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### **Innovation and Inequality**

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# Innovation and Inequality<sup>1</sup>

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Global inequality is a changing phenomenon molded by a variety of interlocking dynamic forces. Technological change is one of these. If we picture the world system as a cross-tabulation of nation states and technological capabilities, we see a core of advanced and advancing nations, a small set of countries rapidly developing their capabilities, and a large number of countries struggling to maintain or build (Sagasti 2004). These groups correspond roughly to the economic hierarchy of nations, in which only four countries have moved into the top group in the last five decades: South Korea, Taiwan, Singapore, and Hong Kong (Milanovic 2005). It is no accident that these four are also the models constantly offered for technology-based economic development.

By focusing on economic development, innovation systems research has contributed to the debate on how to reduce inequality between nations. From its inception, national innovation systems analysis has probed the differences between affluent and aspiring nations (Nelson 1993). Recent volumes in this tradition have focused on developing world regions: Africa (Muchie, Gammeltoft et al. 2003), Latin America (Cassiolato, Lastres et al. 2003.), Asia (Lundvall, Intarakumnerd et al. 2006.); and its ideas have been incorporated into strategy documents for the international community (Juma and Yee-Cheong 2005). The innovation systems tradition has also paid significant attention to inequalities between sub-national regions, from old core high-technology regions through new ones to those that hope to be (Cook 2001). When inequalities are geographically based and can be addressed with concepts of economic development, innovation systems research has a great deal to contribute.

Innovation systems research, however, has not given much attention to another dimension of development, namely, inequalities between individuals, households, or groups. As mentioned earlier in this volume, the lack of a perspective on the role of individual actors in innovation systems is one of the major flaws of the innovation systems approach. This chapter attempts to fill that gap. Econometric studies have shown that income inequality within countries hinders economic development (Deininger and Squire 1998), and ethnic fragmentation has also recently been demonstrated to do the same (Easterly and Levine 1997). The econometric studies reflect the human reality that inequalities place barriers in the path of using innovation for development and keep it from achieving everything it could. We cannot have effective theory, policy, or practice in this area without addressing these issues.

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<sup>1</sup> This chapter has been prepared for Innovation policy, theory and practice: an international handbook, edited by Ruud Smits, Stefan Kuhlmann, and Philip Shapira. Edward Elgar Publishers, scheduled for publication in 2008.

Like inequalities between countries, inequalities between individuals and households are a complex phenomenon with many dimensions.<sup>2</sup> This chapter groups them into three broad types.

- First, most of the conventional literature on inequality is about differences in income, wage, or wealth between individuals or households. Economists refer to these as *vertical* inequalities (Stewart 2001). In this chapter, I refer to the public interventions that reduce them as *egalitarian*.
- Second, the bottom end of the income scale is designated as *poverty*, and many efforts to reduce inequality focus on reducing it. Economic growth can eliminate absolute poverty, which the World Bank measures as income per capita of \$1 or \$2 per day.<sup>3</sup> I refer to public interventions that aim to reduce poverty or make life better for the poor as *pro-poor* policies or programs.
- Third, culturally-defined groups often show different profiles in relation to income, poverty, and other social goods. These differences carry the label *horizontal*. Horizontal inequalities may appear by gender, ethnicity, and religion. This chapter refers to public interventions to reduce the differences between culturally-defined groups in the distribution of things people value as *fairness* policies and programs.

Reducing vertical inequalities, eliminating poverty, and achieving fairness across horizontally defined groups are three types of re-distributive objectives that innovation policy might adopt.

Measures of inequality in income are neutral representations of grueling human realities.<sup>4</sup> One in five infants in poor countries dies before the age of one, as compared with five in a thousand in affluent countries. There are almost no under-five children who are underweight in affluent countries, but rates of 25-50% are common in poor ones; and adult undernourishment is commonly 30%. A child born in Australia, Ireland, Japan, or Italy can expect to live 80 years or more, while one born in many central African countries could expect less than 40. People living in affluent countries can assume access to clean water and basic sanitation, but less than half of those in many poor countries can make the same assumption.

If the definition of innovation includes new and better ways of solving societal problems, then it could be used to tackle these human development challenges as well.

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<sup>2</sup> Milanovic has recently attempted to construct an estimate of household income inequality at global level. That is, ignoring national boundaries, how unequal is the distribution of income among the world's households? The global Gini coefficient – a common measure of inequality that ranges from 0 (complete equality) to 1 (complete inequality) is about .65, or approximately in the range of the highest individual country measures, about .65, leading him to the intriguing conclusion that there is no world middle class. Because individual and household global inequality is so hard to grasp empirically, this chapter will confine its attention to inequalities within countries.

<sup>3</sup> These are calculated in constant-dollar purchasing power parity terms.

<sup>4</sup> All these figures come from UNDP (2006). *Beyond Scarcity: Power, Poverty, and the Global Water Crisis*. New York, United Nations Development Program. Although I am illustrating differences between individuals, the data are reported by country because comparisons by individuals, households, and groups at global level are not readily available.

