Will Information Technology Reshape the North-South Asymmetry of Power in the Global Political Economy?

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Digital technologies are sufficiently disruptive to current ways of doing things to call into question assumptions about the "inevitability" or "natural state" of many economic processes and organizational principles. In particular, the impact of digital technologies on our conceptions of property rights has potentially dramatic implications for the North-South divide and the distribution of power in the global political economy. Drawing on recent experiences with open-source property rights regimes, we present two scenarios, the "imperialism of property rights" and the "shared global digital infrastructure," to highlight how debates over property-rights could influence the development of the global digital infrastructure and, in turn, contribute to significantly different outcomes in global economic power.

Simon Kuznets described "epochal innovations" as "major breakthroughs in the advance of human knowledge" that become "dominant sources of sustained growth over long periods and spread to a substantial part of the world" (Kuznets, 1973). Many have argued that digital technologies of computation and communication will constitute a Kuznets-style epochal innovation, and that economic and social historians of the twenty-first century will look back on the invention of the microprocessor and a few associated technologies as being revolutionary on at least the scale of the internal combustion engine and electricity.

But the present article does not demand that you share this view. It rests on a simpler and less rigid proposition: simply that digital technologies are sufficiently

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disruptive to current ways of doing things to call into question assumptions about the "inevitability" or "natural state" of many economic processes and organizational principles. Here we will concentrate in particular on the impact of digital technologies on ideas about and implementations of a system of property rights. Although this is not the only "assumption" whose supposed inevitability is being undermined, it is one with potentially far-ranging implications for North-South asymmetries in economic potential and power.

Putting a question mark over an assumption of inevitability is interesting, but of course it is not nearly a sufficient condition for meaningful change. It is certainly possible (although we don't believe it) that the global political economy of 2050 will be digitally-enabled but not digitally-transformed; that there will be firms, states, and markets—and distributions of economic power among them—that look very much like they did in 1985 or thereabouts. To read this paper seriously, you must simply agree to the notion that we would not get to that place along a predetermined path. If the future does look very much like the past, it will be so because the questions that we raise in this paper were answered in a particular way that reinforced existing structures—and not because the various actors involved never sought to contest them.

The questions are roughly these: How significant are transaction costs when it comes to driving change in the organization of firms and production networks versus systems of property rights? As we experiment with alternative notions of property, what kinds of major cleavages develop in the global economy, and how do they affect the prospects and possibilities for developing countries, particularly? What big problems are likely to emerge across a modified North-South divide? And who might be in an advantageous position to conceptualize, construct, and implement solutions or strategies to manage those problems? This paper aims to develop in a preliminary way some ideas about these questions, mainly so that we can reflect back with more precision on the audacious question posed in the title: Will information technology change the nature of the distribution of power in the global political economy?

We're Only Getting Started

It's now approximately 35 years since Robert Noyce and Gordon Moore offered to the world Intel's first microprocessor. A little more than a decade later, IBM and Apple introduced the notion of a "personal" computer. Another decade brought widespread diffusion of the Internet, connecting all those computers together, and a bit later came the World Wide Web, a system for linking together documents located pretty much anywhere in the network. Roughly another decade brings us to the present, where the Internet has gone wireless and is on the verge of becoming ubiquitous. Processing power is now just about so inexpensive and connectivity so widespread that the vision of "smart objects"—that is, sensory capabilities and intelligence embedded in just about every physical object that people use—is becoming a reality.

Big deal. From a global macro-perspective, the international political economy has changed little. The United States is still rich and Africa is still poor. Most developing countries still export raw materials and low-cost manufactured goods and are

thus more vulnerable to economic shocks and creeping commoditization than are developed countries. And the supposed "end of geography" effect has been anything but: look at a map of Internet bandwidth and notice the thickness of the lines that converge on North America relative to the extraordinarily thin coverage in the global South.[1] An email from Rwanda to Ethiopia most likely travels through New York or London in order to reach its destination. The geography of telecommunications is almost painfully reminiscent of colonial railroads that ran toward export ports but systematically avoided direct inter-colonial connections. Surely the biggest shift in global development over the last 25 years is the emergence of China—but that story began prior to the digital revolution. And although new technologies have certainly facilitated the effective insertion of China into global production networks, the Chinese development story really has been driven principally by other factors.

It might have become fashionable, particularly in the wake of the late-1990s equity-market burst, to extend the Solow paradox ("computers show up everywhere except in the productivity statistics") to an argument about economic development overall. The overblown hype of the late 1990s positively invites this kind of reaction. But it's an overreaction. In fact, the Solow paradox (if it was ever really as paradoxical as it sounded) has begun to unravel, at least in the way American productivity statistics held up during the most recent recession and recovery. More sober voices of organizational theory reminded everyone of another "law" that goes along with Moore's Law, that for every $1 that a successful company spends on technology, it spends $10 on investment in reorganization in order to be able to effectively use that technology (Brynjolfsson and Hitt, 2000). And Carlota Perez, in *Technological Revolutions and Financial Capital*, put forward a simple five-phase model of technology revolutions that is strikingly isomorphic across at least four modern historical episodes: the first industrial revolution in Britain, the age of steam and railways, the age of steel and heavy engineering, and the age of oil, the automobile, and mass production (Perez, 2003: 18).

The expectations that Perez's arguments create for digital technology are pretty clear. In the 1980s we probably passed through what Perez calls the "irruption phase," where new technologies emerge and show hints of their future potential across a broad range of industries. The 1990s gave us her "frenzy phase," where financial capital gets ahead of everything else and creates a market bubble of overinvestment, which tends to overshadow the very significant buildup of new infrastructure and technological capabilities that will provide a foundation for widespread economic change. The frenzy phase, of course, ends in a "turning point" brought on by the recession that follows the collapse of the financial bubble. It's during the turning point that institutions broadly begin to adjust in significant ways to take advantage of the new technologies. Government regulations change, people experiment with distinctive ways of organizing production, markets are remade—the "fetters on the mode of production" are released. What follows is a "synergy phase" in which the rules and the organizations are aligned to facilitate a full flourishing of what the technology makes possible. The cycle ends with a "maturity phase" in which the productive extensions of the new technology are on the verge of exhaustion, new applications show diminishing marginal returns, investment shrinks, and markets stagnate.

This revolution was, ironically, so fully broadcast by its own technologies that Perez's cycle was both accentuated and accelerated. The irruption phase was fast (in part because the Internet began as a software overlay on an existing infrastructure) and the frenzy phase explosive (in part because communication technology was used so effectively to hype the investment potential of, well, communication technology). It's a fair bet that we are now in something very much like the turning point. It is in the upcoming synergy phase that the costs of technology decrease and access spreads. But we should not assume that these trends will be similarly dramatic for everyone; the characteristics of this phase are yet to be determined. We believe that the synergy phase of information and communication technologies (ICTs) will depend upon how these technologies are thought of, and used, to modify the transaction costs of—*and* the property-rights systems that underpin—economic exchange.

