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In Search of Principles for a Stable World Order

Technologies and Innovations Contributing to Peace, Stability, and Fairness

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Working Draft

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Note: In preparation for the Congress of Vienna 2015, the Chumir Foundation for Ethics in Leadership commissioned papers from leading global experts to address the topics we plan to discuss. The papers are works-in-progress, and will be finalized after the Congress for publication by the Foundation. However, we have made the papers available to the Delegates as a resource.

CONGRESS
OF VIENNA
2015

IN SEARCH OF
PRINCIPLES
FOR A STABLE
WORLD ORDER

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Executive Summary

Extreme poverty is too prevalent in the world of 2015. The gap between rich and poor is growing within countries, while high inequality at the global scale persists. Inequality hurts everyone, not just the poor, through poor health, damaged child wellbeing, educational gaps, and violence. New dynamics of inequality have arisen from changes in the world order. Technological innovation increases inequalities, through its association with power and wealth and its orientation towards affluent consumers. But there are ways to reorient the innovation process to provide more benefits for the disadvantaged. The options for national governments to use innovation in this way have been explored. This paper focuses on options at international level.

Concepts

Inequality is the unequal distribution of something people value. Health, education, energy, information, and security, for example, are all unequally distributed among the world's families. Income inequality, which receives the most attention from economists, is rising within most countries of the world. At the global level, among the world's households taken as a group, inequality is very high and discouragingly stable. There has been a major movement upwards, however, in household incomes: the number of people living in extreme poverty has dropped over the last two decades. Many countries have shown improvements in the multi-indicator Human Development Index.

Globalization is seen as an important context for the rising levels of within-country inequality. The current era of globalization is characterized by trade in manufactured goods between the traditional core countries and a set of emerging economies. Because of falling transportation and communication costs and rising capability of coordinating across geographic space, multinational firms are able to spread production to different locations around the world. The new level of connections creates new cultural and political conditions as well. Global governance thus arises as a key issue.

Technological innovation is the introduction and use of new physical or virtual technologies, with accompanying changes in sociotechnical systems. In the economics of innovation, the phrase has come to refer to the introduction of new products or processes, usually by the private sector, but sometimes by the public sector. In the classic economic theory of innovation, in order to compete in the market, firms adopt more efficient processes that give them an edge in price or develop new products that give them a temporary monopoly over a particular capability and allow them to charge high prices while the monopoly lasts.

Theoretical Frameworks

Theories of economic growth have stressed the importance of knowledge as a factor of production, creating a "knowledge society." In an ever more technology-intensive society, high levels of skill command a wage premium; that premium can be seen in the data from many affluent countries, and leads to growing wage

¹ My thanks go to the Chumir Foundation for support of this analysis. I am grateful to reviewers of this paper for their comments and suggestions: Eduardo Bonilla-Silva, Dan Breznitz, Joanna Chataway, Kemal Dervis, Seymour Goodman, Raphael Kaplinsky, and Joel Bell, the organizer of the Congress of Vienna 2015. All mistakes, analysis, conclusions, and recommendations are mine and do not represent either the Chumir Foundation or my institution.

inequality through “skill-biased technological change.” Many economists see that phenomenon as the major cause of rising inequality within countries.

The global spread of production is another source of within-country inequality. As good jobs in manufacturing appear in emerging economies, the loss of middle-wage jobs in the traditional core countries increases inequality there. Rising levels of income for many people in emerging economies creates a market opportunity to sell low-cost manufactured goods; many firms in those economies are taking up that opportunity, thus broadening the range of countries involved in active product and process innovation.

Innovation may affect inequality through the distribution of assets (in particular intellectual property), through the destruction and generation of jobs, through development of products for affluent markets, or through diffusion dynamics. Innovation may be a direct cause of an inequality, but inequalities may also stimulate innovation. The policies with the largest influence these relationships may not be innovation policies per se, but rather competition or regulatory policies that shape distribution dynamics downstream.

Approaches to Fairness through Innovation

Scholars of innovation have identified several approaches that redirect innovation towards inclusive development, approaches often gathered under the phrase “inclusive innovation.” These approaches fall into three general categories: frugal innovation (how the innovation is achieved), grassroots innovation (who is involved in the innovation process), and pro-poor innovation (to whom the innovation is directed). Frugal innovation solves problems using what is available in a low-resource environment. Grassroots innovation calls on the knowledge and inventiveness of poor communities or otherwise disadvantaged groups in the innovation process. Pro-poor innovations are designed to make life better for people at the bottom of the income distribution. Some more structural approaches have also been suggested, including directing innovation to industries that produce middle-income jobs and forming public-private partnerships to assure markets for products that would otherwise not be developed.

Case Studies in International Organizations

International organizations are tackling some important instances of unequal distributions of things people value. The case studies presented in this paper touch on aspects of the unequal global distribution of essential medicines, energy, information, and security, seen through the eyes of poor households and communities. The role of international organizations is different in each case, and there are distinct challenges in each case in achieving equitable distributions.

In the case of essential medicines, intellectual property plays a key role. The establishment of the World Trade Organization (WTO) brought with it the Trade Related Intellectual Property Agreements (TRIPS), under which all WTO countries agree to enforce the same rules of ownership of inventions and innovations. The rules protect established innovation powers and limit the opportunity for new actors to enter the space. They also create the potential for high prices to prevent existing treatments from reaching people who need them. How can public need and private incentives be balanced? The WTO, in its complex decision processes, is at the center of debate on this issue.

Energy equality should be an easy value to embrace: it seems simple to agree that everyone should have access to electricity as a gateway to modern technology. But expanding access with fuels that produce greenhouse gases would ruin the environment. Innovation is clearly necessary. International organizations have recognized the need, but not yet found an effective mechanism to stimulate the appropriate innovation. Some of the solutions to the energy access problem may be making inequality worse.

Information and communication technologies (ICTs) have been changing very quickly. Enormous fortunes have been made in the industry, in both developed and developing countries. Universal access to the Internet

has also been recognized as an issue of justice, in the discourse on the Digital Divide. Bottom-up innovation, in the meantime, has produced a variety of simple, low-cost technologies that have significantly improved information access for poor household to services and information. The ICT industry has managed to serve both high end and low end consumers, with minimum intervention from international agreements.

Finally, military technology is another hot spot of innovation, with national security considerations constantly moving the frontier forward. Poor communities, however, tend to be the victims of technological change in this area. The world's poorest countries are often wracked by civil wars, which destroy households and communities and set off waves of migration. The militarization of police forces turns urban communities into battlegrounds, with poor households as the enemy. International relations and agreements show promise for reducing the first threat. Are they relevant to the second one as well?

National and International Options

National governments have traditional routes available for reducing income inequality, such as taxes and other "social transfers." Using less conventional innovation tools, they can target innovation towards industries that produce middle-income jobs, create markets for essential products that poor families cannot afford, or put programs in place to develop pro-poor technologies, encourage grassroots innovation, or embrace frugal methods. Innovation cannot solve the inequality challenge on its own, but it can be part of the solution rather than part of the problem.

International action is particularly appropriate in setting the ground rules that allow the benefits of new technologies to be shared broadly. First, international programs that are science, technology, or innovation intensive can incorporate pro-poor, grassroots, and frugal innovation approaches. Second, international organizations can change the process and outcome of intellectual property arrangements by working to right-size intellectual property protection, seeking the right balance between innovation incentives and public needs, and counteracting asymmetrical power relationships in IP negotiations through higher standards of transparency, inclusiveness, and equal participation. Third, they can work with multinational firms on technological and skills upgrading for suppliers in global value chains, thus allowing greater sharing of the value added. Finally, any movement towards demilitarization either globally or locally would relieve some of the burden of violence that currently falls so heavily on poor households and communities.

In conclusion, the commitment to innovation for inclusive development calls for global action, and therefore for international agreements and institutions that take inclusive innovation seriously. The Vienna Congress goals of peace, stability, and fairness will only be met when new concepts of technological innovation are in place.

Introduction

Extreme poverty persists, and inequality is on the rise. How can this be, in a world with rapidly expanding capabilities and substantial economic growth?

One in seven people in the world live in extreme poverty, on less than \$1.25 per day (World-Bank-Group 2015). In some regions, the share reaches close to 50%,² and the total is over a billion people.³ Poverty persists for a variety of reasons in a variety of settings. Although more than 70% of the world's extremely-poor live in middle income countries (Sumner 2012), a billion people live in countries that appear stuck at the bottom of the international distribution (Collier 2007). Farming families, home to half the world's population, are trapped by natural weather variations and wiped out by disasters (World-Bank-Group 2015).

In addition to the persistence of extreme poverty, income inequality is on the rise within countries around the world. It is rising within rich countries, as documented by the Organization for Economic Cooperation and Development:

In most OECD countries, the gap between rich and poor is at its highest level since 30 years. Today, the richest 10 per cent of the population in the OECD area earn 9.5 times the income of the poorest 10 per cent; in the 1980s this ratio stood at 7:1 and has been rising continuously ever since. However, the rise in overall income inequality is not (only) about surging top income shares: often, incomes at the bottom grew much slower during the prosperous years and fell during downturns...⁴

Income inequality has also been rising in emerging economies. In China, “the incomes of the poor are growing but it appears the rich are getting richer much faster.”⁵ India's economy is polarizing by region.⁶ In Africa, “In the 2000s, six of the ten fastest-growing countries were [in the region], but this has not significantly helped to equal incomes or to redistribute wealth” (African-Development-Bank 2012). Since inequality is a phenomenon shared between rich and poor countries, international organizations have adopted the goal of improving the living standards of the bottom 40 percent of the population in every country (World-Bank-Group 2015). Global income inequality, the gap between the incomes of the world's poorest households and its richest, is larger and more stable than the gap within any individual country (Lakner and Milanovic 2013). This paper focuses on inequalities at this global scale.