Communities could be actively involved in trying out new solutions to their challenges. Governments could innovate to become more efficient in the provision of basic services like highways, telecommunications, clean water, and electricity. Industries could produce new, life-enhancing products, through environmentally friendly processes, creating employment. All these efforts could contribute to eliminating poverty and distributing the benefits of technological change widely.

In practice, however, innovation systems often are organized in ways that reproduce and even amplify inequalities between individuals, households, and groups. Even growth-producing technological change brings both benefits and costs, for example, by creating and eliminating jobs and creating effective but expensive new medical options. Thus while technological change seen from one angle is a source of progress, from another angle it creates the potential to increase gaps between rich and poor not just in wealth but also in well-being.

Can innovation policies help to re-invent innovation practice so that it helps to reduce these inequalities rather than reproducing them? That is the central question of this chapter. Section One of the chapter therefore describes four processes of cumulative advantage that link the current practice of innovation with individual and group inequalities, through assets, employment, products, and diffusion. The four processes illustrate changes in policy that have first responded to, and then contributed to innovation practices, resulting in changing relationships to the distribution of benefits and costs in the knowledge society.

Section Two outlines actions that private industry, civil society, research institutions, and the public sector are taking to change innovation practice, re-inventing it in inequality-reducing ways and forming what could be the nucleus of another innovation system variant, the “human development innovation system.” While the literature identifies industry, research institutions, and government as key actors in innovation systems, the “human development innovation system” would be more “bottom up,” with priorities and new ideas coming from actors and communities that scarcely appear in the standard accounts of innovation systems. Innovation systems theory will itself need to take these developments into account if it is to be capable of analyzing the dynamics of these newly-configured systems. The growing attention of innovation scholars, policy makers and practitioners for user involvement in innovation processes seems a promising development in this context.

Christopher Freeman (Freeman 2000) has observed that techno-economic paradigm shifts increase inequalities in part by rendering the redistributive mechanisms of the old paradigms ineffective. After such dramatic shifts, societies must create new redistributive processes if they are going to re-establish shared prosperity. Global society is currently in need of such new mechanisms, and innovation practice and policy could contribute.

## **Dynamics**

### *Assets*

Ownership of assets is a central and age-old facet of the process of cumulative advantage. Wealth is still remarkably concentrated in the contemporary world, with 2%

of the world's population holding 51% of its assets, and citizens of the countries of North America, Europe, and high-income Asia holding almost 90% of it (Davies, Sandstrom et al. 2006). But ownership has also traditionally been a policy option for redistribution. For example, land reform – breaking up large hereditary holdings and distributing land to those who farm it – was an essential step in modernization and improvement in agricultural productivity. Likewise, middle class prosperity in the United States rests in part on the widespread ownership of business assets through tax-subsidized investments in pension funds.

One particular form of ownership has co-evolved with the modern innovation system, Innovation policy is the home of one particular and specialized form of ownership, namely, ownership of intellectual property (Granstrand 2006). Based on a principle first established as part of the U.S. Constitution, Patent and copyright laws are one of the oldest forms of innovation policy, designed specifically to provide incentives for invention. As corporations have become the homes for most inventors, intellectual property has also become an important set of assets for firms. While a new technology remains under the control of the firm that invented it, the firm can charge monopoly prices for its product or services. These high prices (or “monopoly rents,” as economists call them), are one incentive for firms to innovate in radical ways rather than simply incrementally improve their products or services (Duffy 2004; Pogge 2005). The search for monopoly rents has turned the patent system into a huge enterprise, fed by the research and development efforts of large firms and guarded by an army of patent attorneys.

The relationships between technological learning, innovation, and intellectual property protection have been explored extensively in the national innovation systems literature. Kim (Kim 1997) portrays Korea, for example, as moving from a period of dependence of imported technology through reverse engineering (which is easier when intellectual property protection is weak) towards its current status as an innovator nation. The literature also notes that many of today's affluent countries achieved their early economic growth while ignoring or skirting intellectual property laws. The ever-tightening control of intellectual property through the World Trade Organization is thus changing the conditions for technological learning in today's developing economies, “kicking away the ladder” that other countries climbed (Chang 2002; Drahos and Braithwaite 2002). The co-evolution of global economic patterns and intellectual property regimes is thus a key research topic in understanding inequalities between nations. But do the new regimes have any role in relation to individual and group inequalities?

Several current controversies illustrate the connection. One concerns rights to indigenous knowledge. Indigenous knowledge is “local and tacit knowledge that is unique to a given culture or society” (Rao 2006). It may be the knowledge of aboriginal groups about the plants in their territory (Marinova and Raven 2006), knowledge of traditional medicines (Bermudez, Oliveira-Miranda et al. 2005), plant varieties developed by farmers (Borowiak 2004) or language, oral traditions, and epistemologies (Tatsch 2004). Regardless of content, indigenous knowledge is owned in ways that are different from those that intellectual property systems establish. This situation has led to attempts to appropriate that knowledge under IPR systems, taking it out of collective ownership

(Timmermans 2003). Conflicts over these issues reflect inequalities between ethnic groups and between powerful and less powerful social actors. The imposition of Northern concepts of ownership fails to respect the cultural diversity of knowledge owners and raises the distributive issue of fairness (UNDP 2004). This aspect of innovation policy thus becomes a choice point between more and less fair policies, and an active place for innovation in redistributive mechanisms for the Knowledge Economy.