Transaction Costs

Technological revolutions do not automatically lead to a revival of interest in an earlier generation's economic theorists. But for whatever reason, the digital revolution adopted as its economic prophets Joseph Schumpeter and Ronald Coase. Schumpeter (probably because some of his arguments could be labeled, for easier consumption, "Schumpeterian" rather than "Marxist") was mined principally for his concept of creative destruction, the celebration of capitalism's dynamism and (not coincidentally) his acceptance of monopolies as a legitimate and even necessary part of that process.

Coase, on the other hand, became the prophet of "perfecting markets" through the reduction of transaction costs. "The Problem of Social Cost" was adopted as a mantra, cited in nearly every article, business plan, and essay about the Internet revolution. The ability to move information around the world without friction became deeply associated with a market metaphor, and even more deeply with a market-based ontology as a way of seeing the world. All economic decisions would be pushed down either to the individual or to the machine on a case-by-case basis, and the massive reduction of transaction costs would enable those individuals (or machines) to find each other and agree to an exchange. Externalities would be systematically squeezed out. And so the Internet would become a "perfecter" of markets, bringing a vision of efficiency ordered through "perfect" information and Coasian equilibrium arrived at in relationships outside of corporate, state, university, or other organizational authority.

Ebay, a massive, low-transaction cost, person-to-person, electronic "flea market," where buyers and sellers are empowered to find each other and contract through a modified auction process that relies on a reputation system for transactors (rather than evaluations of the object of the exchange per se), became the exemplar of the Coasian world. Soon the metaphor extended further, toward affinity communities that are much less about economic exchange than some other kind of human connection. For example, people suffering from rare diseases presumably would like to communicate with each other not only to exchange information but also offer each other support. But the transaction costs these individuals faced in finding each other around the world were prohibitively high—until now. In this kind of discourse, the

failure of a community to take shape because of high transaction costs is just as much a market failure as is the inability of a widget owner to find a buyer and negotiate a widget-exchange contract that would benefit both sides. The perfection of markets and the realization of potential communities are theoretically parallel.

The vision of a low–transaction cost economy and society was in fact rather radical. The re-engineering of production processes and community organization set off by this reduction in transaction costs toward an asymptote of zero would be broad, massive, and—most importantly for our discussion here—global. It would have seemed very strange and inconsistent (as well as unfashionably pessimistic) to imagine a world where barriers and boundaries were being knocked down by technology just as soon as someone leaned on them, and at the same time posit the firm maintenance of the North-South, core-periphery, or similar distinction. And so "e-development" became a new slogan, describing a digitally enabled optimism for re-engineering the place of developing countries in global economic flows.

The G-8 Digital Opportunity Task Force (DOT Force)—a joint venture of United Nations specialized agencies, the Markle Foundation, and Accenture Consulting, among others—was a powerful symbol of this kind of thinking. Bridging the "digital divide" was the goal, which meant empowering developing countries to participate effectively in the emerging global economy. So-called e-readyness was the prerequisite. And although each recommendation was hedged with the obligatory caveat that technology was no silver bullet for development, the clear message coming from the DOT Force and numerous similar groups was this: Make yourself ready for Internet technology–related direct investment, liberalize your telecommunications sector, release restrictions on information flow, play by the rules set by the newly relevant standards bodies (the Internet Corporation for Assigned Names and Numbers, for example), and the new global economy will more or less come to you. And that will be a good thing for development.

Of course it was not that simple; even the mega-optimists were not so naïve as that. Bill Gates spoke up to remind people that Microsoft (or at least the Bill and Melinda Gates Foundation) understood perfectly well that many poor countries need clean water and access to affordable pharmaceuticals a great deal more than they need gigabyte ethernet. Some observers pointed out that transaction costs were in many cases the bread and butter of rent-seeking regimes, and that people in power very well might not want to reduce the market inefficiencies that enabled very lucrative corruption. Others pressed more deeply into assumptions about the terms of trade in a digital global economy: Was exporting data-entry work, low-level coding, or for that matter cheaply assembled computer hardware really more advantageous to developing economies than exporting textiles or copper or shoes? Was the investment and upgrade path to higher value-added products and services really that much clearer in digital goods than in manufactures? In an unpublished paper, Weber explored the implications of digitally enabled international trade for commercial liberalism arguments: Does trading in bits and bytes rather than steel and autos disincentivize countries to go to war?[2]

These were all good, and in some cases researchable, questions (see Saxenian, 2005). On the whole, they helped to embed the "digital divide" idea in a (usefully) broader discussion, by reminding everyone that fundamental disparities in access to and the ability to use new technologies reflect long-standing divides of poverty,

education, and freedom to make choices. That perspective led to a (defensible) concern that digital technologies might exacerbate global inequality rather than reduce it. In fact, it is remarkably easy to write a "lock-out" scenario in which developing economies risk falling further behind the leading edge of a digitizing world economy. The combination of Moore's Law (rapid increases in processing power at declining prices) and Metcalfe's Law (positive network externalities, meaning that the value of the network increases disproportionately as it grows) suggests that markets could grow intensively and dramatically *within* the developed world without necessarily having to expand geographically at the same pace. After all, it is not a law of nature that trade grows faster than GDP; there is significant room for within-network growth without creating market links to developing economies.

As developed economies build networked purchasing and production systems that depend on advanced digital technologies, countries that are not connected on favorable terms (and firms within those countries) are deeply disadvantaged. While these markets may eventually become saturated, in the meantime the effect on developing countries' economies will be significant. International organizations and non-governmental organizations are increasingly computer-enabled as well, which means that they will favor interaction with countries and organizations in the developing world that are similarly enabled and can interact effectively with their information systems.

The point is that sophisticated information-technology (IT) capabilities are becoming a prerequisite to effective interaction with much of the world economy. And while the prerequisites have grown, so have the potential downsides of lacking them. The industrial economy may have had inherent limits to growth, implying that exclusion of much of the world's population was actually necessary in some sense (it is impossible to imagine a functioning global economy in which every family in China burns gasoline in an internal combustion engine). There are no such inherent limits to the information economy, at least not that we can now see. While the physical infrastructures of the information economy are not trivial, they are quite a lot cheaper to start, they scale in ways that engines don't, and although they do require some energy to run, they are really not very petroleum-dependent. Bit-twiddlers produce very little greenhouse gas per unit of value creation, and many ideas are infinitely customizable for use in different contexts. From an efficiency perspective, the possible exclusion of four billion people from the next era of wealth creation makes no sense. From an ethical standpoint, it is even more problematic than was the exclusion of previous eras, because there is no intrinsic environmental or resource-base reason for it.

All this simply from a reduction in transaction costs? Not entirely. Changes in transactions costs, like any other costs, are phenomena that occur at the margin (in the economic, not pejorative, sense). The important point is that transaction costs are only one ingredient of the Coase equilibrium; the other ingredient, of course, is secure and well-defined property rights. It took a little longer to see it, but digital technologies also empower people and organizations to experiment in new ways with the rules and norms that make up a property-rights regime. And if Ronald Coase, Douglass North, and Hernando de Soto could agree on one thing, it would be that shifting property rights can and will destabilize the foundations of existing cooperative arrangements, institutions, and power dynamics—including the North-

South divide—and probably in more radical ways than do changing transaction costs.