Inequality hurts everyone, not just the poor. Its effects have been studied most often within countries, but they extend to global scale as well. High levels of income inequality have been linked to political polarization (Galbraith 1998). Health outcomes are worse in rich countries with high levels of income inequality, even after controlling for health care provision (Wilkinson 1996). In rich countries, many indicators of standard of living are better in more equal societies, including an index of both health and social problems. The index is strongly correlated to income inequality rather than average income. Child well-being and educational scores are also better in more equal societies.⁷ As the gap grows between rich and poor, so do the chances for violent conflicts.⁸ Violence within countries has been attributed to inequalities in “access to services, land holding, or political

2 <http://www.worldbank.org/en/publication/global-monitoring-report/poverty-forecasts>, accessed July 26, 2015

3 <http://www.worldbank.org/en/publication/global-monitoring-report/poverty-forecasts>, accessed July 26, 2015

4 http://www.oecd-ilibrary.org/social-issues-migration-health/trends-in-income-inequality-and-its-impact-on-economic-growth_5jxrjncwvxv6j-en, accessed July 26, 2015

5 <http://journalistsresource.org/studies/international/china/income-inequality-todays-china>, accessed July 26, 2015

6 <http://blogs.lse.ac.uk/southasia/2013/03/27/why-inequality-in-india-is-on-the-rise/>, accessed July 26, 2015

7 <https://www.equalitytrust.org.uk/about-inequality/spirit-level>, accessed September 6, 2015. Included in the index are life expectancy, math and literacy, infant mortality, homicides, imprisonment, teenage births, trust, obesity, mental illness and social mobility.

8 <http://www.wfs.org/futurist/2014-issues-futurist/september-october-2014-vol-48-no-5/inequality-predictor-civil-war>, accessed July 26, 2015

participation, unemployment, and rapid unregulated urbanization without rule of law or social protection.”⁹ Homicide rates are higher in more unequal rich countries, and children experience more conflict in unequal societies.¹⁰ Finally, economists now agree (Milanovic 2011; Ostry, Berg et al. 2014) that inequality hurts economic growth, a prerequisite for the elimination of extreme poverty.

The long-run increase in income inequality not only raises social and political concerns, but also economic ones. It tends to drag down GDP growth, due to the rising distance of the lower 40% from the rest of society. Lower income people have been prevented from realising their human capital potential, which is bad for the economy as a whole.¹¹

The contemporary pattern of global inequality is not only dangerous but also unfair, according to at least one prominent philosophical theory of distributional justice. John Rawls (Rawls 1971) argues for a standard of justice that would be adopted by even the least advantaged if they were presented with the choice. He calls the standard “justice as fairness.” In a fair system of distribution, even the least advantaged members of a system derive some benefit. The least advantaged members of today’s global society often do not appear to benefit. This is particularly true when broader concepts of inequality are considered, those that go beyond income to unequal distributions of opportunity, power, and other things that people value; this paper uses those broader concepts.

What does technological innovation have to do with these issues? The first section of this paper addresses this question. What do we know about the interactions among technologies, innovations, and the dynamics of inequality in the global system today? What concepts and theoretical frameworks help us understand those interactions? What empirical base is available to evaluate the theories? The literature suggests that technologies affect the dynamics of inequality in both positive and negative ways, contingent on a wide variety specific circumstances and historical processes.

Some observers consider inequality to be an inevitable or temporary by-product of economic growth. Accumulation of wealth at the top of the income distribution is a small price to pay, according to this argument, for new economic conditions that are lifting millions out of absolute poverty. Under this reasoning, as the new technological order is put in place, the gaps will close, as they did after the mammoth shifts from rural to urban livelihoods in the Industrial Revolution (Kuznets 1955; Abdullah, Doucouliagos et al. 2015; Foster 2015). Others argue that there is nothing inevitable about the adjustment; new institutions had to be invented after the Industrial Revolution to put new distributive rules in place (Freeman 2000). Likewise, the current technological order requires new thinking about the social order.

Most of that thinking has focused on policy options within countries (see for example (Piketty and Saez 2014)). But national institutions that re-distribute accumulated wealth appear to be weakening, and in any event, are not effective across national boundaries; they therefore do not address the global inequality which is the focus here. Scholars of technological innovation have called for equality to be built into the innovation process itself. Conventional innovation policies tend to increase inequality unless they are specifically designed to do otherwise, and a variety of national innovation policy mechanisms have been suggested with equality in mind (see the section below on Approaches to Fairness through Innovation).

The second part of this paper takes up a complementary set of questions with regard to international institutions. It asks: What international agreements implicitly or explicitly affect technology/inequality dynamics? In what ways do they reflect either cooperation or conflict? What are their strengths and weaknesses with regard to

9 http://www.who.int/violence_injury_prevention/violence/4th_milestones_meeting/marmot.pdf, slide 15, accessed July 26, 2015

10 http://www.who.int/violence_injury_prevention/violence/4th_milestones_meeting/marmot.pdf, slides 16 and 17, accessed July 26, 2015

11 <http://www.oecd.org/social/inequality-and-poverty.htm>, accessed July 26, 2015

advancing peace, stability, and fairness? The paper argues that the particular role of international agreements is to address global inequalities, the broader patterns that emerge across households in different countries. At the global scale, income inequality is less accessible to policy action than inequality in other valued items. The case studies in Part Two analyze the role of international agreements in the global distribution of health, sustainable energy, information and communication, and security.

The overall goal of the analysis is to lead to suggestions for ways to use international agreements to seek peace, stability, and fairness with regards to technological innovation at global scale. What potential exists for new agreements, relationships, or institutions to widen the distribution of benefits, create more equal power relationships, and increase harmony at the global level around technology and innovation? After a review of what is known about technological innovation and inequality in Part One, and a consideration in Part Two of particular cases, the final section of the paper suggests an international action agenda that would help to reorient the process.

Part One: Technologies and Inequalities

Initial Concepts

In order to understand the relationships between technologies and inequalities, we need first to establish some common concepts. This section of the paper reviews three: inequalities, globalization, and technological innovation. The next section takes up the theories that link technological innovation with the other two.

Inequalities

Inequality is the unequal distribution of something people value. This paper refers often to “inequalities” because there are many valued items that are unequally distributed among the world’s seven-plus billion people, such as good health or access to energy. Inequalities in the various valued items are often related to each other. Power is heavily influenced by and influences all the other unequally distributed items. As Amartya Sen, the greatest contemporary scholar of inequality, puts it, inequality is a multi-dimensional space (Sen 1992).

Since so much of the literature on inequality deals with income inequality within countries, it is useful to reorient readers by highlighting some basic points about the analysis here:

1. The paper does not limit itself to consideration of income inequality, but explicitly extends the analysis to inequalities in power, opportunity, and other fundamental human needs. Inclusion and exclusion from opportunities is a key feature of inequality, since it affects the extent to which people can change their own life circumstances (Sen 1992).
2. Inequality has two dimensions, vertical and horizontal (Stewart 2002). The vertical dimension is rich-poor or socioeconomic and the horizontal dimension further differentiates in terms of culturally-defined groups such as gender, religion, ethnicity, or perceived race. Advantaged horizontal groups still experience a distribution from high to low of any valued item, but the distribution is skewed upwards in comparison with disadvantaged groups.
3. Most analyses of world inequality use countries as the unit of analysis. This paper looks beyond national borders to focus on inequalities across communities, households, and individuals. It attempts to picture inequalities as though the national borders were erased from the map. Following Milanovic (Milanovic 2007), the paper refers to this perspective as global.
4. Income inequality is most often measured with the Gini index, a statistic that varies from zero (perfect equality) to one (perfect inequality). The main alternative that appears in the literature is comparison among income deciles or percent of total income going to the top 1% of households. Almost all measures of unequal distribution of other valued items use averages, a measure that neglects the variation

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within groups and is often available only for nations as the unit of analysis. Use of such measures gives only a rough indication of the deeper dynamics of inequality at community, household, or individual level.

Given these preliminaries, let us briefly summarize what is known empirically about trends in both income inequality and some other forms, postponing consideration of why these trends have emerged to a later section. Both public policy interest and economic scholarship on income inequality have recently surged. Thomas Piketty, currently the most-cited scholar in the area, has examined historical data for income inequality in the United States and Europe, noting that both income and wealth inequality were higher in these regions a century ago (Piketty and Saez 2014). After dramatic drops to about 1980, inequality has surged back in the United States, and to a lesser degree in Europe. Income inequality within a country stems from rising incomes in households at the top of the distribution and stagnating or declining incomes in the lower reaches of the distribution; this pattern has characterized a large number of countries and is the pattern observed in the United States and Europe.

The trend towards inequality holds even across a broader range of nations. As mentioned already in the introduction, income inequality has been rising within countries over the last few decades, with very few exceptions (Galbraith and Berner 2001; Bourguignon 2015). Within world regions, over the period 1988 to 2008, inequality has been rising in mature economies, as well as in China, India, other Asian countries, and Sub-Saharan Africa. It has declined slightly in the Middle East and North Africa; declined steadily in Russia, Central Asia, and Southeastern Europe; and first rose then subsided to its 1988 level in Latin America (Cornia 2012; Lakner and Milanovic 2013). Global income inequality – the distribution among world households – has remained stable and quite high over the same period, at a Gini index of .70 (Lakner and Milanovic 2013).

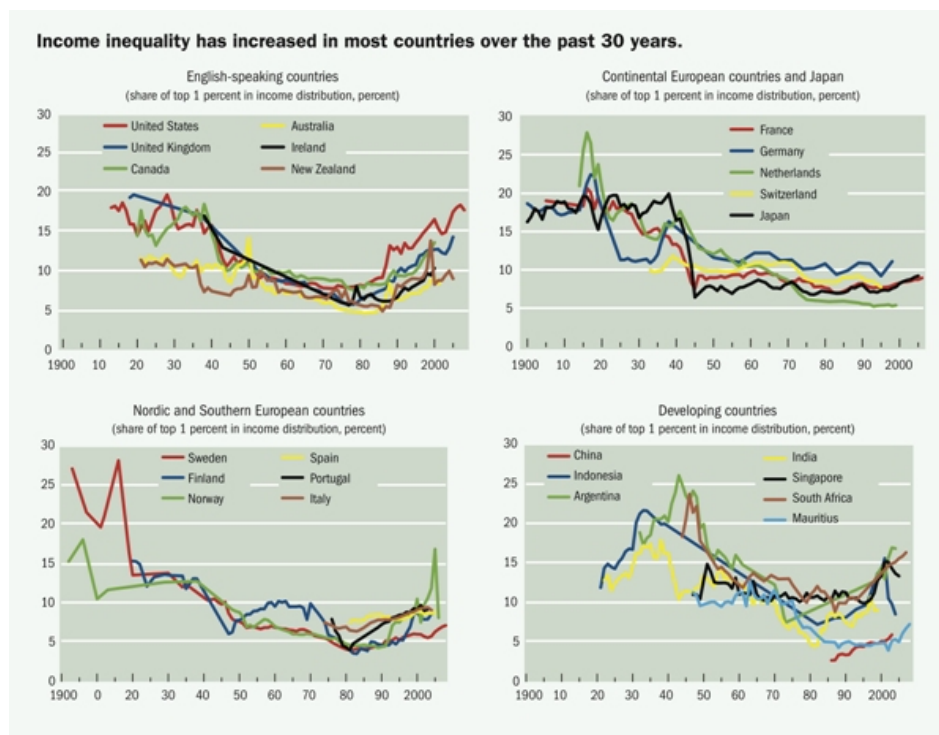


Figure One

From the International Monetary Fund,
<http://www.imf.org/external/np/fad/inequality/>, accessed September 7, 2015.

