with rationally determined priorities. Sewage disposal and drinking water safety are typically government/collective responsibilities, where individual incentives play little role and "free riders" abound. Cell phone service, by contrast, offers pots of gold to the entrepreneurs who do it first and/or fastest.

	GDP/PERSON, 2012 (PPP)	% OF POPULATION WITH IMPROVED SANITATION, 2010	CELL PHONES/ 100 POPULATION, 2012	POPULATION/ SQ. MILE, 2012
Afghanistan	$1,100	37%	54	101
Haiti	1,300	26	59	997
Benin	1,700	13	90	238
Bangladesh	2,100	56	64	2,678
Nigeria	2,800	31	68	487
Ghana	3,400	14	100	267
India	3,900	34	69	989
Bolivia	5,200	27	93	23
Mongolia	5,500	51	118	5
China	9,300	91	81	365

SOURCES: World Bank; CIA World Factbook; Unicef

ALAMY, ISTOCKPHOTO