Experiments with Property Rights

Changes in technology uncover hidden assumptions of inevitability in production systems and the social arrangements that accompany them. One core assumption of market-exchange economies is that property rights are centrally about the ability to exclude others from something according to terms that the property owner controls. In practical implementations, of course, property carries with it expectations and obligations as well as rights. But the right of exclusion is essential because it brings with it opportunities to sell access or transfer the right of exclusion to someone else, under terms that the owner can set. In the realm of intellectual property, copyright—and particularly the fair-use provision—reflects a practical compromise between the interest of the owner-creator in having exclusive rights and the aggregate interests of society in gaining access to ideas, which do not get "used up" as they are used. Patent is a grant of temporary monopoly in markets, in return for an agreement to make the new intellectual property available to others who can build on its insights. All of this sounds pragmatic and sensible, a nearly intuitive response to the non-rival nature of intellectual property. But none of the characteristics of these compromises are predetermined by the facts of nature.

And so innovators have used new technology to experiment with the basic notion of property as the right to exclude. The most visible and market-changing experiment has come in the form of a mini-economy built around software code, specifically open-source software. "Open source" refers to software in which the source code—the human-language programming that interacts with machine-language 0's and 1's to configure particular operating systems or end-user software applications—is available for all users to view and modify. This is in contrast to proprietary-source code, such as for Microsoft's Windows, which, like the formula for Coca-Cola, is a jealously guarded secret.[3] The open-source process radically inverts the idea of exclusion as a basis for thinking about property.

Property in open source is configured fundamentally around the right to distribute, not the right to exclude. This places the open-source process a step beyond standard norms of sharing in a conventional scientific research community. The entire research product and the process of generating the product are made open; copying is allowed and encouraged; and under the most commonly used open-source licenses, modifications and improvements of any sort must be given back to the community fully and without any restriction. It is almost as if the concept of fair use—a provision allowing for the free reproduction of copyrighted works under certain limited circumstances—was extended without boundaries, along with a guarantee that no individual's fair use will be permitted to constrain subsequent fair use by any other individual, for any purpose.

Open source is profoundly remaking the economics of the IT sector in advanced countries. It is already a major part of the mainstream IT economy, and it increasingly dominates aspects of that economy which will likely be the leading edge (in technological and market terms) over the next decade. There exist thousands of open-source projects, ranging from small utilities and device drivers to office suites

like OpenOffice, database systems like MySQL, and operating systems like Linux. The Linux operating system and the Apache Web server attract the most public attention. Apache simply dominates the Web-server market: over 65% of all active Web sites use Apache.[4] Nearly 40% of large American companies use Linux in some form; it is the operating system for more than a third of active Web servers and holds a significant and increasing proportion of the server market overall.[5] If you use Google to search the Web, you use a cluster of thousands of computers running Linux. Examples of other open-source projects in wide use abound. Sendmail is an open-source email transfer and management program that powers about 80% of the world's mail servers. BIND is an open-source program that acts as the major addressing system for the Internet. Yahoo runs its directory services on FreeBSD, another open-source operating system. If you saw the movies *Titanic* or *Lord of the Rings*, you were watching special effects rendered on Linux machines that are running at companies like Disney, Dreamworks, and Pixar. Increasingly, open-source software is running major enterprise applications for large and small corporations alike. Amazon, E*trade, Reuters, and Merrill Lynch are examples of companies that have recently switched backend computer systems to Linux. Large parts of the United States government, including the Defense Department, the Department of Energy, and the National Security Agency, work with open-source software (Weber, 2004). Microsoft cites open-source alternatives as its major business threat in several of the market sectors the company dominates (Hellweg, 2004). IBM has essentially bet its future on a strategy built around open-source platforms (Galli, 2005). And open-source software is a major factor in fast-evolving markets for embedded code that runs "smart" devices, a sector that many foresee as the major source of growth in the IT economy over the next decade.

Open source is not a marginal phenomenon that can be dismissed as the quixotic activity of software enthusiasts and code hobbyists. It is mainstream and central to the IT economy. Innovation is being fostered and promoted in dispersed networks of collaborators who are not held together under a corporate, state, university, or other authoritative organization. And as a result, software is becoming a tool, and even more so a commodity in some of the most important applications and markets. Value and profits are being redistributed to people and companies that provide services, customization, integration, design, and in some cases (ironically) hardware.

From a global economic perspective, the success of open source is doing two very important things. First, it is removing raw software code—which arguably is to the next era of economic growth what petroleum as it comes out of a well was to an earlier era—from the control of any company or government and turning it into something like a commons, albeit a commons that is uniquely valuable because it cannot be depleted by overuse. Second, it is creating a large and growing body of code that can be studied, manipulated, customized, and recombined into new configurations by anyone who has the training and experience to work with it. Weber argues in *The Success of Open Source* (2004) that this will deeply accelerate the rate of innovation in information technology overall, since software is by any reasonable measure the rate-limiting step in the information economy.

For developing economies in particular, Weber (2004) argues that the implications could be very significant. Assume, again, the simple notion that software is a tool for manipulating information. If the tool is essentially free to anyone who wants

to use it, and freely modifiable to make it useful in whatever way the user can manage, then lots of people will grab the tool and experiment with it. The open-source community has been international from the start and remains so; it transcends national boundaries in a profound way because its interests (as well as its product) are not tied to or dependent on any government. This observation is more than simply the fact that open-source developers live in countries all over the world. It is important that developers in China, Indonesia, and other developing countries contribute to open source software, but what is more important is that they all have access to the tool, and on equal terms. We consider the implications of this access for the South in greater detail below.

A more expansive and speculative argument sees digital ICTs—and, as we discuss below, the success of the open-source software process—as driving changes in ideas about ownership, property, and control—the way in which people order economies in the broadest sense of that term. In *Institutions, Institutional Change, and Economic Performance* (1990), Douglass North labels these kinds of ideas as institutions, "humanly devised constraints that shape human interaction." By creating patterns of incentives and constraints for individuals to act and to organize for joint action, institutions establish self-reinforcing and (more or less) locked-in paths of economic development (North, 1990). If you accept North's simple model, then the potential leverage on development paths comes not from technology itself per se, but from the broad organizational changes that technology will drive via its impact on institutions. And there is no institution more central to market-exchange systems than property rights. A production process that challenges existing property rights has the potential to undermine the stability of low-performance but otherwise self-reinforcing equilibrium conditions. After all, importing a new property-rights regime is at least as much "shock therapy" as importing someone else's currency and price regime.

In this way ICTs, and particularly open source, may challenge or transform global systems of property rights. What are the implications for global development, and particularly the North-South divide? While the story is yet to be written, we lay out two scenarios below with very different implications for the global division of wealth and power.