The debate over access to essential medicines, a controversy that has focused on the availability of antiretroviral drugs to treat HIV/AIDS in poor countries, provides a second example of intellectual property rules and human development in potential conflict. “The worldwide HIV/AIDS epidemic has generated intense criticism of pharmaceutical drug prices,” write Calfee and Bate (Calfee and Bate 2004). Drug prices are not generated entirely by development cost or investment (Keyhani, Diener-West et al. 2005). Intellectual property laws, along with recent world trade laws, significantly affect price and therefore who has access to which drugs (Loff 2003). Non-governmental organizations (NGOs) advocating human health rights led the pro-poor fight to activate provisions of the international law that allows production and use of lower-priced generic versions (Matthews 2004; Sell and Prakash 2004). But the controversy stimulated a wide debate on changes in incentive structures and patent provisions to make it more likely that innovation in medicines would serve those who need it most (De George 2005; Pogge 2005).

These two examples illustrate that revamped intellectual property rules need to be part of the new redistributive institutions that the Knowledge Society needs to develop. They also illustrate that those rules will need to be developed on a global rather than national basis, since the relevant innovation system in each case involved a mix of national and transnational actors. In the larger picture, owned innovations are undoubtedly only a subset of new approaches that are improving life at both the bottom and the top of the global income scale; so perhaps a pro-poor, fair, and egalitarian innovation policy would pay much less attention in general to intellectual property and provide a broader set of incentives for benefits that come through many routes.

### *Employment*

Innovation has huge effects on people at the middle and bottom of the income distribution through its relationships to employment. Process innovations are considered essential to efficiency, productivity, and competitiveness, but they often achieve these goals by eliminating jobs. At the same time product innovations, which create something new to be sold, usually create jobs. The overall process of economic growth requires both dynamics: increasing efficiency of existing industries and expanding new business (and thus employment) opportunities. At the generic level, current innovation policies are almost always oriented towards increasing productivity, and government innovation policies are closely linked, sometimes synonymous with, their industrial policies. Policy, industry, and employment patterns thus co-evolve.

While innovation systems studies have paid careful and continuous attention to the expansion of new industries, they have paid almost no attention to the contraction of older ones, and very little to the kinds and numbers of jobs generated or lost in either process. For example, in telecommunications, the automation of directory assistance

services has drastically reduced the number of people necessary to look up numbers and therefore reduced costs for telephone companies, while creating jobs for those who write voice-recognition software and search algorithms. The mobile phone industry has created jobs in design, production, and sales, while eliminating jobs associated with pay telephones and reducing those devoted to land lines. More radical innovations can replace whole product lines or industries, as the photocopier replaced carbon paper and the personal computer replaced typewriters.

The competitiveness of firms, industries, regions, and countries depends on such processes of technological change, but where there is competition there are of course winners and losers. The new jobs created may be located in different places than the old ones, undercutting some local economies while building others up. Urban-rural divides are thus likely to be exacerbated.

A classic theory of inequality, the Kuznets hypothesis (Kuznets 1955), claims that rising inequality is a temporary phenomenon associated with the shift of labor from low-productivity, low-income agriculture into higher-productivity, higher-income industrial employment. Inequality will increase during the process, as the gap between the two first widens, then falls when stable low post-industrial rural employment levels are reached. Since women today constitute a large proportion, some say a majority, of the world's agricultural workers (FAO 2002; Hornady 2006), this pattern – admittedly still a matter of controversy<sup>5</sup> -- widens gender as well as urban-rural gaps.

Kuznets saw industrialization as a temporary transformation process, but there is no end in sight for current trends. If more productive industries survive, grow, and produce new employment opportunities, and if less productive ones decline, then the phase of increasing inequality would seem to stretch indefinitely into the future.

It is also the case that contemporary technology-based economic development is highly selective geographically, not even characterizing all urban areas. This is true whether it takes place in agriculturally based economies or service based ones. Galbraith and Hale (Galbraith and Hale 2003) have graphically demonstrated the accumulation of wealth in just a few counties in the U.S. during the IT-based boom in the late 1990s, for example. Likewise, technology-based developments in China and India are confined to a few locations, leading Shanghai, Beijing, and Bangalore to international fame, while leaving the countryside in both countries largely untouched in opportunity or wealth (Wan and Zhang 2006). Growing industries generate other jobs in an area through the multiplier effect, while shrinking ones remove those jobs from the local economy.

New jobs may also call for different skills. Older workers displaced by technological change will not qualify for jobs requiring skills they never acquired. Weak educational systems may not prepare young people for the emerging employment opportunities, and disadvantaged social groups, including women in many countries,

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<sup>5</sup> Scholars have debated the Kuznets hypothesis and tested it with contemporary data, with inconclusive results on its validity today. For example, contrast Deininger, K. and L. Squire (1997). "Economic Growth and Income Inequality: Re-examining the Links." Finance and Development, with Galbraith, J. K., P. Conceicao, et al. (2000). "Inequality and Growth Reconsidered Once Again: Some New Evidence from Old Data." UTIP Working Paper No. 17..

often have fewer opportunities for formal education. Economists invoke “skill-biased technological change” as a major explanation for growing wage gaps observed in some OECD countries (Greiner, Rubart et al. 2004; Piva, Santarelli et al. 2005). When demand for higher skills rises, according to this theory, higher skill workers receive premium wages. The premiums will show up as rising returns to education and a growing gap in income between skilled and less skilled workers (Lemieux 2006). Where educational opportunities are unequally distributed by region, gender, or ethnicity, these horizontal differences will make the gap even greater.