Over this time period, however, there has been a major movement upwards in household incomes from the very bottom of the distribution. In the last two decades, the number of people living in extreme poverty in the world has dropped, from 1.9 billion in 1990 to 1.2 billion in 2010.¹² 1.1 billion households have been lifted out of extreme poverty, and a growing modest-income group is evident in the distributions (Lakner and Milanovic 2013). Some predict that in the next two decades extreme poverty will be eliminated in China and reduced significantly in India. Sub-Saharan Africa, however, is likely still to have large numbers of people below the poverty line.¹³

Another sign of progress comes from the Human Development Index, a composite measure that includes health and education indicators along with income. This index shows that most countries have closed the gap compared to the average for the top ten countries: 108 out of 115 countries with data have an HDI that is closer to the average of top 10 countries in 2013 than it was in 1980. For example if for a given country in 1980 the HDI was 50% of the average of the top 10, it is now 60%. The seven countries in which that observation is NOT true are the two Congos, Lesotho, Zimbabwe, Swaziland, Congo, Namibia, and Romania.¹⁴

Note, however, that these data are expressed in terms of national averages. Household income is strongly correlated with the distributions of both health and education, particularly in poor countries. So rising national averages could be generated by improved outcomes for households at the top of the income distribution, while those at the bottom lag. Education is often highly unequally distributed within countries, with public schools providing poor quality preparation, particularly for employment in a knowledge-based economy, and families of means opting out of the public systems to prepare their children better in a private environment. Horizontal inequalities would also be masked by national averages. Even within an affluent country such as the United States, African-American men live on average nearly six fewer years than white men; differences remain even after controlling for income. Outside the affluent world, girls receive many fewer years of education than boys.¹⁵

Globalization

Globalization is the process of rapidly increasing linkages and interactions across national borders. Ghose (Ghose 2003) describes the last great wave of globalization, at the end of the 19th century, as characterized by the movement of people and increase in trade. Trade relationships, however, were unequal; countries of the periphery traded raw materials for manufactured goods from the industrialized North. The current wave is characterized instead by trade in manufactured goods between developed countries and the “emerging economies,” particularly China and India. Production takes place in different countries around the world, moving a particular process to the place where appropriate labor is least expensive. On the one hand, this form of production depends on falling transportation costs. Large-scale container shipping and mechanized loading and unloading have had a huge influence on these. On the other hand, global production depends on the ability to coordinate production processes across vast distances, an ability that comes from modern telecommunications. Not only have communication costs dropped, but capacity has improved. Without technology, then, global production would not be possible on today’s scale.

12 Economist, <http://www.economist.com/news/briefing/21578643-world-has-astonishing-chance-take-billion-people-out-extreme-poverty-2030-not>, accessed September 29, 2015.

13 Economist, <http://www.economist.com/news/briefing/21578643-world-has-astonishing-chance-take-billion-people-out-extreme-poverty-2030-not>, September 29, 2015.

14 I am indebted to Eduardo Diaz-Bonilla, a reviewer of this paper, for these observations. I have used his words here. The Human Development Report, including full data on the Index, is available at <http://hdr.undp.org/>. A number of countries are excluded from the HDI because of lack of data.

15 UNESCO, <http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/ED/GMR/images/2011/girls-factsheet-en.pdf>, accessed September 29, 2015.

Globalization is also understood as a cultural phenomenon (Steger 2009). The spread of mass communication enabled by the information technologies just described changes social and political relationships, with opinions differing on whether the change is for the better or the worse. On the one hand, more information is available to more people than ever before about the rest of the world; on the other, international media availability may supplant local values and ideas. In the era of global media, both private and public, it is impossible to isolate political action in one country, as the fax machines showed during the Tien An Men Square uprising in 1989 and social media displayed in the Arab Spring.

Environmental issues embody another dimension of globalization. Countries vary in their policies and practices, but none is immune from the consequences of what others are doing, when the atmosphere and oceans touch all of us. Likewise with security. State actors form alliances; non-state actors ignore national boundaries. Both work to develop and adopt the latest technologies that help in their missions. The world's airports and airlines work together to protect passengers through socio-technological systems of increasing sophistication. Cybersecurity has to be an international effort. In short, none of us lives in a world that is not linked technologically across national boundaries. We are all globalized.

“Global governance” has therefore been a topic of intense debate for several decades. If humans are really all in it together now, how will they work together? How will competing interests be resolved? International institutions have struggled to establish influence in this newly-interacting economic, cultural, and social system. On the one hand, because of the global operation of multinational firms, it is clear that national governments are less in control of and more at the mercy of the companies that operate within their boundaries; those companies create or dismantle prosperity. Multinational firms should therefore play an important role in the global governance process; but to whom are they accountable? What roles are they likely to play? On the other hand, multilateral institutions have not established a clear pattern of learning by doing, particularly not at a pace fast enough to meet the global challenges that are emerging. In some cases, as we will see in Part Two, multilateralism seems to be falling back, not moving forward towards a set of mutually beneficial ground rules.

Global inequality is of interest both out of a concern for global justice and because it captures some of the effects of globalization ((Anand and Segal 2008), cited in Lakner and Milanovic 2013). Bourguignon argues that globalization has played a role in rising inequality within countries as the surge in economic activity has increased returns to capital, both in manufacturing and resource extractive industries (Bourguignon 2015). This argument complements Piketty's claim that relative holdings of wealth, not just capital, are the critical drivers of income inequality, although the effect is weaker during periods of high growth (Piketty and Saez 2014). According to Bourguignon, the computerization of financial transactions has also allowed for intensive accumulation of wealth among some traders (Bourguignon 2015). Financial globalization of national economies is more closely related to inequality than trade globalization per se (Jaumotte, Lall et al. 2013).

The literature on global value chains and networks makes the connection explicit between trade processes and rising income inequality within countries. The concept of global value chains (Gereffi, Humphrey et al. 2001; Kaplinsky and Morris 2001) portrays the spread of manufacturing activities within a firm to different locations around the world, which transforms firms that operate in this way into global powers, not just national ones. Gereffi and Lee describe the evolution of this new power dynamic (Gereffi and Lee 2012). Since the mid-1960s, U.S. firms and buyers (such as retail chains) have been seeking low-cost suppliers offshore. In the 1970s and 1980s, in the context of low transportation and communication costs, U.S. retailers began to seek low-cost goods overseas, combining production and sales in global supply chains. These trans-national activities expanded exponentially in the 1990s and 2000s, affecting a wide range of industries and services. The Global Value Chain approach views the phenomenon both from a top-down perspective (from the viewpoint of lead firms) and bottom-up, from the viewpoint of national or regional governments working on skills and technological upgrading. “Governance” in the value chain approach “shows how corporate power can actively shape the

distribution of profits and risk in an industry, and the actors who exercise such power through their activities” (Gereffi and Lee 2012, p. 25). Value chain governance thus influences global inequality both through the distribution of higher value-added activities to particular people and places, and through the distribution of the workplace and environmental risks associated with a part of the production chain.

The current era of global interaction thus consists of trade in tasks and intermediaries as much as goods. People are not moving, but goods and capital are moving freely. In the high-income countries, this new, fluid division of labor had led to a decline in wages, a fall in manufacturing jobs, and a rise in knowledge intensive services.¹⁶ The loss of manufacturing jobs has resulted in the hollowing-out of the income distribution, as workers who are not prepared for high-skill jobs lose their middle-skill, middle-wage employment and slip back into low-skill, low wage positions – or unemployment.

Technological Innovation

Technology is generically defined as the tools that humans have developed and use to expand their capabilities. The tools may be physical, like a harvester; virtual, like a financial analysis system; or organizational, like an agricultural cooperative. In a market economy, most of these tools are sold as products. Technological change almost always involves the evolution of sociotechnical systems, combinations of new physical or virtual tools with new ways that people live and work together. History, sociology, anthropology, and economics have all studied technological change, and each of these disciplines makes contributions to understanding technology’s connections to inequalities.

In this paper, the term innovation will refer broadly to the active process of doing new things or old things in new ways. Technological innovation will refer to the introduction of new physical or virtual technologies, with accompanying changes in sociotechnical systems. In the economics of innovation, the phrase has come to refer to the introduction of new products or processes, usually by the private sector, but sometimes by the public sector.

In the classic literature of the economics of innovation, private firms are the driving force. They seek competitive advantage in the market by introducing new products that give them a temporary monopoly. By charging high prices during the period of temporary monopoly, the firm makes profits and grows. Introducing new processes can result in competitive advantage if that step reduces costs or increases productivity. In this view, firms drive innovation in order to survive and win in the marketplace. Ideas about how firms innovate have evolved, as the process itself has evolved. In the 1950s and 1960s, the focus was research and development within firms. Companies invested strategically in in-house research in order to develop new products that would give them that temporary monopoly. In a later stage of competition, firms reduced their in-house efforts but reached out actively to university partners for the new ideas that could lead to new products. Firms are now seen, however, as information gathering and processing organizations, that draw from a wide array of sources both inside and outside to innovate in many ways to produce competitive advantage.

Technological innovation may be “new to the firm,” “new to the market,” or “new to the world.” In the first two, the firm is adopting and perhaps adapting technologies that already exist, but using them in a new context. In the last, the firm invents something entirely new. A technology that is new to the firm, while purchased outside, may allow it to compete effectively to produce for a national market when something newer or cheaper might be available as an import. This process of upgrading to international technological standards is sometimes called “modernization” or “industrialization.” A technology that is new to the market also gives a temporary monopoly there, and depending on competitive conditions can generate significant profits. An example is the

¹⁶ I am indebted to Raphael Kaplinsky and Dan Breznitz, reviewers of this paper, for these insights. I have used some of their words here.

introduction of mobile phone technology in countries where competition was limited by regulation or where the technical or financial capability of putting networks in place was limited. Technologies that are “new to the world,” like the personal computer, have mostly emerged under conditions where research is well-supported and an abundance of well-trained people keep new ideas moving towards the marketplace. Significant support from and in the public sector for research and development are among those conditions. Some economies have thrived on producing such “disruptive” innovations. But global economic competitiveness at this time depends as much on the incremental innovations that go into product improvements as on game-changing breakthroughs.