Two Scenarios about Digital Technology, Property Rights, and Development

Digital technologies make it possible to reduce transaction costs and experiment with property rights, separately and simultaneously. The consequences can be quite distinct. Software (like music, since both are pure information goods) is much cheaper to distribute over the Internet than on physical media like CDs or magnetic tape. But lowering the costs of distribution does not make software available to anyone who wants it, any more than lowering the costs of delivering a piece of music through iTunes stops Apple from controlling to whom and under what conditions one can "share" that music. These are matters of transaction costs, exclusively. Open-source software moves beyond transaction costs into property rights by experimenting with what it means to own information, regardless of how it is distributed. Similarly, the non-profit Creative Commons built a set of licenses that tweak various aspects of rights that an artist can choose among as he or she wishes.[6]

This distinction extends beyond music, software, and other purely "digital goods." For example, the same distinct consequences would apply to the knowledge-intensive pharmaceuticals sector. IT can reduce the cost of distributing drugs, for example, by placing Radio Frequency Identification (RFID) tags on bottles of pills, or consolidating distribution into one giant Internet pharmacy. These same technologies could reinforce existing market structures even while reducing transaction costs (for example, by preventing re-importation against national price differentials). Or technology could be deployed to shift the logic of property rights that surround drugs. Experiments with open source–style property systems in the pharmaceutical industry—for example, releasing a molecule under a General Public License or similar license—would change in much more dramatic ways the manner in which drugs are studied, sold, paid for, and developed over time.

One of the most quotable aphorisms of the 1990s IT revolution came from Stewart Brand, who stated that "Information wants to be free." He later modified this statement, saying "but it also wants to be very expensive." Both statements miss the point. Information doesn't want to be anything; *people* want information to be free, costly, distributable, or enclosed. The place where it lands has something to do with transaction costs, but more fundamentally is a function of property rights—technologically enabled to be sure, but ultimately a product of human imagination, institutions, and the power that allows some people to turn the first statement into the second, or vice versa.

We believe a core determinant of how digital technologies affect the distribution of power in the global political economy lies in the property system(s) that characterize the burgeoning digital infrastructure on which the next generation of economic growth will depend. Whether or not this infrastructure becomes "shared" and "global" are the key questions. It is important to note that shared, global, and digital are three sides of a triangle, none of which fully depends on the other; that is, an infrastructure could be global without being shared, or digital without being global. What is distinctive about digital technologies is that they make it possible to imagine a shared global infrastructure that is far less expensive than a similarly global and shared infrastructure would necessarily have been in a physical environment (think railroads, or even container shipping). Open source can be seen as the software piece of this infrastructure; add to that the profusion of physical transmission through fiber and increasingly through extensive wireless capabilities, along with terminals at the endpoints whose capabilities double every 18 months or so by Moore's Law, and you have something that (probably for the first time in human history) could approach a truly global infrastructure. Whether or not this will happen in practice is an open question.

Two proto-scenarios of how the development of such an infrastructure might play out are on the horizon. These scenarios are rooted in distinct concepts of how property-rights battles evolve, and they can be used to generate differing sketches of a global economic environment for development. In each of these scenarios there is a differing outcome of these property-rights battles, which occur over both the ownership of code, standards, and other knowledge-based factors in the global economy, and the digital infrastructure itself, the physical wires and transmitters on which this knowledge flows. Like any infrastructure, this would become a platform on which people, economies, and societies would build (and potentially share) their

own "applications." Whether or not this infrastructure becomes globally linked and shared among countries is a key difference between the scenarios we propose. There are opportunities for a developmental upside to this picture, but it is not a simple picture to construct, even as a scenario. The critical uncertainties lie in the architecture of this technological infrastructure and, following from that, what behavior(s) it would facilitate or support. In *Code and Other Laws of Cyberspace* (1999), Lawrence Lessig reminds everyone that no architecture (economic or political) is featureless and equally facilitative of all action by all players. Networks have nodes; code instantiates rules; information wants to be neither free nor very expensive. Put simply, a global digital infrastructure is not predisposed to become the foundation of a power-free world, any more so than any other kind of infrastructure would be. Where power lies, in turn, depends on who provides what pieces of the infrastructure, and how it is owned, distributed, taken care of, maintained, and upgraded over time.

This is a partly familiar and partly unfamiliar problem. The familiar part resembles a multiplayer battle of the sexes–type game, where the issue is not whether we all prefer to agree on a standard, but rather is over which standard we prefer to agree upon. Put differently, everyone might desire coordination on a global digital infrastructure, but the battle is joined over the differential distribution of costs and benefits within particular manifestations of that outcome. A simple version of the dilemma looks like this: Two neighbors desire a new streetlight on their block (Varian, 1998). The light is worth $400 to each but costs $700 to build. A contractor may be able to solve this problem (but not always, depending on other aspects of the neighbors' preferences) in the first instance by soliciting increasing bids from each neighbor until she is offered more than $700 total. But that does not solve the maintenance problem, or for that matter other aspects of the distributional problem, such as where on the street the lamp will be built. Scaled up to multiple players, this part of the problem may not change shape in principle, but in practice it gets enormously more complicated.

The less familiar part of the problem emerges when the game stretches out over time. A global digital infrastructure can be a kind of commons. The less familiar problem is that we are not just trying to manage the provision of a commons, which then has to be governed so as to make certain that it does not get degraded by overuse; we are trying in addition to do something a bit harder, the maintenance and care-taking and particularly the upgrading of that commons over time, since infrastructures, whether of steel-reinforced road bed or computer code, require modification for evolving applications and in any case deteriorate with use and over time. And we would necessarily be doing it all outside the boundaries of authoritative, state-organized politics, since the state's role as a key provider of shared infrastructure is declining generally and has always been of lesser importance in the digital world than elsewhere.

The economics here are about sustained, multi-dimensional, dynamic sharing, rather than just iterated cooperation. A priori, our expectation is that power takes on new and perhaps distinctive dimensions in this kind of problem, and that the actors will discover at least some of these dimensions over time rather than plan for or strategize around them from the start. For example, the politics of distributing Internet addresses—which once seemed to be a pure coordination problem without signifi-

cant consequences—have become remarkably contentious as "name-space" emerged to be a scarce and valuable resource for the World Wide Web (Bach, 2004). For a speculative example, consider that in a (future) world of far more open financial networks, central banks' ability to control short-term interest rates may be a significantly less powerful regulator of economic activity than the ability to control access to bandwidth. Uncertainty about this future may act as a salutary veil of ignorance behind which new and reasonably well-functioning institutions get built to manage digital standards. But it may also generate anticipatory strategic behavior to gain power over infrastructure and standards, which will make it very hard to build much of anything that can be shared among diverse actors.

The scenarios we lay out below address two distinct potential outcomes of these debates. Neither is a best- or worst-case scenario; there are potential benefits and threats to both the North and South in each. But they derive from quite different actions on the part of powerful international actors. They would also have diverse and significant effects on the character of North-South political economic relations. The purpose of drawing out scenarios is decidedly not to predict the future but rather to exaggerate the most important and most uncertain elements of a future, elements that are most easily seen and debated when they are placed in sharp relief.