In addition to the skill dynamic, processes of gender and ethnic identification and closure (Weeden 2002) may lead to uneven distribution of the new employment opportunities opened by technological change even beyond issues related to educational preparation. Since the jobs are in attractive new areas, they are likely to fill early with members of advantaged groups. Women and members of disadvantaged minorities groups may find the resulting work environments difficult. Where network connections have been found to be important business assets (Saxenian, Motohama et al. 2002), informal connections among old-boys networks or within certain ethnic groups may create uneven patterns as well.

In summary, then, innovation creates gradual pressure upwards in the skills levels required in growing parts of the economy. If everyone’s educational level could keep up with the rising demand for skills, this essentially positive dynamic would not exacerbate inequality. But since education is itself highly unequally distributed, between old and young as well as between genders and ethnic groups, the introduction of new technology into the workplace tends to exacerbate inequalities in employment and wages. Vertical income inequality is largely a function of the kinds of employment opportunities available in a society, and horizontal inequalities are primarily a function of where the jobs are located, who is prepared for them, and who is hired for them. Technological change is strongly connected to both patterns. Egalitarian policies are needed to address the first issue and fairness policies for the second. A discussion of targeted re-training programs and thorough-going educational reform go well beyond the scope of this chapter, but surely represent the kinds of conditions governments need to provide as a starting point for maintaining social cohesion in the face of technological change in the workplace.

### *Consumer products and services*

Technological change is not limited to workplace technology, but also includes the availability of consumer goods and services. These in turn play important roles in individual and family well-being. The process of industrial innovation, which takes new ideas and develops them, determines what products are available to consumers, who they are designed for, what problems they are intended to solve, and how much they cost. Service industries make the equivalent determinations for what they sell. Although product development is often influenced by a variety of public policies and programs, including health, safety, and environmental regulation, I will focus in this section on the role of projected markets in determining the availability of products and services at



various prices. The primary reliance on markets to stimulate the development of new technologies is of course a policy choice.

Let us consider how market dynamics affect the availability of products to consumers variously placed in terms of vertical and horizontal inequalities. A market can be thought of as a kind of democracy in which each person holds as many votes as units of disposable income. Each person in the U.S., for example, has on average \$43,740 votes per year for the technologies to be made available to them (that is, the U.S. GDP per capita), and each person in India has on average \$720.<sup>6</sup> Each of the one billion people living at the World Bank's "misery" level has \$1 per day, and each one living at the official U.S. poverty level has \$10,000 or so per day.<sup>7</sup>

Because of these vast differences in available resources, consumers at different income levels buy different things, with the very poor usually focusing their small resources on basic needs like food and housing and those with more income adding other kinds of goods and services (transportation, education, health care, etc.) to their shopping baskets (Goktolga, Bal et al. 2006; Yankelovich and Meer 2006). At the top of the income scale, consumers purchase luxury goods like boats and international travel.

Firms developing consumer products and services can and do think about reaching all of these markets. Innovation policies urge them to match their capabilities and strategies to markets in order to achieve maximum business success; and the same policies encourage their partner institutions like universities and government laboratories to support them in doing so. Firms may choose to include in their portfolios some products or services aimed at affluent markets. Technology-intensive products like sports cars and personalized drugs have small markets but are sold at high enough prices to cover their specialized development and production costs. Firms may also develop products such as video cameras and microwave ovens for "mass" markets, where efficient volume production makes products available to many consumers, with low unit products but high total profits because of volume. Finally, they can develop products and services to sell to the poor, a strategy called "bottom of the pyramid" marketing (Prahalad 2005), attractive because of the large numbers of poor who might be reached. Likewise, firms can develop products designed for specific culturally-defined markets, for example, women or ethnic minorities.

In practice, however, the "democracy" of the market will lead to much more overall new product development effort going into things that middle-class or more affluent consumers will buy. Likewise, there may be other biases in choosing which products to develop. For example, the feminist movement has criticized the pharmaceutical industry for focusing on developing contraceptive pills for women when the male equivalents would be simpler to invent and produce (Jutte 2005).

What markets are unlikely to produce are basic goods and services for the poor, even though society as a whole would benefit from maintaining minimum standards in

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<sup>6</sup> World Bank data, <http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS>, accessed April 1, 2007.