Drawing on this economic model of where technological innovation comes from, industrial policies for a country or region focus on creating the conditions for a set of firms in that geographic area to, at a minimum, achieve and maintain competitive advantage and therefore bring jobs and wealth to the region; the dream is to create a disruptive technology that upgrades local wealth dramatically. The efforts of local or national leaders go into stimulating economic activity per se, on the assumption that what benefits some will eventually benefit all. The distributional approach is “trickle down.” This approach has its prominent critics (for example, (Arocena and Sutz 2010).

Innovation in the public sector or at community level is not easily explained with theories of temporary monopoly or market advantage, even when it has technological components. But innovation in these settings is nonetheless seen as a process that produces benefits by adopting or developing new technologies or processes. Therefore broader definitions of innovation and innovation policy are often adopted among those who study its potential for reducing inequalities, including attention to its outcomes (Chataway, Hanlin et al. 2014). In some key areas, public sector and private sector technological innovation are intertwined, for example, in the interdependence of the aerospace and computer industries with military technologies. Part Two returns to this phenomenon in the discussion of military technology.

Theoretical Frameworks

Scholars of innovation have developed a number of concepts and theories that link technology specifically to inequality. Some deal with “technological change” as a generic concept; others focus on more specific dynamics.

Skills in the knowledge economy

Technological change has been linked to economic growth at a general level through the Nobel-prize winning work of Robert Solow (Solow 1957). Solow noted that classic ideas about economic growth did not fully explain its patterns. Increases in land, labor, and capital, when compared empirically with figures on economic growth, left variation still to be explained. He attributed the residual to technological change. Some societies, he argued, are better than others at inventing and incorporating new technology into their production processes; those that do so will increase productivity and therefore grow more quickly. The idea of the “Solow residual” has been incorporated into measurement of “total factor productivity,” a measure used widely by development economists. Paul Romer (Romer 1990) extended this idea into New Growth Theory. Land, labor, and capital are no longer the only means of production, Romer claimed; knowledge has become the fourth factor, creating the “knowledge economy.” In order to grow, societies must invest in the knowledge base on which they draw, by raising educational levels overall and by investing specifically in research and development. Both theories are favorites among advocates for public investments in research.

The dominant theory among economists to explain rising income inequality within affluent countries is consistent with the claim that we are living in a “knowledge economy,” because it connects technologies to inequalities through skills. As firms introduce new technologies into their production processes, demand rises for higher skills in the workforce. A wage premium develops for higher-skilled workers, and a gap opens

between the earnings of lower-skilled and higher-skilled workers. This phenomenon is called “skill-biased technological change” (SBTC). It is most visible in the gap in earnings between college and high school graduates in the United States and their equivalents in other countries. This gap has been increasing and accounts for about two thirds of the increase in income inequality in the United States over the period since 1980 (Autor 2014).

The observation that the gap is most visible in affluent countries supports the idea that a “knowledge economy” is emerging there. As Autor writes, “A technologically advanced economy requires a literate, numerate, and technically and scientifically trained workforce to develop ideas, manage complex organizations, deliver healthcare services, provide financing and insurance, administer government services, and operate critical infrastructure” (Autor 2014, p. 845) Demand for skills is therefore higher in a technologically advanced economy than in one based on, for example, agriculture or natural resource extraction. Studying longitudinal data from 51 countries, Jaumotte et al. find that “technological progress” (measured in IT infrastructure) has a greater effect on inequality than globalization of trade, because of the increase in returns on human capital (Jaumotte, Lall et al. 2013). This phenomenon, then, points out why inequality is likely to increase for countries that follow the most common policy prescriptions for competing effectively in the knowledge economy: raise education levels generally; move away from pure extraction of raw materials into more knowledge-intensive parts of production; and attract and grow new knowledge-intensive industries. Under conditions of skill biased technological change, all these would increase wage inequality.

The pace of technological change becomes an important issue here. Job displacement by more automated methods has historically been part of moving the labor force to higher value employment. Some suggest that this process may now be stalled by the job replacement time lags and the time required for the development of new skill requirement (something that may never occur for the actual individuals that were displaced). Have we hit an employment displacement trap where the released labor force cannot find jobs? Is employment now less reliable as a vehicle for the socially appropriate distribution of technology gains? These questions are important, although difficult to answer.¹⁷

Changes in the shape of global demand

The global spread of manufacturing through global value chains or networks has often created a new middle-income group in the countries where production is now located; this is the household-level phenomenon that accompanies the trade in manufactured goods between core and non-core countries. The concept of Below the Radar innovation (Kaplinsky, Chataway et al. 2009; Kaplinsky 2011) starts from the observation that these households form a new market opportunity. Rising household incomes in emerging economies (e.g., China, India, and Brazil) create new markets for low-cost products that are designed for the infrastructural conditions of those countries (for example, uneven or limited electricity). Firms located in conditions like these are more likely to capture these markets than those that design for the infrastructural conditions of affluent countries. Since there are more people living in non-affluent than affluent countries, spreading these products beyond the national market can produce a new competitive base. While these firms are innovating for the classical reasons, they are producing benefits for a set of people who would not be the targets of high-technology firms in the global North. This kind of innovation “below the radar” has the potential to change the distributional dynamics of the global economy by shifting both market and production power outwards from the core.

¹⁷ I am indebted to Joel Bell, organizer of the Congress of Vienna 2015, for raising these issues in his review of this paper. I have used some of his words here.

Co-evolutionary dynamics

Analysis of specific actions leads to even more specific connections between technological change and inequalities. Cozzens identifies four pathways through which conventional innovation policies, operating at local, regional, or national level, increase inequalities: through the concentration of assets (in particular intellectual property); through destruction and generation of jobs; through the development of products for markets that can afford them, and thus with a tilt to middle class and affluent markets; and through the unequal diffusion of technological expertise (Cozzens 2010). She posits that unless they are specifically designed to do otherwise, conventional innovation policies inadvertently increase inequalities. For example, skill-biased technological change hits some groups more negatively than others.

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, often have fewer opportunities for formal education.

The global concepts call attention to the distributional consequences of technological innovation in many different contexts, and to the forward dynamics, in producing economies, where new jobs and markets are created, as well as the backward dynamics in consuming economies where inexpensive goods may be available but jobs lost. Analyzing the specific connections between innovations and inequalities therefore sometimes produces patchwork quilts of patterns. Cozzens and Kaplinsky have labeled these “co-evolutionary dynamics” (Cozzens and Kaplinsky 2009). These authors analyze the intersections between four kinds of innovation: competence-building, process innovation, product innovation, functional/chain innovation (related to global value chains discussed earlier) and their connections to household income inequality, absolute poverty, horizontal inequalities, environmental inequalities, inequalities by place, and inequalities in power relations. They point out that the causal connection is not simple: some kinds of inequality affect innovation, innovation affects other kinds, and still others co-evolve. For example, in the environmental area,

“the systematic development of hydrocarbon-based technologies (in processes and products) has reflected and favoured not just the owners of these technologies (auto companies, petrochemical companies, countries with oil deposits) but also the nature of the environmental externalities which results. Alternative patterns of competence-building – notably in regard to renewable energies – would significantly alter the environmental footprint of production and consumption, with very different associate distributional outcomes...”

Cozzens and Thakur similarly reject any simple causal connections between new technologies and inequalities in the global context (Cozzens and Thakur 2014). In a set of interlocking case studies, Cozzens, Thakur, and their co-authors examine the distributional dynamics of five emerging technologies in eight national contexts, four in the Global North and four in the Global South.¹⁸ Each case reflects different dynamics and different distributional consequences, never determined entirely by the origins of the technology, and often affected by policies outside the innovation arena. For example, the mobile phone, which has arguably brought very widespread benefits to a big share of the world’s people, both rich and poor, was developed entirely in the private sector, not as a “pro-poor” public innovation. The biggest government influence towards spreading the benefits of mobile phone were anti-trust policies, not innovation policies. More findings from these case studies appear in the sections below on the roles of international institutions.

¹⁸ The technologies examined were genetically-modified maize; mobile phones; open source software; plant tissue culture; and recombinant insulin. The countries studied were Argentina, Canada, Costa Rica, Germany, Jamaica, Malta, Mozambique, and the United States.

Approaches to Fairness through Innovation

Some observers, including many innovation scholars, are unconcerned about these connections between innovation and inequality, either within countries or internationally. Some consider the pattern just, reflecting accurately the relative contributions of various actors to the economy; students of the phenomenon of skill-biased technological change often fall into this group (Autor 2014). Welfare states tend to see innovation as their source for accumulating wealth, which they then distribute through other policies. Recent analyses of long-term trends in inequality tend to support this view when they cite the erosion of the social welfare state as a factor in the increase over the last few decades. Piketty, for example, advocates tax mechanisms to transform the higher returns to capital into benefits for the general population (Piketty and Saez 2014). Others argue, as we mentioned early in the paper, that innovation is necessary to growth, which in turn is necessary to reduce poverty. Inequality can be tolerated if poverty is being reduced, as has been happening in India and China, according to these observers. (We need to note that the latest analyses show a negative correlation between growth and reductions in absolute poverty (Ravallion 2014), more evidence that “trickle down” does not work.)