Property-Rights Imperialism

The first scenario we call "the imperialism of property rights." The imperial strategies of 1800s European powers were in one sense simple: Go out into the world and find more of the critical factors of production (and consumption) for the industrial economy than you have at home. Organize them in ways that allow easy insertion into your production systems. Integrate them smoothly so that your factories and markets expand apace. Use power—peaceful forms if you can, but more violent forms if you must—to resist any significant challenge. The critical factors of production for this phase of economic growth were land and people, and the strategy was called colonialism. Although Britain led, other countries were of course pressed into a competitive race to enclose what they saw as dwindling supplies of factors into their production systems, so that Britain could not deny it to them. Two obvious consequences were a set of conflicts between colonial powers at the boundaries of their respective holdings, particularly as the windows of opportunity to grab a place in the sun were seen to be closing down; and anti-colonial struggles emerging from the people whose resources were being pressed into forms of property that benefited the colonial power's production systems.

A major thrust of contemporary U.S. foreign economic policy is closely analogous, with the difference being that knowledge and information are now the factors of production to be organized. The Trade Related Aspects of Intellectual Property Rights Agreement (TRIPS), and even more aggressively the TRIPS-Plus provisions that the U.S. has negotiated into a series of bilateral trade accords, are emblematic. U.S. trade negotiators describe "piracy" of intellectual property both as an economic phenomenon and as an ideological, almost moral, affront to modern behavior. For example, A *New York Times Magazine* article of January 2005 quoted an un-named administration official arguing that China's lax enforcement of (Ameri-

can) intellectual property rules were the equivalent of nuclear threats from the Soviet Union during the Cold War. The imperialism of property rights is often advertised as protecting markets, but keep in mind that most of the people who purchase pirated CDs in China would not have bought the real item simply because they could not afford to do so—and thus most piracy in developing countries does not represent lost sales. In software markets, there is actually a clear logic that favors allowing sub rosa piracy in developing countries in order to "hook" users into particular platforms that they must later pay to service and upgrade as GDP rises.

What piracy does represent, importantly, is an institutional challenge to a set of beliefs about what ownership means and why it is configured as it is. The intellectual-property "incumbents" from industries like music, software, pharmaceuticals, and others argue that almost any crack in the firmament of property rights creates a slippery slope toward a black hole for innovation. If they (sometimes) acknowledge that patent and copyright regimes are in practice imperfect, they hardly acknowledge any theoretical alternatives. They also claim that any significant experiments with alternative incentives for innovation and investment will fail and, in the process of failing, destroy existing systems of creativity. As Steve Ballmer, CEO of Microsoft puts it, open source is a "cancer" on the intellectual-property regimes that incentivize innovation.[7]

Some targets of this strategy simply do not care and prefer to free-ride on whatever intellectual property they can access. Many of the targets of this strategy understand the arguments perfectly well, but simply do not accept their claims of exclusive truth. And so there is a reaction to the incumbents' arguments that takes on the tone of an anti-imperialist thrust. China did not simply pirate Viagra; the Chinese State Intellectual Property Office went through a formal process of invalidating the patent. It will likely do the same at some point soon with cholesterol-lowering statin drugs, as the emerging Chinese middle class finds itself suffering from diseases of modernity (such as coronary artery disease) without the Western middle-class income or insurance schemes to pay for these drugs.

As isolated "revolts," these are more significant to Pfizer than they are to the United States economy or to the global economy as a whole; a few invalidated patents does not a revolution make. The more significant risk to intellectual-property colonialism comes when target countries unite to define their own alternative (and autonomous) regimes. Watch for the developing-world consortium that links an Indian generics manufacturer with a Chinese research lab to produce and sell low-cost anti-hypertensives in Brazil and Russia. Whether or not a Frantz Fanon equivalent emerges to give eloquent voice to this kind of initiative, it will in fact represent a significant anti-imperial repositioning to which the United States, in turn, will have to decide how to respond.

There's one powerful objection to this scenario in some American circles; and although it is comforting to those who worry about impending struggles over intellectual property, it is almost certainly wrong, at least in its strong articulation. This view rests on the proposition that convergence onto American notions of intellectual property, and the best ways to "protect" what is valuable within it, is inevitable. This assumption underpins the claim that as China and other emerging economies increasingly generate fundamental innovations, they will become staunch defenders of copyright and something very much like the United States patent system.

This is possible, but not nearly inevitable. Patent and copyright are pragmatic compromises between competing values; their terms have changed over time at least as much in response to the power of economic interests as in response to economic logic. It is hard to find an economist or lawyer who believes that the current American intellectual-property regime is anything like a unique or optimal solution to the underlying problem set it is meant to solve.

To go from that toward a convergence claim strikes us as a naïve application of a latter-day modernization logic, reasoning that today's developing economies will transition toward the same kinds of market structures that last century's developers did, because that is the optimal or only equilibrium path. It seems to us far more likely that today's developers will find other ways of protecting what is valuable and other ways of extracting rents from different parts of a value chain. Greenfield experiments in open source–style property systems should be expected in sectors like music, entertainment, software, pharmaceuticals—and others that happen to be major global strengths for the U.S. economy. To dismiss these challenges as quixotic, idealistic, and unworkable because they are challenging to the business models of globally competitive incumbents (many of whom are based in the U.S.), is to underestimate the creative minds of emerging market entrepreneurs arrayed against the very different market conditions that they face, and overestimates the power of American rules of the game. Some of the larger players, particularly China, have begun to subtly and in some cases aggressively challenge American/European power in standards bodies, which have become a major conduit for internationalization of intellectual property systems (Weber et al., 2005). Whether or not they can successfully change the rules on the global stage, the new players will no doubt try. The most important uncertainty for the distribution of wealth in the global political economy in this scenario is, in fact, how America responds.

Property rights imperialism, then, is a strategy more than an outcome. This scenario certainly does not imply that U.S. notions of property rights will be successfully imposed or otherwise transferred to other parts of the world. In fact, the interesting characteristics of this scenario emerge from the reactions to imperialism. The reaction may take the form of multiple systems of property rights that produce different rules and standards in knowledge-intensive industries and digital infrastructure—a property-rights protectionism, if you will. These inconsistent ownership rules would at a minimum add a layer of transaction costs for moving information internationally, making economic exchange difficult, expensive, lossy (as information theory uses the term[8]), and perhaps practically impossible across intellectual-property boundaries.

One implication for the South might be a set of choices depressingly reminiscent of development politics during the first decades of the Cold War. Developing countries would find themselves needing to choose between patrons, by aligning on intellectual-property grounds with the countries dominating incompatible intellectual-property systems, in all likelihood the U.S. or China. Individual countries would derive few benefits from their alignment, other than a bounded domain for trade, unless they become an exit threat. While some larger developing countries might attempt to build the equivalent of a non-aligned movement, it is difficult to see how the effort would be more successful in the digital era than it was in the industrial age. The North-South divide then becomes differentiated by a second dimension,

and southern countries, while they may benefit through some spoils from their patron state, are unlikely to see any significant change in their position in the dominant international power dynamic.