<sup>7</sup> Poverty threshold in 2006 for an individual was \$10,488 for those under 65 and \$9,669 for those over 65. U.S. Census Bureau, <http://www.census.gov/hhes/www/poverty/threshld/thresh06.html>, accessed April 1, 2007.

areas like health, nutrition, housing, and education. This situation is called “market failure”: private markets produce less than the socially-optimal amount because the incentive is private, not public, return. There are a variety of potential public interventions designed to overcome market failures, among which are several market-based mechanisms. One of these is public procurement – that is, the government buys the item on behalf of the public, thus stimulating private sector development. In these cases, policies and products co-evolve through government action. Some public procurement of technology happens at the high end of the cost and sophistication spectrum, with defense technologies as a prime example. Some are in the basic needs areas, like public health care systems, which purchase medicines and medical services and distribute them free. Pro-poor subsidies for purchases in basic needs areas, such as food stamps or housing allowances, also use the market to serve broader public goals.

I have already introduced one area where such a failure occurs, the development of drugs and vaccines for diseases associated with poverty. This area also illustrates the creative new thinking that is going into using pro-poor public procurement to go beyond simply purchasing goods to stimulating innovation. I will return to some of these possibilities in the Options section of the chapter.

### *Diffusion*

Diffusion of new technologies gets considerable attention in innovation policy as a way of spreading the benefits of new technologies – another co-evolutionary dynamic. For example, diffusion of new technologies in business, from agriculture through service and manufacturing, gets considerable attention in innovation policy. The United States Department of Commerce has a Manufacturing Extension Program that stimulates states to set up outreach efforts that facilitate firms, especially small ones, to adopt new technologies.<sup>8</sup> Programs aimed at SMEs (small and medium-sized enterprises) in other countries usually have a similar orientation. In addition, innovation policies include incentives for the diffusion of technologies with high social benefits, such as energy technologies. In Germany, for example, energy can be sold from alternative energy sources onto the main grid at premium prices. As a result of such policies, Germany has a much higher rate of production of solar energy than countries with much more sunshine, including the United States (Rogers 1962; Klaassen, Miketa et al. 2005).

However, the diffusion of new technologies is often uneven; some groups get more benefits than others. Likewise, there are often costs associated with new technologies, and these may also be unevenly distributed.

The classic study in diffusion of innovation is Everett Rogers’ (Rogers 1962) analysis of the Green Revolution, which set the framework for several generations of later studies. From the earliest stages of this work, the differential effects of introducing new technologies have been prominent in the analysis.

The Rogers model includes several key concepts, starting with the innovation itself. Working in 1962, he took the innovation process itself to be one-directional, delivering a fixed innovation which is either used or not used; later generations of researchers have taken the co-evolution of innovation and users more seriously. The

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<sup>8</sup> <http://www.mep.nist.gov/>, accessed April 9, 2007.

Rogers model also includes a change agent. In the Green Revolution case, this was the extension worker, while in a market version of the model it could be the marketing and advertising departments of the firm along with retailers. The core of the Rogers model is the “adopters,” those who decide to use the technology. He divides these into three groups: early, middle, and late adopters. The growth in number of users over time takes the shape of an S-shaped curve. A few people try the innovation early, taking some risks in doing so. If they like it, they spread the word to others, who join the population of users at increasing rates until the market for the innovation is saturated.

According to Rogers, the diffusion process can widen existing socioeconomic gaps for several reasons. First, innovators and early adopters are people who seek out innovations and can afford the more expensive ones. For example, real estate agents were among the earliest users of car phones. Second, professional change agents concentrate their efforts on innovators and early adopters. In the case of the Green Revolution, the change agents were the extension workers, who naturally concentrated their efforts on the people who were easiest to convince about using new strains. In the case of private sector products, advertising will likewise be oriented towards those who are most likely to buy, not those who need the product most. Third, innovators and early adopters achieve windfall profits by adopting early. In the case of the Green Revolution, for example, the early adopters produced larger quantities while prices were still high. By the time the later adopters increased their yields, prices had dropped because of the larger supply. Thus the whole process, left to operate according to its own logic, will lead to increased advantage for those with greater initial resources (Rogers calls these the “Ups”).

Rogers and his colleagues, however, outline a number of diffusion strategies that can be used to intervene in this dynamic and make diffusion to disadvantaged groups (the “Downs”) more likely. If the problem is that Ups have greater access to information than Downs, one solution is to tailor communication strategies to the Downs. This can be done, for example, by tailoring the level of language in the message and the channels used. Change agents can also organize Downs into small groups to hear the message. Change agents with a re-distributional task should in fact concentrate their communication efforts towards Downs, since Ups are already more likely to adopt.

If the problem is that Ups have greater access to innovation evaluation information from peers than Downs, according to Rogers and his colleagues, then solutions include identifying opinion leaders among the Downs to work with; choosing change agents from among the Downs; and forming groups among the Downs to reinforce innovation decision making. If the problem is that the Ups have greater slack resources for adopting innovation than Downs, the solutions could include recommending appropriate innovations for Downs; creating social organizations that pool Down resources; including Downs in setting priorities for innovation program; and establishing special diffusion agencies to work only with Downs.