Scholars of innovation and inequality, in contrast, tend to take the opposite view: that rising inequality is dangerous as well as morally unjustifiable and that innovation needs to be a part of the solution rather than part of the problem. As Chataway, Hanlin, and Kaplinsky put it (Chataway, Hanlin et al. 2014):

The past two decades have been characterized by an increasing uncoupling of economic growth and social and economic development. Outside of China, the numbers living in absolute poverty have remained stubbornly large; in Africa, they have increased substantially. Although this uncoupling has multiple sources, the trajectory of innovation (large in scale, capital intensive in nature and destructive of the environment) has contributed to these outcomes. Reorienting towards a more ‘inclusive innovation’ path has an important role to play in overcoming exclusion. (p. 33)

Scholars in this area therefore suggest a variety of ways that public and private actors can contribute towards creating a more equal world through innovation. Much of this work goes on under the title of “innovation for inclusive development” or simply “inclusive innovation.” In this section, I describe some of these approaches. These approaches fall into three general categories: frugal innovation (a category that focuses how innovation is achieved), grassroots innovations (characterized by who participates in the innovation process), and pro-poor innovation (distinguished by to whom the innovation is directed). Pro-poor innovation connects to market-based stimulus approaches. The three categories are not mutually exclusive.¹⁹

Frugal innovation solves problems using what is available in a low-resource environment. Prahalad’s description of The Fortune at the Bottom of the Pyramid helped to draw attention to marketing innovations that could reach low-income markets (Prahalad 2005). He argued that low-income households could be served by large firms if products or services were redesigned in a way that fit their available income and its temporal patterns. For example, a Mexican construction materials firm expanded its markets by distributing the supplies for home improvement in smaller lots, with credit extended for shorter periods of time between deliveries. Going further in this direction is the idea of frugal innovation, that is, rethinking a product or service in a way that allows high quality delivery at a fraction of the cost (Radjou and Prabhu 2014). An example is the Aravind Eye Care System, which provides eye surgery on a sliding payment scale in rural areas of Tamil Nadu, India. Innovation in this case, and many others from private companies, improves quality of life for poor households by making technology-enabled treatments available (Andersen and Poulsen 2014; Clement, Roy et al. 2014). A third type

¹⁹ I am indebted to Judith Sutz, a reviewer of this paper, for the characterization of the three types.

of frugal innovation slims down functionalities in order to produce radically new product designs that reach lower-income markets; the new generation of small cars in India serve as an example.²⁰

Grassroots innovation is defined by its origins in poor or marginalized communities. Innovation scholars are interested in the conditions for the rise of businesses based on the local knowledge and inventiveness of poor households and communities. The emblem for such efforts is the Honey Bee Network in India, which identifies grassroots inventors and supports them in their effort to find markets for their inventions and commercialize them (Gupta 2003). The Network was formed to assure that indigenous knowledge and grassroots innovators received value and rewards for their contributions. The Network scouts for grassroots inventions, including treks on foot among Indian villages, and offers both visibility and services to grassroots inventors. It is operating now in 75 countries and is the inspiration for the Indian National Innovation Foundation, under the Indian Department of Science and Technology. The Network recognizes the importance of innovation in the informal sector, that is, outside state regulation, and provides a bridge from informal to formal economic activities.

Some government programs focus on developing innovations that will benefit poor households and communities (pro-poor innovations). The Universidad de la Republica in Uruguay, for example, has tried to systematize making connections of that sort, bringing the expertise of the university together with the wisdom of Uruguay's poor communities, through a program in its Council of Scientific Investigation (CSIC) (Alzugaray, Mederos et al. 2012). The staff of the Council have summarized their experience in the form of a cycle of innovation that needs to move from one spot to another in order to succeed, but that can be short-circuited at a number of different points. The CSIC staff members provide a set of real-life examples of the various stages of the cycle, based on their experiences in trying to formulate and fund useful projects.

- The problem of malnutrition was articulated by a variety of officials who work with poor populations, but the officials all described it differently. The University's call for proposals was open to researchers from many fields, but did not attract proposals from any, because the problem itself was ill-defined and diffuse, not amenable to research.
- In another case, Group B streptococcus, the problem was clearly defined by doctors who faced the illness. They found a willing partner in an engineer who experimented with a detection kit, through the research phase of the cycle. Unfortunately, the kit failed, so the search for a solution did not move to the phase of scale-up.
- The case of synthetic human skin made it past scale-up but not into adoption. The need for an inexpensive alternative to expensive, imported replacement skin was clearly articulated, and the problem was solved at the technical level with a product that used local materials and was much cheaper. The National Burn Center, however, failed to adopt the alternative product. In the CSIC account, families wanted to use the less expensive alternative, but they had not articulated their need strongly enough to the NBC to generate interest on its part.
- Finally, refractory epilepsy offers a positive example of a problem that carried all the way through the cycle to an adopted solution. The problem was to find ways to guide surgeons during brain surgery. The doctors themselves articulated the demand, and the engineers worked with them to find a solution. The result was free and open source software for guidance that was immediately adopted locally and may spread internationally as well.

The CSIC experience illustrates that the connection to markets can often be the downfall of attempts at pro-poor innovation. Some organizations have therefore experimented with ways to create markets for products

²⁰ http://www.cardekho.com/carmodels/Bajaj/Bajaj_RE60;
<http://www.financialexpress.com/article/industry/automobiles/renault-kwid-at-a-price-of-rs-2-57-lakh-the-standout-small-car-eyes-indian-hearts-and-homes/143383/>, accessed September 30, 2015.

that low-income households need, in order to provide the right incentive for innovation by the private sector. One prominent example is the idea of “advance purchase commitments,” alliances that attempt to overcome the lack of a secure market for treatments for the diseases of poverty through promises from several funding sources to purchase sufficient quantities to justify the development costs (Muzumdar and Cline 2009; Hargreaves, Greenwood et al. 2011; Tapia-Conyer, Betancourt-Cravioto et al. 2013). Several approaches have been tried. For example, a vaccine for Meningitis C was developed in the United Kingdom in the early 1990s under a non-binding promise of a market from the Ministry of Health. The Orphan Drug Act in the United States provides tax credits, grants, and expedited regulatory approval, with a guarantee of seven years of market exclusivity. Lessons learned from these examples are that credibility is essential; specifications must be set correctly; the price must be right; and there must be provisions for second and third entrants into the market (Towse and Kettler 2005).

In earlier work, Cozzens identified three approaches to reducing inequality through science and technology: pro-poor, egalitarian, and equalizing (Cozzens 2008). Pro-poor efforts, as just described, are designed to provide benefits for those at the bottom of the income distribution, thus addressing the vertical (rich-poor) dimension of inequality. Egalitarian approaches aim to reduce horizontal inequalities, between culturally-defined groups such as gender or religion; these efforts do not automatically reduce vertical inequalities, unless they specifically take that dimension into account. Equalizing approaches aim to change the shape of an economy in ways that grow the middle of the income distribution. Korea reduced inequality dramatically through this route during its rise as a manufacturing power. This approach would take the form of using employment and livelihoods, rather than growth per se, as a primary criterion in national industrial policy.

Part Two: Innovation, Inequality, and International Agreements

When the analysis of innovation and inequalities focuses on technological innovations themselves, using classic frameworks from the economics of innovation, it appears that the market is the dominant reason that technologies reinforce inequalities. Firms have strong incentives to innovate for profit and competitiveness, and they build up the internal capability to carry out that strategy. Both firms and individuals with low levels of skills or education are increasingly disadvantaged in a high-skill economy. To reduce inequality, it seems, policy makers must focus on equalizing competitiveness, through such steps as rural community development and quality education for all. Pro-poor technology development, of accessible technologies that make lives better for those who are currently poor, can amplify the effects of these efforts. By and large, these are matters that are first and foremost in the purview of national governments, with some help from the international development community.

But under globalization, no playing field can be leveled through action within one country. Firms seek exports; consumers want imports; products diffuse. Big companies can buy, produce, or sell anywhere. Since the market is global, processes that set the ground rules for firms and products to cross national borders are crucial in determining the winners and losers from innovation. This section of the paper examines the influence of those rules and how they are set in four areas of technological innovation, each tied to something people value that is distributed unevenly, and perhaps unfairly, at the global level now.

The lens in each case is the lives of the world’s poor: Are they receiving the benefits of technological innovation in this area? How do international agreements shape the relationship? Each case features an industry, a set of national interests, and a forum for setting the rules of the game. Yet each case produces different distributional dynamics and different results for poor families and communities. Each case asks: How could international agreements contribute to a more equitable distribution of something people value?

Health

The first case touches on the unequal distribution of health on a global basis, focusing on access to essential medicines. The World Health Organization has developed a list of these, and is the locus for debates over drug pricing. This case, however, plays out in a different international organization.

The shape of world medical research is wildly mismatched to the shape of world health problems; 90% of the research is devoted to the health conditions that produce 10% of mortality, and the major causes of death in the world are left relatively understudied (Chataway and Smith 2006). The global pharmaceutical industry is central to this picture. It follows the classic industrial innovation model described in Part I, investing huge amounts in research and development to develop drugs that can be patented and sold at temporary monopoly prices to recoup the investment. The industry is dominated by a few big firms with headquarters in the United States and Europe, but competition is arising from the emerging economies, not so much in new drugs as in generic versions and copycats. The big firms have large legal staffs who try to extend the period of monopoly profits through sets of inter-related patents and take legal action when the new competitors come too close to what is already protected. International patenting rules are thus an arena of fierce conflict in this industry (Gatchair, Bortagaray et al. 2014). Some have even suggested alternative forms of reward that might match innovation better to need.²¹

A primary battleground is the World Trade Organization, formed in 1994 as the outgrowth of international trade agreements started after the Second World War. Established along with the WTO was a set of Trade Related Intellectual Property Agreements (TRIPS) (Love and Lattimore 2009). Industry had grown up in the United States and Europe in an era of open intellectual property, when it was easy to steal or copy someone else's idea or product, with little fear of legal repercussions. Most developing countries were in a similar open-market state in 1994, freely selling generic versions of drugs developed by the big companies. TRIPS required them to come into the global patenting system in order to participate in the WTO, and they agreed because of the other benefits the WTO could bring (Cozzens, Gatchair et al. 2007). In order to give countries appropriate time to put intellectual property institutions in place, the effective date for TRIPS was delayed to 2005 in middle income countries; it will come into effect in the least developed countries in 2016. By that time, all WTO members will be expected to have patent protection equal to that in the developed countries. Although TRIPS addresses a wide range of issues and has implications in other areas such as software and plant breeding (Kapur 2011), pharmaceutical firms have become very important players because of their influence over the positions the United States takes in the negotiations (Escobar-Andrae 2011).

The rationale for extending intellectual property protection, as with the original rationale for patenting, was that it would stimulate more drug development (Milstien and Kaddar 2006). While increased patent protection in affluent countries is assumed to be associated with more innovation (a claim that is hotly contested in more venues today,²² the introduction of patenting in developing countries has not led to greater R&D on the diseases that are most common there (Milstien and Kaddar 2006; Qiu and Yu 2010; Kyle and McGahan 2012). TRIPS attempts to strike "a proper balance between incentives to create and those to promote dynamic competition" ((He 2011) page 827). But TRIPS has been interpreted so tightly that it has not left room for local inventors in developing countries ((He 2011); Ala 2013; Temmerman 2014; (Okediji 2014); (Wilson, Kohler et al. 2012)).

Controversy erupted early in the history of TRIPS over access to anti-retrovirals to treat HIV/AIDS. In 1997, South Africa legalized exceptions to national patent laws to reduce the price of AIDS pharmaceuticals (Okediji

21 Joseph Stiglitz, "Prizes, Not Patents," Project Syndicate, <http://www.project-syndicate.org/print/prizes--not-patents>, accessed September 7, 2015.