Shared Global Digital Infrastructure

The second scenario we call the "shared global digital infrastructure" world. In this case, the digital infrastructure and intellectual property rules and standards are shared among countries. Wired and wireless connections would be linked in a manner such that southern transmissions would not require northern hubs, and software standards would allow lossless transmission of knowledge-based goods across country boundaries. This world would likely involve significant coordination, beyond simple standardization of protocols, around open-source models of property rights, particularly in the software and hardware domains. The imperialism of a single or multiple models is alleviated by bargains among actors to utilize intellectual-property models that produce benefits outside those derived purely from royalties.

This scenario depends on stable and sustainable agreements on critical elements of commons management. The negotiation of who will maintain the digital infrastructure and what international bodies will support the development of rules on these issues are open questions. The drivers of decisions on this shared model could indeed be the developing countries themselves. Argentina, Brazil, and thirteen other southern countries are pressuring the World Intellectual Property Organization to become a real alternative institutional base of support for developing countries' intellectual-property agendas. This effort comes in response to the current dominance of the TRIPs agreement, and highlights the significance of these international bodies as locations for these debates.[9] Individual countries also play an important role, for instance, in recent efforts by the Brazilian government to support open source–based management of Top Level Domain registries in African countries. These examples represent an increasingly common coordination between southern actors to support open standards (Wanjiku, 2005).

There are significant advantages to this model of a unified, extensible, and shared global digital infrastructure. Countries in both the North and the South would benefit from as-yet unrealized network externalities that increase their access to both knowledge and global markets. For countries in the South in particular, there could be significant benefits to an open property-rights system. The early evidence of this can be seen in the enthusiastic response of developing countries to the open-source software movement. With the combination of lower up-front costs to access code, less-onerous intellectual-property restrictions on customization and redistribution, and the relative lack of legacy systems in many places, it is no surprise that developing-world markets have become a hotbed of enthusiasm for open-source deployments. China's Linux sales grew 20% in 2004 and are expected to continue double-digit growth for the foreseeable future. Latin Americans are increasingly adopting Linux on the desktop. Government procurement policies are particularly important in the developing world, where governments are often lead users in a technical sense as well as a major market presence. The Brazilian government now requires companies and research institutes that receive government financing for the purpose of developing software, to then license it as open source (Benson, 2005).

In 2003, the Chinese government declared Linux the "operating system of choice" for new installations. Venezuela's national IT institute has said that it expects more than half the country's public agencies to be using open-source platforms by 2007. South Korea's government plans to replace a significant proportion of its desktop installations with open-source packages in the next two years, as do the Israeli and South African governments.[10] These are, of course, anecdotes, and a series of anecdotes is not a substitute for comprehensive data. But in the absence of satisfactory data, these anecdotes at least demonstrate a pattern of proliferating open-source initiatives. Certainly Microsoft's increasingly aggressive campaigns to compete with and undermine open-source alternatives in developing-country markets signal that Microsoft perceives a significant pattern.[11]

The degree to which a software tool can be utilized and expanded is limited in practice. Open-source software, however, is limited only by the knowledge and learning of the potential users, not by exclusionary property rights, prices, or the power of rich countries and corporations. It is important to be cautious in thinking about what this means: knowledge and learning are real constraints (albeit a different kind of constraint than are exclusionary rights and power). The free diffusion of tools will not create a profound leveling phenomenon. Even when everyone has equal access to tools, some people can and will use those tools to create and add more value than others. Consider an analogy to an imaginary world where everyone had access to as many steam engines as they wanted, all at the same time, at nearly no cost, and with an open ability to disassemble, customize, and reassemble the components. It is still the case that economic development in the industrial era would have been uneven, but it very well might have been less drastically uneven than it is today.

If extrapolating this analogy to the information economy sounds outlandish even as a hypothesis, take a step backward toward more familiar discussions about the question of "appropriate technology" for poor countries. For most of the second half of the 20th century it was rich-country governments, and the international development institutions dominated by them, that made the most important decisions about what was appropriate technology to transfer to developing countries. Developing countries themselves had little say in these processes. Open-source software shifts the decision-making prerogative into the hands of people in the developing countries. In one sense, the provision of a freely available technological infrastructure still represents by itself a form of wealth transfer to poor countries, but it is a wealth transfer that developing countries can maneuver to their particular advantage. To provide real products and services on top of the infrastructure requires an investment of local labor to start. India, China, and many other developing countries have a surplus of inexpensive technical manpower. Combining surplus manpower with free software tools creates the possibility of an interesting kind of comparative advantage that will certainly matter in local markets and in some cases might become important on global markets, as well. One of the advantages of open-source licensing is that it then prevents a dysfunctional enclosure of mobilized "southern" resources into "northern" properties protected by patents that are offered for resale to the "South" at exploitative prices, a depressingly common pattern for knowledge-intensive products as diverse as music, plant varieties, and pharmaceuticals.

The promise inherent in this argument is that software innovations can and should

come from everywhere. Emerging markets are not implicitly stuck relying on commoditized, hand-me-down innovation from the developed world. They can have their own lead users who pull technology development toward applications that fit specifically the indigenous needs and demands of emerging markets (Von Hippel, 2005). Indeed, because information technology often has great plasticity and is more easily customized than were many industrial-era technologies, the opportunity for autonomous lead users in emerging markets to deeply influence the direction of technology development is considerable. Open-source software helps to tap this potential. Our hypothesis here is that many of the "killer apps" for developing economies (more modestly, the applications that find widespread acceptance and drive technology and infrastructure deployment forward) will almost certainly come from within those economies. This would be accentuated in the context of a shared global digital infrastructure. In other words, user-centered design principles developed in the United States and for American users will not be directly transferable to much of the rest of the world. The same is true of the granular peculiarities of payment systems, and even more so of e-governance applications. While open-source coding work is still disproportionately concentrated in the U.S. and Western Europe, software developers in emerging markets (notably China, Mexico, and South Africa) are making increasing contributions both to local adaptations of open-source packages and to broader projects that enter the global market. A recent survey of Chinese software developers reported that 65% expected to write applications for Linux; nearly half had already done so (Liu, 2002). Companies like Oracle, Red Hat, IBM, and others have established Linux and open-source research centers in Southeast Asia. Again, these are anecdotes, but they similarly represent early indicators of a pattern of behavior which is proliferating and which no government, including the U.S. (given the government's extensive use of open-source software), has an obvious incentive or capability to disrupt.

It is also the case that many countries have distinct political and security incentives to avoid lock-in to proprietary software products. Local and national government agencies in Brazil have been at the forefront of mandating the use of free software when possible. In the spring of 2002, a Peruvian congressman defended a similar bill brought up in Lima with these arguments:

> To guarantee national security or the security of the State, it is indispensable to rely on systems without elements that would allow control from a distance or the undesired transmission of information to third parties. We need systems with source code freely accessible to the public so that they may be inspected by the State itself, by the citizens, and by a large number of independent experts throughout the world. Our proposal offers greater security, since the knowledge of the source code will eliminate the growing number of programs with "spy code."[12]

We quote at length because this statement demonstrates vividly that the issue is more than saving costs. There is nationalist ideology behind these initiatives, but also concrete interests. It is no surprise to industrial organization theorists that governments (like any customer in a market) want to avoid locking themselves into a single private provider for crucial tools. And it is no surprise to international-rela-

tions theorists that states want to avoid becoming dependent on software whose export is under U.S. legal jurisdiction and whose development and licensing is controlled by America's dominant software industry. Communications networks, e-government applications, and of course just about everything that makes up a modern military force increasingly run on sophisticated software. No national government, if it had alternatives, would have chosen during the 20th century to accept dependence for steel or petroleum on a single supplier or a small number of suppliers based in a potential rival nation. And so it is unsurprising that the Chinese government in particular has supported the development of Red Flag Linux and other open-source packages as a distinct alternative to proprietary software—in part as a development tool, and in part as a lever to reduce potential dependence on a company that just happens to be based in Redmond, Washington, USA.