These recommendations are obviously oriented to situations in which the public sector is trying to increase adoption of a technology through a change agent. Despite the move towards more market-based implementation of policies, there are still plenty of examples of government-led processes. The manufacturing extension services listed earlier are one such example, and many more can be drawn from public health, including the diffusion of condom use to prevent AIDS; childhood vaccines; safe drinking water

systems in villages; etc. Some of the Rogers principles are being applied as pro-poor policies options in these settings, such as programs that encourage strong community involvement in planning and implementation. In the section on Options, I will return to the possibilities for private firms developing bottom of the pyramid markets to apply the principles as well.

The work on diffusion of innovations, however, deals largely with the distribution of benefits. The distribution of the costs of technologies has received much less attention, although it is an aspect of diffusion. The exception is the literature on environmental justice, which has correlated the spatial distribution of hazardous wastes and other technology-generated pollutants to poor neighborhoods and disadvantaged ethnic groups in the United States (Bullard 1990), as well as tracking the off-shoring of hazardous wastes of affluent countries to less affluent ones (Bullard 2005). The Downs are less able to avoid or fight off such undesirable living conditions. Innovation policies are shrinking the size of this problem by encouraging overall reduction of environmental impacts through product life cycle analysis (Norris 2006), but this technique does not include an accompanying analysis of differential costs and benefits, and thus does not yet incorporate the principle of fairness called for by the environmental justice movement.

### *Summary*

In short, traditional approaches to innovation policy rely on mechanisms that, unless designed specifically to do otherwise, tend to increase inequalities. Strengthening intellectual property regimes can turn public goods into private ones, narrowing the group that benefits from them. A tight focus in innovation policy on competitiveness through raising productivity can create the conditions for increasing rewards to already advantaged places and groups. Leaving most of the stimulus for and diffusion of new products, processes, and services to the market is likely to leave the needs of the poor unmet. Finally, the traditional policies do not pay attention to differential distribution of the costs of technological change.

Indeed, the whole framing of innovation policies, in a conventional framework of assumptions partly<sup>9</sup> shared by both innovation systems theory and practice, leaves the connections to these larger social dynamics out of the picture. Furthermore, the focus on R&D in firms neglects the possibilities of distributed demand-driven innovation. In the next section, I turn to some different uses of innovation policies that allow more room for bottom-up, creative responses from more actors in the broader social system.

### **Options**

In the introduction to this chapter, I invoked Chris Freeman's image of new techno-economic paradigms needing new re-distributive institutions. The industrial revolution created its own working class, which in turn organized into unions to demand their fair share of its benefits. Likewise, the industrial revolution was accompanied by centralized welfare systems run by national governments and by compulsory mass

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<sup>9</sup> The notion of system failure as opposed to market failure as rationale for innovation policies offers opportunities to solve some of the problems caused by the more neo-classical based approach. An example could be the importance the innovation systems approach attaches to processes of demand articulation by which better opportunities for bottom up based policies are created (e.g. Smits et al in this volume).

education. These redistributive institutions were particularly well suited to the geographically concentrated activities of industrial production.

What re-distributive mechanisms are being generated in the current economic environment, characterized as it is by multi-national firms who are not just trading but producing globally; shrinking rather than growing roles for national governments; and an expanded civil society highly connected globally through the new communication channels? I will argue in this section that some new and distinctive redistributive processes are emerging in this new techno-economic regime, under phrases such as “public-private partnerships,” “corporate social responsibility,” “socially responsible investing,” “fair trade,” “bottom of the pyramid marketing,” and “social entrepreneurship.” These new mechanisms are addressing some but not all of the processes of cumulative advantage described in the last section. Traditional re-distributive approaches co-exist with the new ones and have strengths that should not be neglected in the effort to reduce the inequalities that are standing in the way of human development.

### *Assets*

Let us consider again the area of assets to see what redistributive dynamics are developing. On the one hand, we noted that intellectual property rules are strengthening on a global basis through the expanding reach of the World Trade Organization. This trend has the potential to undermine the arrangements that have made low-cost versions of technologies available to the poor, with the prominent example being medicines. The traditional re-distributive mechanism in medicine is usually public health services. But as private health care insurance has grown up beside public services in many countries, the gap in quality and access grows as well. Furthermore, in this case, as in many generated in world economy today, if the problem is global, the solution cannot be local.

Indeed, public health services were not the mechanism through which the happy ending to the essential medicines story was negotiated. Instead, there were two lines of action. On the one hand, the international community of WTO members insisted on provisions in TRIPS that allowed nations with pharmaceutical capabilities to use them for the public good (Lai and Qiu 2003; Barton 2004; Atik and Lidgard 2006). So what global institutions took away, they in part gave back. And on the other, a coalition of non-governmental organizations (NGOs) negotiated lower prices with generic manufacturers and used these as leverage with the name brand companies (Pogge 2005). The power of civil society played an important pro-poor role. These are themes we will see in other examples.

A traditional mechanism is being used in a creative way in the essential medicines story, however, through an institutional invention called “advance purchase commitments” (Berndt and Hurvitz 2005; Towse and Kettler 2005). Under this mechanism, a set of donors (that could include both private philanthropies as well as governments) contracts with a drug company to develop a drug that is important for the poor and to sell it to them at a specific price. The company then bears the technical costs and risks of developing it, but with an assured market. The first such agreement has just been written. Italy, Canada, Norway, Russia and the United Kingdom, along with the Bill and Melinda Gates Foundation, have committed to purchase “vaccines against

pneumococcal disease (pneumonia, meningitis, and other killers), which annually claims the lives of up to one million children a year.”<sup>10</sup> This mechanism uses the old idea of public procurement, but in the mode of a “public-private partnership” with traditional private sector incentives. By spreading the benefits of new medicines more broadly, the mechanism is playing an egalitarian role.