22 http://www.rand.org/content/dam/rand/pubs/research_reports/RR500/RR512/RAND_RR512.sum.pdf, accessed September 7, 2015.

2014); the United States threatened unilateral trade sanctions. The Clinton administration backed down from this stance after strong negative public reaction, but the case marked the beginning of an international movement for “access to essential medicines.”(Okediji 2014) This movement has affected later rounds of interpretation and use of TRIPS. Some developing countries have undertaken other innovations in the legal sphere, such as an Indian court decision that rejected a patent application from a big non-Indian firm for the solid form of a previously-patented compound, to get what they want while staying within the TRIPS rules (Okediji 2014).

Through the WTO, two revision processes have been undertaken to allow countries to balance public welfare concerns with compliance with TRIPS. The 2001 Doha Ministerial Conference reaffirmed the principle that TRIPS “does not and should not prevent countries from taking measures to safeguard public health,” along with allowing countries “to produce pharmaceuticals and vaccines under compulsory license, even for export ... under certain circumstances” (Milstien and Kaddar 2006). In 2005, the WTO proposed a Protocol Amending the TRIPS Agreement to help countries make use of the compulsory licensing provisions of the Agreement although as of 2010, the number of member states adopting the Amendment fell far short of the number required for it to take effect (Kennedy 2010).

While WTO dialogue was providing a forum for the needs of developing countries, developed countries embarked on a surge of bilateral and plurilateral free trade agreements with provisions nicknamed “TRIPS-plus” – even stronger intellectual property protection than TRIPS, negotiated bilaterally rather than multilaterally through the WTO (Escobar-Andrae 2011). The asymmetries of power that characterize negotiations in the WTO are exacerbated in the negotiation of these agreements, which tend to negate the flexibility provided by TRIPS (Flint and Payne 2013). A number of observers are urging developing countries, particularly those where HIV/AIDS is still epidemic, to “fight hard to reinvigorate multilateral institutions like the World Trade Organization ... in order to offset the power of developed countries” ((Flint and Payne 2013) p. 500).

How could international agreements contribute to a more equitable distribution of the benefits innovation provides through medicines? Scott and Harman explore the negative effect of the current trend in WTO negotiations for health services and livelihoods among the poor, and urge broader considerations beyond intellectual property (Scott and Harman 2013). Other observers propose developing frameworks for licensing and technology transfer and promoting innovative vaccine development in developing countries, and stress that international organizations should define best practices, disseminate information, and monitor TRIPS impact to assure optimal access to new treatments (Milstien and Kaddar 2006). The Max Planck Institute for Intellectual Property and Competition Law has proposed principles for intellectual property provisions in bilateral and regional agreements, including the process, interpretation, and implementation of negotiated agreements, with a stress on openness and transparency (Ruse-Khan, Drexel et al. 2013). In short, market reform in the health arena, with IP reform at its core, should be a priority in this area.

The importance of action in this area is reflected in the 2015 Sustainable Development Goals, under Goal 3: Ensure healthy lives and promote well-being for all at all ages.²³ There we find an objective related to the analysis just provided:

Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the

23 <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>, accessed September 7, 2015.

Agreement on Trade Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all.

While the objective is easy to state, as experience with TRIPS has shown, the challenge is implementation.

Sustainable Energy

“We need innovation to spread throughout the world – especially where energy demand is growing fastest. We need partnerships with the private sector, the global engine of growth and the primary source of new investments” – Ban Ki-moon, Secretary-General of the United Nations

In the 2015 Sustainable Development goals, the United Nations has recognized the importance of access to energy in the development process; the steep inequality in energy is an unacceptable condition. The new SE4ALL Initiative²⁴ (Sustainable Energy for All) starts from a stark statement of the problem of access to energy and its mirror image sustainability challenge:

Energy is the golden thread that connects economic growth, increased social equity, and an environment that allows the world to thrive. At a time when 1.2 billion people worldwide lack access to electricity, when 2.8 billion people do not have clean and safe cooking facilities, and when a shift to sustainable energy use is imperative to protect the Earth’s climate, no less than a worldwide effort is required to achieve sustainable energy for all.

Sustainable Development Goal 7²⁵ reads, “Ensure access to affordable, reliable, sustainable and modern energy for all,” and includes a specific target for ensuring universal access to energy by 2030 – in other words, reducing energy inequality and eliminating energy poverty. This objective is balanced against a number of others that stress sustainable pathways to the goal:

- By 2030, increase substantially the share of renewable energy in the global energy mix
- By 2030, double the global rate of improvement in energy efficiency

Innovation in energy technology is explicitly included:

- By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

While access to energy is crucial to transforming the lives of the world’s poor, the shifts associated with climate change – sea level rising, more frequent extreme climate events, etc. – are superimposed on existing vulnerabilities for the poor. Access to clean drinking water will be affected. Decreasing crop yields will threaten famines. Migration may be the only solution in some areas. Developing countries are expected to be affected most profoundly, both at community level and in terms of national resources for development. “Climate change is a serious risk to poverty reduction and threatens to undo decades of development efforts” (OECD 2003). The World Bank projects that “up to 325 million extremely poor people will be living in the 45 countries most exposed to drought, extreme temperatures, and flood hazards in 2030” (World-Bank 2014), p. 24). Floods will be more common as sea levels rise and precipitation falls as rain rather than snow; and the displacement associated with floods has been shown to exacerbate civil unrest and wars (Ghimire, Ferreira et al. 2015).

24 <http://www.se4all.org/decade/>, accessed September 7, 2015.

25 <http://www.un.org/sustainabledevelopment/development-agenda/>, accessed September 7, 2015.

At the same time, climate change is intimately connected to processes of innovation. In the first instance, the dependence on fossil fuels came with the Industrial Revolution, a technological revolution *par excellence*. Many technological advances have drawn on the availability of fossil fuels, including road transportation with internal combustion engines, an activity which now accounts for a quarter of carbon emissions in the United States.²⁶ On the other hand, having invented our way into the crisis, we must certainly invent our way out of it. The best chance for a projected human population of 9 billion to survive on our one small planet is to dramatically reduce our use of fossil fuels and release of greenhouse gases into the atmosphere, while raising our standards of living. This is the vision of the low-carbon economy, a transformation that will require innovation.

Multilateral organizations are centrally involved in trying to negotiate global rules that will contain the current damage while encouraging a survivable future. While the rules have to do with controlling carbon emissions, the way countries try to abide by the rules involves innovation, for example, in providing the research base for more efficient appliances and heating sources for households, or more efficient cars to meet transportation needs with lower emissions.

As one example, the United Nations Framework Convention on Climate Change (UNFCCC) has incorporated an innovation-inducing mechanism into the global ground rules: the Clean Development Mechanism (CDM). Under this mechanism, firms in industrialized nations invest in projects in developing ones, with the goal of reducing, avoiding, destroying, or sequestering greenhouse gas (GHG) emissions there. The GHG reductions are tradable commodities exchanged in carbon markets. The assumption is that both receiving and investing countries benefit (Byrom, Thomas et al. 2014). Although the original hope for the CDM program was that it would stimulate new technologies, the projects that have come forward qualify as innovations in a different sense: they are not expected to be “new to the world” innovations, but rather “new to the country” or “new to the firm” or even “new to the community” innovations -- new ways of doing things that are more sustainable than the alternatives. The increment of GHG savings is certified through a process organized by the United Nations, under the care of the CDM Executive Board.²⁷

There is considerable skepticism that the CDM program is helping to reduce greenhouse gas emissions; instead it is shifting them from South to North (Erickson, Lazarus et al. 2014). Firms in the North are buying the credits, thus providing some development funds for firms and communities in the South. At the level of the community in which the project happens, however, several observers report that CDM projects raise serious issues from the viewpoint of distributive justice. Crowe (Crowe 2013) has examined the potential of CDM projects to deliver pro-poor benefits at the community level. Mathur and his coauthors (Mathur, Afionis et al. 2014) point to the multiple levels of governance where either distributive or procedural justice might be achieved: global priorities vs. local concerns; national/regional objectives vs. local aspirations; business vs. community interests; and within local communities. On each of these “axes,” as they call them, one party or another may get most of the benefit, and some voices but not others may be heard.

What would energy fairness look like? How far do the current “pro-poor” energy inventions like low-cost but low-efficiency solar cells move us towards this goal? Should the development of energy systems be done inclusively? Should they be frugal? Is the fair distribution of this valued item likely to be achieved through the worldwide push for alternative and renewable energy sources, pushing the cost down and the sustainability of the systems up? The principles of inclusive innovation suggests that it would be appropriate for the international energy initiatives to ask these questions.

26 <http://www3.epa.gov/climatechange/ghgemissions/sources.html>, accessed September 30, 2015.

27 <http://cdm.unfccc.int/>, accessed June 5, 2015

Information and Communication

Information and communication technologies (ICTs) are rich in connections to innovation, globalization, and inequalities. Has this technological revolution produced benefits for the least advantaged members of society, as the principle of “justice as fairness” would require? Is equality of access to communication and information important? Or is minimum access enough?

The combination of computing and communications has produced a transformative family of technologies with multiple branches that have diverged and converged over the last fifty years at a remarkable rate. Computing itself was born in the military realm, but moved into business with desktop systems and then into household and individual use with laptops and tablets. In the meantime, telephones had become wireless and mobile, as well as ever smaller and more powerful, until they, too merged into the grey zone of tablet and phone that so many affluent citizens of the world carry with them today. The infrastructure to support these systems also evolved rapidly, from cable to wireless, with satellite capabilities added to the mix.

ICTs have facilitated the falling costs of global communication which, along with falling transportation costs, are the key factors in the globalization of production. They have also made global mass media possible, allowing sharing of cultures more widely than ever before in human history. Participation in the surge in production of ICT products has transformed the economies of several countries, with South Korea being a prominent example (Kim 1997). Several of the richest people in the world made their fortunes in the ICT industries, including Bill Gates of Microsoft and Carlos Slim, a Mexican telecommunications magnate.²⁸ But several countries have also moved their average standard of life up significantly, riding wave of growth in the telecommunications industry, including Taiwan, Thailand, South Korea, and others. Wealth has accumulated in the global North in telecommunications, but it has also accumulated at some places in the global South.