The version of digital optimism we are putting forward here recognizes a transformative potential of computing: IT can create new opportunities to gain leverage on development problems that have been intransigent during the prior phase of modern industrial development. Poverty alleviation and improving governance through the enabling of information systems that empower individuals to participate more fully and effectively in existing economic and political systems would not be trivial achievements. This does not necessarily mean that the global divide would shrink in relative terms, but there is the potential for increases in absolute development that rely less on structurally unequal power dynamics between northern and southern countries.

But the news would not be all good. A shared infrastructure built on open protocols does not necessarily imply continued openness to exchange. A shared global digital infrastructure would be a powerful solvent of many existing boundaries, but when boundaries are broken down between groups they are often rebuilt in new, and perhaps surprising, ways. Thus, an important uncertainty of a shared global digital infrastructure is its relationship to liberal ordering principles, both political and economic. This scenario will have to grapple with a huge, multifaceted, and generally unaddressed question that was left over from studies of globalization during the 1990s: Is the diversity of cultural, religious, and other such "tastes" exhibited by human beings on this planet a rich set of preferences for global markets to satisfy, or is it a set of increasingly impenetrable boundaries to economic exchange and political discourse?

This question is a backward flip of what globalization pessimists in the 1990s feared: the monotone of cultural homogenization. The worry then was that economic liberalization would drive preferences around the world to a least-common-denominator, mass-production-oriented set of tastes—or even worse for some, a set of tastes manufactured within and legitimated by American culture. This worry seemed to rest on an underlying argument that the expressed diversity of desires and demand functions in different cultural settings was a result of barriers to exchange, rather than a fundamental characteristic of human nature(s). So far as we can tell in 2005, this argument and the accompanying concerns appear to have been exaggerated. As we remove economic barriers, we do see the proliferation of Wal-Mart. But we also see a flowering of diversity in preferences and enthusiastic recombinant mixing of elements of culture. This is nowhere more visible than in younger generations. The oversimplified idea of a "global teen"—a wishful fantasy

of marketing executives and a dreary nightmare of cultural critics—has proven to be dead wrong. But would that recognition be good news for liberalism in this scenario?

With a shared global digital infrastructure in place, the differentiating factor between markets that support homogenization and markets that demand cultural and other kinds of segmentation might increasingly be what people most deeply want out of economic exchange, rather than any kind of technological or transaction-cost concern. Wal-Mart-style efficiency (low price, reliable availability, etc.) is the goal of some economic exchange carried out by some people some of the time. That part of the economy becomes increasingly uninteresting, however, except to the very few massive organizations that can increase their throughput sufficiently to be profitable. Using economic exchange to promote and support other values becomes much more interesting, and will likely become a goal of more people, more of the time. And this change would be enabled by the surplus wealth recovered from the Wal-Mart-style exchanges. We see simple and early manifestations here in Berkeley: consumers shop at Costco and Price Club for low-cost commodities, and then pay premium prices at farmers' markets for local organic lettuce and hand-kneaded artisanal bread baked on stones from Sonoma County quarries. At the same time they are supporting California organic agriculture, remember that they are not buying apples from Chile or lemons from Argentina—globally sourced goods from developing countries. It is not just the technologically enabled economic efficiency of Wal-Mart that makes this scenario possible. It is as much the diversity of values and, more importantly in this future scenario, the ability of digital technologies enabled by a shared global infrastructure to mark out products and production systems that adhere to particular sets of values.

One result could be a technologically enabled illiberal capitalism that carries the farmers' market story out much further. This scenario would emerge where value-driven economic exchange (facilitated by technology) leads to intensified economic interdependence among groups that share certain cultural, religious, or environmental values—and reduced exchange and interdependence across groups. Weber has made the argument elsewhere that the notion of a "price" as the basis of calculating values in an exchange relationship is a massively compressed way to carry information relevant to the exchange, barely good enough for the thin-bandwidth world of the past (Weber, 2004: Chapter 8). Shift to a thick-bandwidth world where parties to an exchange have huge communication and computation capabilities at their beck and call, and price as a way of expressing values seems quaint. Technologies like RFID tags, networked together into a global database, massively increase the amount of information that a product can carry about itself on what used to be called a "price tag." And when economic artifacts carry within them all the information about the inputs and production processes that led to their creation, will affinity groups based on religion, gender, diasporic networks, or genetic boundaries determine patterns of commerce—either on the buy side ("I only buy Catholic products made in Catholic factories with Catholic inputs") or even on the sell side ("I only sell my products to Catholic customers")? The same could be the case for Islamic exchanges, or any other value-based, rather than geographically-based, differentiator. If this scenario sounds mildly bizarre, try substituting the adjective

"green" (as in environmentally-friendly) for "Catholic"; such patterns of commerce are already in place.

Durkheim might call this vision "technologically empowered mechanical solidarity." We might call it an economy of high-tech kinship networks. It does not have a very liberal feel to it. Certainly the first things to go would be the international institutions that we associate with a liberalizing global economy (for better or worse). While some might argue that high-tech kinship networks are empowering for actors in the South, they also, like closed property-rights systems, place limits on the openness of trade. This not only means a challenge to American power, in part because the U.S. benefits disproportionately from a liberal globalizing economy, but also to the trade opportunities of actors in the South who are excluded from these networks, and who will consequently be increasingly disadvantaged. In addition, while the members of a global religious trade network may link across North-South economic boundaries, there is no reason to believe that the power dynamics in networks would differ from those that currently exist between the North and South. Thus, this vision is not particularly hopeful for global politics, or for any sense of enhanced solidarity between developing and developed countries.

Where Are We Heading?

If these visions of the future are cast as equally viable, the question then becomes, Which of the tendencies that these scenarios highlight will come to dominate what segments of the global economy, and why? To state a comprehensive set of hypotheses on that question is a monumental undertaking, perhaps impossible given the number of variables in play and the unpredictability of the development of the underlying technologies. It is possible, however, that pieces of the answer to this question can be seen in the evolution of particular current struggles, which can be monitored for signals and early indicators of where power lies, how it operates, and who has agency around these problems.