Before we leave the topic of assets, let us note an egalitarian trend that becomes important in the next section. The citizens of the affluent countries of Europe, North America, and Asia now commonly own shares in companies, either local or multi-national, either directly or through retirement funds. This fact presents the opportunity for them to play a decentralized but significant role in shaping the policies of those companies.

### *Products*

The complex relationships among shareholders, consumers, and corporate leaders form the backdrop for some emerging patterns in product availability and design. The traditional part of the pattern is government regulation. Both in the past and currently, national governments regulate product safety and environmental quality (of course some more stringently than others and some with much better enforcement than others). The diversity and assertiveness of national environmental regulations has in fact led to an effort among multi-national firms to stay ahead of policymakers in their own environmental standards, leading to such mechanisms as ISO14000, a high international standard that firms try voluntarily to meet (Curkovic, Sroufe et al. 2005; Potoski and Prakash 2005; Raines and Prakash 2005; Brodhag and Taliere 2006; Prakash and Potoski 2006). Neither government regulations nor voluntary mechanisms, however, are particularly re-distributive.

Perhaps the most interesting development of the last few decades in corporate governance has been the rise of consumer and shareholder movements to address safety and environmental issues around new technologies through direct action in the corporation itself, sometimes with goals that are re-distributive (Haigh and Hazelton 2004; Klein, Smith et al. 2004). These movements supplement formal regulation, which is itself a standard part of traditional innovation policy. Consumer boycotts on specific issues stretch back for decades, to the boycott of Nestle products over its sales of baby formula in the developing world, which was framed as a fairness issue (Gaskin 1981; Post 1985; Delamothe 1989). A more recent and dramatic example is the consumer movement in Europe against genetically-modified foods. European consumers perceived risks to them in the products and rejected them, in part on the grocery shelves and in part through press coverage generated by NGO actions (Levidow 1999; Bourgeois 2001). In both cases, affluent consumers use their consumer power to shape corporate product choices.

In the same vein, the socially responsible investment movement has organized the shareholder value of constituencies in the North. A socially-responsible investment portfolio meets a set of criteria that go beyond profitability. This mechanism directs

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<sup>10</sup> [http://blogs.cgdev.org/globalhealth/2007/02/incentives\\_for.php](http://blogs.cgdev.org/globalhealth/2007/02/incentives_for.php), accessed April 9, 2007.

resources towards the parts of the business community that meet the moral standards of investors (Woodward 2003; Guay, Doh et al. 2004).

These mechanisms, however, have primarily negative, not positive power. They can stop products that are on the way or being sold, but they cannot actively generate products that serve the needs of the poor. While government procurement could in principle do so, in practice it has not used the innovation route effectively. Likewise, consumer organizations could take an active, creative role, stimulating a debate on how consumers could benefit from new technologies, for instance in food and health care. But we do not know of examples in which they have taken up the challenge.

Instead, some interesting bottom-up methods in the private sector are getting increasing attention. The best-known variant is “micro-finance,” pioneered by the Grameen Bank under Muhammad Yunus, the 2006 winner of the Nobel Prize (Yunus 2006). Micro-financiers lend very small amounts of money to low-income people, often women, to start their own businesses using their existing skills and simple materials. These businesses tend to produce products and services that are needed in low-income communities. In some cases, these are technological inventions, as in the case of the KickStart pump (Fisher 2006). Sometimes they use technologies in creative ways that make their benefits available in low-income communities, as in the “telephone ladies” who sell minutes rather than subscription plans on mobile phones.<sup>11</sup> These are pro-poor businesses, a whole new source of innovation and creativity.

### *Employment*

Along with issues of product and environmental safety, the consumer and shareholder based civil society movements have sometimes taken up labor and trade issues. Many socially-responsible investment screens include a set of good labor practices, and the “Fair Trade” movement raises the question of whether producers are being paid reasonable amounts by middlemen and corporations that market their goods in the North (Fridell 2004; Mutersbaugh 2005; Hira and Ferrie 2006). Likewise, some rugs are now certified as free of the inputs of child labor.<sup>12</sup> These movements, however, do not appear to be capable of addressing the more structural issues associated with employment. While they can raise the expectation that producers will be paid a minimum amount, they cannot exert pressure for industrial production to produce a range of jobs including those at middle wage levels.

The structural issues could be raised in more direct labor negotiations – again, a traditional re-distributive mechanism still playing an important role. For example, in the Nordic countries and in Japan, strong labor participation in technological change led to transformation of jobs toward greater worker autonomy and higher skills, rather than replacement of workers with automated processes (Yamada, Yamada et al. 1997; Gregory 2003). This transformation turned into an advantage in product quality that helped firms in these regions in global competition. Similarly, when a community is

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<sup>11</sup> Close cousins to micro-finance are “social entrepreneurship” (Cook, Dodds et al. 2003; Christie and Honig 2006; Dees 2007) and “bottom of the pyramid” marketing (Prahalad 2005), both ways of thinking about small, local businesses building economic strength through providing goods and services that low-income communities need.