There are parts of this technology realm that have been and continue to be far away from the lives of the world’s poor; the Internet, for example, which was once thought to be headed towards universal access, is still used by only perhaps 40% of the world’s population, including less than one in five people in Africa.²⁹ Universal Internet access is far enough away to have been adopted as one of the UN’s Sustainable Development Goals in 2015.³⁰

Sustainable Development Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation

- Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020

But there are other parts of the ICT world that have reached into the daily lives of very low income households. Mobile telephones are the poster child of near-universal diffusion, with subscriptions expected to reach 7 billion by the end of 2014, as compared with a total population of 7.2 billion.³¹ The spread of mobile phones illustrates nicely that innovation is much more than technology (Thakur, Beckert et al. 2014). Pre-paid plans were the invention that opened the mobile market to low-income consumers, who could acquire cheap used handsets and pay for minutes when they had the money without having to pay at times when cash was scarce. The technical capability of selling pre-paid plans existed long before the mobile companies began to use them. The breakup of national monopolies and the opening of competition for mobile subscribers stimulated companies to expand their markets by reaching lower-income consumers with a more affordable product. The wide

28 <http://www.theRichest.com/rich-list/world/carlos-slim-helu-biography-the-richest-man-in-the-world/>, accessed June 7, 2015.

29 http://www.itu.int/net/pressoffice/press_releases/2014/23.aspx#.VXSKno3bIuS, accessed June 7, 2015

30 <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>, accessed September 7, 2015

31 http://www.itu.int/net/pressoffice/press_releases/2014/23.aspx#.VXSKno3bIuS, accessed June 7, 2015;

<http://www.census.gov/popclock/>, accessed June 7, 2015

diffusion of the product/service combination is complemented by the small scale and sometimes informal economic activities that support it, such as “mobile phone ladies” selling minutes in urban slums and street vendors selling recharge cards at traffic lights.

What has been most remarkable about the spread of mobile phone access is not just the ability to call someone, as miraculous as that must be for many users. The deepest transformation is coming from the content of the communications. On the one hand, there is plain contact: some studies show that telephone access has led to greater contact with overseas family members, leading to the remittances that make up significant percentages of the GDP of some poor countries and exceeding official development assistance. The World Bank estimates that by 2016, people in developing countries will receive over \$500 billion in such payments.³² On the other hand, crucial information can be shared much more easily over distances in the mobile-infused world. Farmers can increase their income by receiving information on markets by text, allowing them to take their goods to sell where prices are highest.³³ Information and even training in health care can be shared more easily with rural areas.³⁴ Reminders to take medicine can be sent by text, and remote health workers can consult with experts in the city as needed. Mobile sensing and lab capabilities are being built into mobile devices. Banking has gone mobile in many developing countries as well, with M-PESA (M for mobile, pesa for money in Swahili), a mobile system nicknamed “banking for the unbanked.” As of 2011, 75% of people in Kenya outside Nairobi without bank accounts nonetheless used M-PESA to do money transfers.³⁵ “When bad things happened – illness, crop failure, job loss, and violence – households with access to M-PESA were able to get help faster, from more people, and in larger amounts,” according to that study.³⁶ M-Pesa has decreased the prices of competing money transfer services such as Western Union and improved individual outcomes by promoting banking and increasing transfers (Mbiti and Weil 2011). “The service has brought millions of people into the formal financial system, hobbled crime by substituting cash for pin-secured virtual accounts, and created tens of thousands of jobs”(Mutiga 2014).

The success of mobile phone penetration into poor communities, both urban and rural, has inspired a whole movement devoted to pro-poor innovation in software. The “ICTs for Development” (ICT4D) community has been encouraged by the Canadian International Development Research Centre and by the World Bank. Innovation in software happens both in software behemoths and in a counter culture of free and open-source software development (Thakur, Beckert et al. 2014). These movements do not constitute “democratization,” as some have claimed (Von Hippel 2005), because individuals or organizations who engage have to have elite-level software development skills to participate. But they have led to a profusion of experimentation, including ideas that might be useful in the development context. This is a technological area that is not waiting around for corporate philanthropy or big-firm programs to reach the “Bottom of the Pyramid”; creative minds are leading the way in that direction on their own.

32 <http://www.worldbank.org/en/news/press-release/2014/04/11/remittances-developing-countries-deportations-migrant-workers-wb>, accessed June 7, 2015

33 <http://www.iicd.org/articles/ethiopian-farmers-learn-to-use-mobile-apps-to-improve-income>, accessed June 7, 2015; <http://gadgets.ndtv.com/mobiles/news/mobile-phone-services-can-raise-farmers-income-by-rs-56000-crores-696751>, accessed June 7, 2015

34 <http://www.computerweekly.com/feature/How-mobile-phones-support-healthcare-in-the-developing-world>, accessed June 7, 2015; <http://www.ihealthbeat.org/insight/2009/Mobile-Phones-Driving-Health-IT-Innovation-in-Developing-Countries>, accessed June 7, 2015; <http://www.ihealthbeat.org/insight/2009/Mobile-Phones-Driving-Health-IT-Innovation-in-Developing-Countries>, accessed June 7, 2015.

35 http://www.slate.com/blogs/future_tense/2012/02/27/m_pesa_ict4d_and_mobile_banking_for_the_poor_.html, accessed June 7, 2015. Study done by Tavneet Suri (MIT) and Billy Jack (Georgetown University).

36 http://www.slate.com/blogs/future_tense/2012/02/27/m_pesa_ict4d_and_mobile_banking_for_the_poor_.html, accessed June 7, 2015. Study done by Tavneet Suri (MIT) and Billy Jack (Georgetown University).

The exploding world of ICTs has been nourished by some critical global governance processes. Global governance of the Internet was passed on from its U.S. government origins to ICANN, the Internet Corporation for Assigned Names and Numbers, which assigns Internet communication identifiers.³⁷ A public-private partnership, ICANN operates on a multi-stakeholder model (ICANN 2013):

At the heart of ICANN's policy-making is what is called a "multistakeholder model." This decentralized governance model places individuals, industry, non-commercial interests and government on an equal level. Unlike more traditional, top-down governance models, where governments make policy decisions, the multistakeholder approach used by ICANN allows for community-based consensus-driven policy-making. The idea is that Internet governance should mimic the structure of the Internet itself – borderless and open to all.

Despite this open model, ICANN's policy scope is quite limited. The ITU (International Telecommunication Union) is a United Nations agency, with broader convening power. It "allocates global radio spectrum and satellite orbits, develops the technical standards that ensure networks and technologies seamlessly interconnect, and strives to improve access to ICTs to underserved communities worldwide."³⁸ Since the issues on the ITU's agenda are bread and butter for telecommunications service and equipment providers, they participate actively in its processes.

While these global governance organizations set the stage for both profit-making and public activity in today's telecommunications, they do not write the script. The revolutionary character of ICTs has come from the ways people have invented to use them. In sharp competition, companies have discovered ways to reach the widest range of consumers. And users have been extraordinarily creative in finding ways to use the products to transform their lives. In addition to the economic and development applications already described, the role of distributed communication in the democratic movements of the Arab Spring have been widely noted. ICTs may thus provide an example of an innovation area where multinational agreements are best kept to a minimum.

Security

Household security is highly unequally distributed in the modern world. Poor households are more likely to be subject to violence than either middle-income or rich households. Some of the violence comes from within, but much comes from without, in the form of state violence, violence from nonstarter actors, gang violence, or police violence. Does innovation play any role in this unequal distribution?

The role of innovation in contemporary military strategy is clear. The United States military, by far the biggest in the world, views itself as protecting national security by maintaining technological dominance. The logic applies to whatever technologies are understood to be relevant to the goal, whether they are weapons, transportation, protective and augmentative equipment for individual war-fighters, intelligence, or information for command and control. Cooperating with its traditional allies, the United States works to maintain technological dominance through defense research and development spending and alert attention to the state of relevant technologies in other parts of the world. Staying one technological step ahead is at the core of U.S. defense strategy, and has been at least since the Second World War.

In this environment, innovation in the military context focuses on superior capabilities, regardless of cost. This approach is quite different from most innovation in industry, which focuses on competitive capabilities at competitive cost, always keeping in mind the marketplace, what consumers want, and what other firms are offering. Military innovation always has the capability, then, of pioneering in a technology that might not be pursued in a purely private sector environment. In addition, work on highly sophisticated military technologies

37 <https://www.icann.org/>, accessed June 7, 2015.

38 <http://www.itu.int/en/about/Pages/default.aspx>, accessed June 7, 2015.

stimulates imaginations and builds technical skills that may have applications in civilian technology. In this connection, there have been many spinoff benefits for civilian society of the huge U.S. investment in research and development. Several have already been mentioned in the previous sections. Digital computing started in the military effort of the Second World War; the Internet was fostered in its early stages by DARPA, although invented in a civilian research environment; and much of space technology, now the workhorse of telecommunications, was initially pursued with military goals in mind. The aerospace industry has grown up in symbiosis with military needs. Some health advances owe their impetus to defense applications, such as the development of mass production processes for penicillin.³⁹

Nonetheless, there is reasonable consensus among innovation scholars that if the goal is civilian innovation, the best route is to invest in it directly, not indirectly through military technology. The United States devotes a respectable portion of its economic resources to research and development (2.8% of GDP)⁴⁰, but a much larger share of its public R&D support to military purposes than any other country. There is an argument to be made that this kind of investment hurts competitiveness in the civilian economy. Likewise, the huge portion of overall government funding for defense, some argue, could be more productively applied to basic needs such as education and health care, which are investments in a more competitive workforce. To the extent that our allies are winning in economic competition, their success could be attributed to the subsidy to their economies provided by the U.S. taxpayer, who pays for a large share of their defense.

It is not the goal of this section to debate whether technological dominance is still the right military strategy for the United States, nor whether the scale of U.S. investment in defense or defense R&D is warranted. Instead, the section focuses on the consequences for the world's poor of the reality of military technology. Those consequences stem much more from established technologies than from the new ones that emerge in the military innovation process. One route for the influence is through war itself, primarily the civil wars that are intertwined with the circumstances of the world's poorest nations. A second route is through the militarization of poor communities, especially in urban poverty areas around the world, including in the United States.

The first route is described by Paul Collier in his book, *The Bottom Billion*. A former director of the Development Research Group at the World Bank, Collier reports in the book on a series of econometric studies designed to shed light on why the world's poorest countries stay poor. Those countries (roughly equivalent to what the United Nations calls "Least Developed Countries" or LDCs) have been at the bottom of the GDP/capita distribution for a long time, and are not moving up economically in the way that the "emerging economies" like India and China are. "Why?" he asks. What makes their experience different from those of the countries that are moving up? These countries collectively house about a billion people out of the world population of seven billion; thus his title. These countries collectively show a much higher percentage of very poor people than other groups of countries.