We propose that while ICTs played an important role in opening up questions on property rights, it is likely to be developments in the pharmaceutical sector that set the tone for answering questions about the future of global intellectual property in the next few years. The stakes in pharmaceuticals are much higher than in software, telecommunications, or entertainment content, across several dimensions. Drugs touch directly on matters of life and death in ways that software and music do not. Prescription drug sales (and profits) exceed sales of music by orders of magnitude. The U.S. economy is likely to have and possibly maintain greater competitive advantage in the life sciences than elsewhere. National security interests relating to the proliferation of the underlying capabilities to manipulate genomic material and design pathogens is obviously a much greater concern post–September 11. And the private players in this sector—big pharma—have unrivalled political influence in Washington, DC.

But the conceptual fragility of the property-rights system that underpins the pharmaceutical industry's business model is becoming clear at precisely the same time that the industry's political foundations are being shaken. By most assessments, the current intellectual-property regime under which pharmaceuticals operate has failed

on its own terms. Pricing is dysfunctional: drugs are too expensive in the United States, too cheap in price-controlled markets in Europe, and still unaffordable for most of the world's population. Innovation is languid: the productivity of research and development within the industry has been declining steadily for more than a decade, with fewer new chemical entities receiving FDA approval every year (53 in 1996, declining to 21 in 2003; in the same period, research and development spending roughly doubled to around 32 billion dollars). "Me-too" drugs, which compete with existing therapies and are not significantly better, are rampant. Dubious means of extending patent protection for six months to a couple of years (by modest reformulations or testing for safety in children) are the norm. And the strategic behavior of firms does not reflect a vibrant culture of discovery that the intellectual-property regime was supposed to incentivize: clinical trial data are "massaged" by sponsors. "Land grabs" of the human genome by companies that file for low-quality patents make it likely that almost any interesting new molecule can be held up in litigation. Putting together a patent portfolio to pursue the development of particular chemical compounds involves a huge amount of legal and business wrangling. The deadweight costs are passed on to consumers. Overall, the perceived legitimacy of the pharmaceutical industry and its implied license to operate is at real risk, at least in part because the intellectual-property regime is not working.

The international politics of pharmaceuticals are yet more fragile. To a citizen of South Africa, the cost of anti-retroviral treatment for AIDS is like a weapon of mass destruction. The debate over pricing and availability of drugs in poor countries takes place in the shadow of predictions that 100 million people may die in Africa from a disease that can now be treated as a chronic condition in the United States. Indian manufacturers will, in the course of 2005, be brought under WTO restrictions on exporting generic formulations of patented drugs to other developing countries. And the Chinese challenge to U.S. drug patents, as we mentioned earlier, looms large.

There are parallels to each of these concerns in the software sector and most other knowledge-intensive industries. If the pharmaceutical industry is distinctive, it is probably because the arguments are further advanced and because the stakes are more immediately tangible. What happens as the battles over property rights in the pharmaceutical industry are joined in the next few years will yield early signals for other industries that development thinkers should watch with great interest.

Conclusion

The potential futures we present here reflect two different sets of consequences that might follow a simple cause: the staggering increase in availability of digital technologies, which has forced reconsideration of both the inevitability of transaction costs and the "predetermined" nature of intellectual property regimes. We have focused on potential shifts in property rights to highlight looming debates that may have significant implications for the global economy. It may indeed be that the North-South power dynamics of 2050 look very similar to those of today, but it is clear from examining these scenarios that if that turns out to be the case, actors in the South will have, at the very least, made significant attempts to influence that trajectory.

Our discussion probably focuses more heavily on the potential downsides of the two scenarios. This was a conscious choice. While there are important potential benefits to actors in the South in either case, and particularly within the shared global digital infrastructure, it is necessary to highlight areas of concern that might not be immediately obvious otherwise. Movement toward a single model of property rights may backfire if the assumptions of that system do not meet the requirements of increasingly more powerful actors in the international arena. Pressure instead for an open and shared system of infrastructure and standards promises greater benefits to all, but is limited by the potential rise of value-laden barriers to exchange. In each of these scenarios, the breaking down of some barriers, be they economic or technological, could be met with the formation of new barriers driven by the economic interests of powerful states or the culturally rooted preferences of individual actors.

This is not to say that new barriers to exchange are predetermined. As we argued earlier, the two scenarios we have developed here merely set out some central concerns and opportunities for international development in a digitally enabled world. The implications of the digital revolution for the South are mixed, which seems unsurprising given the results of previous development efforts. The digital revolution is not necessarily more likely to eradicate the North-South divide than the industrial revolution did. But these technologies do create new spaces for debate within which developing-country actors can experiment and innovate in an effort to shape outcomes. Thus, while the answer to the somewhat audacious question in our title is likely to reflect a compromise between the alternatives we have sketched, what is certain is that development in a digital era will be powerfully shaped by the answers to the questions raised here.

Notes

1. For example, see <http://www.telegeography.com/products/map_internet/index.php?PHPSESSID=8a5368ca2835ec7f301b9fafebb00c8c>. Accessed 17 April 2005.
2. The argument on this point was that to the extent that breaking up difficult-to-replace supply chains was a disincentive to conflict, commercial liberal driving forces that press against war would likely be weaker in a digital economy than in a physical one—simply put, because the digital economy requires less-fixed and non-redeployable investment. It is easier and less expensive to relocate software engineering (which you can buy in pieces) than it is to relocate an FDI-funded physical factory. General Motors has more to lose from a Sino-American conflict than does Microsoft, at least on the production side of the equation.
3. For a detailed explanation of open-source development processes and characteristics, see Weber (2004).
4. http://www.netcraft.com/survey/.
5. Precise estimates on this point vary, depending on the metrics. The research firm IDC estimates that Linux ran on 23% of new servers shipped in 2002 and projects an increase to 32% by 2007. Gartner puts the numbers at 7% and 16.4%. Most analysts agree that the rate of growth is somewhere in the range of 20% per year. See for example "The Linux Uprising," *Business Week* 3 March 2003; the IDC study is available at www.osdl.org/docs/linux_market_overview.pdf.
6. Creative Commons: www.creativecommons.org/about/licenses.
7. http://news.com.com/Why+Microsoft+is+wary+of+open+source/2100-1001_3-268520.html.
8. A lossy image is one in which the image after compression is different from the original image due to lost information.
9 See http://www.cptech.org/ip/wipo/da.html and http://www.wipo.int/documents/en/document/govbody/wo_gb_ga/pdf/wo_ga_31_11.pdf.

10. These initiatives are reported in Steve Hamm, "Linux Moves In On the Desktop," *Business Week* 23 Feb 2004; Ken Spencer Brown, "IBM, Others Pushing Linux onto the Desktop" *Investor's Business Daily* 22 Dec 2003; CNet News.com, "Oracle, Red Hat Set Up Linux Center in Singapore," 23 June 2004; *Business News Americas*, "Open Source in 50% of Public Entities by 2007," March 9 2005.
11. For example, see http://www.infoworld.com/article/04/03/16/HNopensourcemodel_1.html.
12. Letter from Congressman Dr. Edgar David Villaneuva Nunez to Microsoft Peru, May 2002, cited in Ariana Cha, "Europe's Microsoft Alternative: Region in Spain Abandons Windows, Embraces Linux," *Washington Post* 3 November 2002, p. A1.

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