<sup>12</sup> [http://www.rugmark.org/child\\_labor\\_problem.php?cid=3](http://www.rugmark.org/child_labor_problem.php?cid=3), accessed April 9, 2007.

trying to lure a firm to invest in production there, the traditional land and tax incentives could be accompanied by asking for commitments about the levels of jobs created and local suppliers. But since these mechanisms are place-based, it is likely that they will need to be replaced eventually in the new techno-economic regime.

### *Diffusion*

One side of the diffusion issues raised above was the uneven distribution of the costs of technologies, especially the environmental costs. This issue is being addressed, through a pattern of interaction among civil society, government, and industry that by this point in the discussion should be familiar. The issue of environmental justice was raised first in the United States by a coalition of religious and civil rights activists, specifically working from their culturally-defined political positions. They took the issue to the Environmental Protection Agency, and eventually the President signed an executive order on the matter – a fairness policy (Bullard, Mohai et al. 2007). Government agencies have initiated modest programs, mostly stimulating local action around the issues and providing technical support.<sup>13</sup> The movement, however, has gone world-wide, aligning environmental activists in many places to oppose the globalization of garbage.<sup>14</sup> In the meantime, stronger and stronger environmental regulations in Europe and the United States have stimulated firms to clean up their waste dumps and effluents, and to build environmental sustainability into the design of many new products (Gungor and Gupta 1999; Maxwell and van der Vorst 2003). The results are getting better for everyone, including the disadvantaged communities who are still exposed disproportionately, but to a smaller risk. From the viewpoint of innovation systems, the important point to note in these developments is the technology-stimulating effect of the community-government-industry partnership, which operates as a newly configured innovation system.

The other part of the diffusion problem is making the benefits of technology more widely available. Several of the new mechanisms already mentioned have contributed in this area: advance purchase commitments in the area of essential medicines; micro-enterprise in consumer goods and sometimes in technologies needed for small-scale production. Universities can maintain or refocus efforts on educating leaders for public innovation and employees that in firms and other organization are better able to identify technological options and align them with the firms and societies interests, rather than simply supporting private sector goals and objectives. Public research institutions can be turned to pro-poor objectives, as they have been in South Africa under democracy.<sup>15</sup> But the pro-poor mission is constantly in tension with the increasing pressure for such public research institutions to subordinate their public agendas to those of private firms – encouraged ironically by the growth-oriented versions of innovation systems concepts. Again, the entry of community-based or other civil society organizations into innovation system discussions can change the balance in those discussions.

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<sup>13</sup> <http://www.niehs.nih.gov/translat/envjust/envjust.htm>, accessed April 9, 2007

<sup>14</sup> See for example <http://blog.foreignpolicy.com/node/3747>, accessed April 9, 2007

<sup>15</sup> [http://www.csir.co.za/plsql/ptl0002/PTL0002\\_PGE038\\_ARTICLE?ARTICLE\\_NO=7040183](http://www.csir.co.za/plsql/ptl0002/PTL0002_PGE038_ARTICLE?ARTICLE_NO=7040183), accessed April 9, 2007.



## Summary and Conclusions

Inequalities are standing between technologies and human development, and the concepts and practices of innovation systems, aided by innovation policy, are often helping. To distribute their potential benefits, technologies have to jump over the barriers of monopoly pricing, skill-biased technological change, and lopsided market development and diffusion to reach most of the world's people. Innovation theories and policies that are oriented entirely towards economic growth distract attention from the potential of technologies for human development.

The second section of this paper has illustrated, however, that an interesting new system of innovation may be emerging, with a distinctive coalition of actors seeking human development objectives through pro-poor, egalitarian, and fair innovation processes. Micro-entrepreneurs, local communities, and other bottom-up movements in civil society are often in the lead in this coalition, with strong messages coming over the Internet from activists in the South to align with the consumer and shareholder power of those in the North. This new source of global pressure helps the international community build human development goals into innovation-shaping institutions like TRIPS and helps multi-national corporations take up the challenge of doing well by doing good.

This "human development innovation system," like its national, regional, and sectoral cousins, is characterized not just by its distinctive set of actors, but in particular by the relationships among them: civil society articulating the goals and drawing attention to the issues, national governments setting the rules of the game, and corporations being pushed into a leadership position in order to stay in business. Current innovation systems theory, focused as it is on private firms as entrepreneurs, will need significant revision to be able to understand how governments can provide supportive environments for this next generation of public innovators. As was said already, the growing attention to user involvement and demand articulation may be a promising first steps in this direction.

The innovation policy that co-evolves with the new systems will thus look much like the traditional ones in terms of process: a multi-actor, consultative space that encourages and supports new ideas. The key difference is that this will be a space where Freeman's vision of new distributional mechanisms for a changed technological regime can be put into practice and where non-traditional actors like users and consumers may get better opportunities to exploit technological potential in a way that is beneficial to them.

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