One of the answers to Collier's "why" question is war. The Bottom Billion countries are more likely than those on the way up to have been disrupted socially and economically by civil war during the period of time Collier examines. The implications for the very poor people in those countries is obvious: whatever tenuous foothold on the ladder up these families may have achieved would be wiped out by civil war in many cases. One army sweeps through the village, then the opposing one. Men in the household are conscripted or killed. Multi-year crops like coffee trees may be destroyed; seeds for annual crops may be consumed. Health services disappear. The precarious balance among labor, land, and income is lost. The family starts over, either where they began or in a safer spot.

39 <http://www.acs.org/content/acs/en/education/whatischemistry/landmarks/flemingpenicillin.html#us-penicillin-production>, accessed September 7, 2015

40 <http://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS>, accessed September 30, 2015

Is there any connection between the civil wars that cause this disruption and the military strategies of affluent countries? During the Cold War – and much of the historical data Collier analyzed would have come from this period – the geopolitical connection was clear. The interests of the competing superpowers were being fought out in the lives of the world’s poorest people, as each side armed its allies and increased the probability and destructiveness of the conflict. One study shows that since the end of the Cold War, international wars have been rare, but civil wars have been common although shorter.⁴¹ Recent instances, although generated by internal struggles, have begun to show signs of superpower conflict surrogacy again.

Let us now consider the second route through which military technology affects the lives of poor people around the world: militarization of their communities. The term militarization refers to the adoption by civilian law enforcement officials of military-style tactics and equipment. A number of urban areas around the world have been described as increasingly militarized: Mumbai and Gaza (Sassen 2010); Rio de Janeiro and Lagos (Adey 2010); and Cairo (Abaza 2014). Indeed, Bishop (Bishop 2010) claims that megacities and warlike states go hand in hand:

From full-scale military invasion to internecine ethnic and tribal conflict, from paramilitary incursions to strategic car bombs, from slum clearance to pervasive everyday low-level violence, from Mafia-led armies to incessant inflictions of violence on the urban poor, and from missile launches to machete attacks, megacities, most unfortunately, have them all.

Military-style tactics are available regardless of technology; but the military-style equipment is particularly fed by the relentless pursuit of innovation to insure technological dominance. Either the police or criminal forces may seek technological dominance, just as their military counterparts do. As in other wars, innocent and uninvolved civilians may be drawn into the conflict. The addition of homeland security measures that depend on “first responders” (often police) accelerates the transformation of “Mayberry” into Mumbai.

A number of popular books describe the militarization of police forces in the United States. An example is Balko’s *Rise of the Warrior Cop: the Militarization of America’s Policy Forces* (Balko 2013). Michelle Alexander makes an explicit connection between this militarization and the so-called “war on drugs” of the 1980s (Alexander 2010). The war-like quality of this campaign was a major factor in establishing what she calls the New Jim Crow, in which mass incarceration replaces legal restrictions as a way of controlling black men, and through them tearing apart the fabric of black family life. Recent confrontations between police and black communities have dramatized the trend. The community emerges as the enemy for the police force, and the defensive stance of technological dominance takes innocent lives. The destabilizing effects on communities is clear. The original surge of acquisition of military equipment was supported by major infusions of federal funds, which not only supported the “war” but also enlarged the markets of firms that manufacture military equipment.

Are there any multinational processes that might help to demilitarize these urban zones, each of which seems subject to its national priorities, yet all of which bear the common stamp of the availability and ideological support for arms acquisition? Policy action to redefine community police functions will be local and national. Strengthened controls on conventional arms, rather than active distribution of them to police forces, would help. . And at the broadest level, reducing international tensions and decreasing the size and influence of the military would take the foot off the accelerator of urban arms wars as well.

The Sustainable Development Goals seem barely to take militarization into account as a factor encouraging violence. Goal 16 (Promote just, peaceful and inclusive societies) comes the closest, with the following targets:

- Significantly reduce all forms of violence and related death rates everywhere.

41 <http://www.economist.com/news/briefing/21589431-bringing-end-conflicts-within-states-vexatious-history-provides-guide>, accessed September 30, 2015

- By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime

Goal 11 also sounds relevant (Make cities inclusive, safe, resilient and sustainable), but does not refer to militarization or police/community relationships. International agreements about demilitarization apparently will apparently need to be developed outside the United Nations' Sustainable Development process.

In summary, the risks and burdens of militarization fall disproportionately on poor communities, on both poor and rich countries. Any movement in the direction of demilitarization, international or domestic, would help to relieve those burdens and create conditions more favorable to inclusive development.

Discussion and Conclusions

The Sustainable Development Goals include Goal 10: Reduce inequality within and among countries.⁴² It is of particular interest for this analysis that nothing related to technological innovation appears among the objectives listed under this goal. Half of the objectives are addressed to national governments: raising income for the bottom 40% of the population of each country; strengthening wage policies; and ending discrimination. Half focus at global level, calling for regulation of global financial markets; orderly migration processes; and voice and preference for the least developed countries in world trade and official development assistance.

A plain vanilla version of technological innovation appears under Goal 9, as though it had nothing to do with inequality and was entirely a national matter:

- Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending
- Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities

The scholarship reviewed in this paper argues against leaving research, development, and technological innovation on their own, without anchoring them firmly in the effort to reduce the unequal distribution of things that matter in the lives of the poor. The benefits of technological innovation do not trickle down on their own; active efforts are needed. National governments can use the traditional route, taxing wealth generated by technological innovation in order to redistribute income and provide good public services to all. They can also try to grow a middle class by targeting innovation and technological upgrading efforts to industries that generate mid-wage jobs matched to the skill levels of the population, while working to raise those skills. And they can put programs in place that embody the inclusive innovation principles: pro-poor, grassroots, and frugal.

At the global level, this paper has argued, the appropriate places for international action are not in conventional innovation policies but rather in shaping institutions that set the ground rules for sharing the benefits of new technologies broadly. In closing, let me outline the general features of an action agenda that approach suggests.

First, **the inclusive innovation approach needs to be incorporated into all the science and technology-intensive goals articulated in the global agenda.** Energy is the example used in this paper. The search for greater equality in sustainable energy access is already a pro-poor technological initiative in concept. The literature on inclusive innovation suggests that this goal is less likely to be achieved in a top-down mode, and more likely to happen through pro-poor, grassroots, and frugal innovation. For example,

⁴² <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>, accessed October 1, 2015.

communities should be involved in planning for their own energy needs. There should be a preference for distributed energy systems that utilize local knowledge. Large scale systems should never displace indigenous communities. Similar directions could be taken by several of the other Sustainable Development Goals, including water, food security, and health.

Second, **international ground rules that open opportunities for new actors** are essential; international institutions have been central in trying to negotiate these conditions and must continue in that effort. Certain issues need to be addressed at global rather than national level, in particular those that correct for asymmetries of power that distort agreements and hold development back. Technological innovation in general amplifies power; that tendency must be countered if technological progress is to benefit everyone. Two issues emerge from the analysis in this paper as particularly pressing in this regard.

A) One is a classic, central issue in innovation policy: **intellectual property**. The sites for action are the World Intellectual Property Organization and the World Trade Organization along with alliances with other institutions such as the World Health Organization and the Food and Agriculture Organization. These organizations must continue the struggle for patent reform, with a focus on the following points that are particularly relevant to innovation:

- 1) **Right-size IP protection.** Too much IP stifles competition and too little IP encourages imitation.⁴³ The relevant international organizations must make every effort to hold the patent system to its original intent of providing a short period of positive incentives. Well-known dysfunctions like defensive patenting, “trolls,” and “thickets” must be minimized.
- 2) **Seek the right balance between innovation incentives and public needs.** No one should go without treatment so that someone else can profit. Arrangements must be negotiated in ways that are fair to all parties, including providing benefits for the least advantaged.
- 3) **Transparency, inclusiveness, and equal participation** should characterize all international negotiations including bilateral and multilateral agreements, as outlined in the Max Planck Institute Declaration (Ruse-Khan, Drexel et al. 2013). For example, the negotiation agenda should be publicly available and countries facing IP demands should develop their own positions through public consultation. The negotiation should include all stakeholders, and all stakeholders should have an opportunity to comment on drafts. “The negotiated outcome should respect all international obligations of the parties, in particular those relating to the protection of human rights, biological diversity, the environment, food security and public health.” No bilateral agreement should undermine the ability of the signatories to use the public interest related flexibilities in the TRIPS agreement. In other words, the rules of the game should reduce asymmetrical power.

B) The second issue directs the activities of multi-national firms towards inclusive development through the **technological and skills upgrading process**. The international development community is debating requirements for lead firms in global value chains to invest in upgrading for their suppliers, through Aid for Trade provisions. Aid for Trade focuses overseas development assistance on reducing supply-side and trade related obstacles that constrain their ability to engage in international trade.⁴⁴ Within that effort, the asymmetrical relationships between the lead firms in value chains and local suppliers has been recognized, and international organizations are trying to use their influence to get a better deal for the suppliers, one that builds their capabilities and thus contributes to inclusive development. The negotiations provide an opportunity to establish conditions that utilize and improve the chances for local innovations to affect local livelihoods. What is at stake

43 <http://www.wipo.int/ip-competition/en/>, accessed October 1, 2015

44 https://www.wto.org/english/tratop_e/devel_e/a4t_e/aid4trade_e.htm, <http://www.oecd.org/trade/aft/>, accessed October 1, 2015

is not just “upgrading” to technologies or skills that have been defined outside the local context, but in fact the contributions of local ingenuity and knowledge to adding value in the chain. The WTO is heading to Nairobi in December of this year for a Ministerial Conference, in which they hope to demonstrate that they can negotiate positive outcomes in trade agreements for “the poorest and most marginalized.”⁴⁵ As with other S&T-based development goals, the WTO in these negotiations should be looking for pro-poor, grassroots, and frugal pathways that grow mid-wage jobs that match the local skills environment.

Finally, the analysis presented here shows that any **movement towards demilitarization** in the global or local environment would be good for the world’s poor. Redirecting creative energy away from arms and towards solving the challenges of the daily lives of the poor would make the contribution of technological innovation to reducing inequality significantly more positive. If the innovation-inducing strengths of military technology development are needed, including the (anti-frugal) encouragement of breakthrough ideas regardless of initial cost, the approach should be shifted to other areas of grand challenges, such as health, transportation, water, or housing.

In conclusion, the commitment to innovation for inclusive development calls for global action, and therefore for international agreements and institutions that take inclusive innovation seriously. The Vienna Congress goals of peace, stability, and fairness will only be met with new concepts of technological innovation on the table.

45 <http://allafrica.com/stories/201509151868.html>, accessed October 1, 2015

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