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CHINA

**INCLUSIVE INNOVATION FOR SUSTAINABLE INCLUSIVE GROWTH
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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank	MOA	Ministry of Agriculture
AEDC	Alternative Energy Development Corporation (South Africa)	MOH	Ministry of Health
AfDB	African Development Bank	MOF	Ministry of Finance
ARPU	Average Revenue Per User	MOST	Ministry of Science and Technology
BiOS	Biological Innovation for Open Society	MLM	More from Less for More (or Many)
BoP	Base of the Pyramid	MTB	Mycobacterium Tuberculosis
BRICS	Brazil, Russia, India, China and South Africa	NEA	National Energy Administration
CAS	Chinese Academy of Sciences	NGOs	Non-Governmental Organizations
CBRC	China Banking Regulatory Commission	NInC	National Innovation Council (India)
CCTV	Closed-Circuit Television	NIF	National Innovation Foundation (India)
CHNS	China Health and Nutrition Survey	NSFC	National Natural Science Foundation Committee
CSIR	Council of Scientific and Industrial Research (India)	OECD	Organization for Economic Cooperation and Development
FYP	Five-Year Plan	OSDD	Open Source Drug Discovery
GDP	Gross Domestic Product	PBC	People's Bank of China
GRA	Global Research Alliance	PCM	Phase Change Material
GRL	Global Responsibility License	PHS	Personal Handset System
MDGs	Millennium Development Goals	PIPRA	Public Intellectual Property Rights for Agriculture
ICT	Information and Communications Technology	P2P	Peer-to-Peer or Person-to-Person
IFIs	International Financial Institutions	R&D	Research and Development
ICAR	Indian Council of Agricultural Research	RMB	Renminbi (China)
ICMR	Indian Council of Medical Research	RTIs	Research and Technology Institutes
IDEAS	Innovation, Development, Enterprise, Action and Service	SSFC	National Social Science Committee
IDB	Inter-American Development Bank	SIAT	Shenzhen Institute of Advanced Technology
IFAD	International Fund for Agricultural Development	S&T	Science and Technology
INPRA	Information Network Platform for Rural Area	SMART	Simple, Maintenance-Friendly, Affordable, Reliable and Timely to Market
IP	Intellectual Property	SMEs	Small and Medium Enterprises
IPR	Intellectual Property Rights	SRISTI	Society for Research and Initiatives for Sustainable Technologies and Institutions (India)
IRS	Internal Revenue Service (USA)	STI	Science, Technology and Innovation
MDGs	Millennium Development Goals	TISTR	Thailand Institute of Scientific and Technological Research
MOE	Ministry of Education	TUFE	Tianjin University of Finance and Economics
MEP	Ministry of Environmental Protection	UN	United Nations Economic & Social Commission for Asia and the Pacific
MIIT	Ministry of Industry and Information Technology	ESCAP	Asia and the Pacific
		VC	Venture Capital
		VCFEI	Venture Capital Funds for Emerging Industries

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Inclusive innovation is of high relevance for the Chinese authorities but the concept is new to the Chinese government, from both conceptual and policy perspective; So far, China has emphasized frontier innovation, yet has recognized the importance of inclusive innovation in addressing increasing disparity between the rich and poor. In China, many efforts are being made in the domain of inclusive innovation, but there is no clear strategy and implementation plan. The Report, therefore, aims to help build awareness and set the stage for the potential implementation and operationalization of inclusive innovation policy in China and possibly in other countries. The Report is presented in four Chapters and an Executive Summary. Chapter I presents the concept of inclusive innovation and why it is relevant for China. Chapter II discusses the current landscape for inclusive innovation in China. Chapter III presents international experience and examples. Finally, Chapter IV outlines some policy options for consideration by the Chinese authorities.

CHINA

INCLUSIVE INNOVATION FOR SUSTAINABLE INCLUSIVE GROWTH

EXECUTIVE SUMMARY

Rationale for Inclusive Innovation

1. **The “Base of the Pyramid” is the world’s largest but poorest socio-economic group** comprising the 2.6 billion people worldwide— a majority of whom live in Asia (486 million in China)—subsisting on less than US\$2 a day. The BoP members constitute 40 percent of the world’s population, but live on the cost of a Starbucks coffee or two packs of M&M chocolates. The immense size of the BoP poses significant challenges to poverty eradication efforts and social harmony. Given the fiscal constraints prevailing in most countries, social policies can only achieve nation-wide coverage if innovative ways are adopted to ensure that social support programs are efficient, innovative, scalable and financially sustainable.

2. **China’s rapid and consistent economic growth over the past several decades substantially reduced the number of people living in poverty, but sharply increased income inequality.** The Gini coefficient of income inequality increased from 38.2 in 1988 to 48.0 in 2007, and urban-rural disparities in household income have grown from 1.9:1 in 1985 to 3.2:1 in 2010. In 2005, the richest 10 percent of households possessed 31.4 percent of all disposable income— 13 times higher than the 2.4 percent share held by the poorest 10 percent. Disparities between the coastal and the interior regions are also widening.

3. **Income offers just one measure of inequality; China also has high inequality of access to essential goods and services.** In China and all over the world, the “disadvantaged,” “economically excluded” or “resource-poor” (a group even larger than the BoP) lack access to the basic necessities of life such as clean water, sanitation services, affordable housing, food, basic health care, electricity, roads, basic education, and financial services. Access to health, education, financial, information technology resources and health outcomes in China vary widely across urban and rural areas and across regions. Significant disparities in access between urban and rural citizens make the nature of the exclusion more visible, particularly when considering that a large majority of BoP members live in rural areas. Moreover, despite their extremely large aggregate purchasing power (well over a trillion US dollars per year world-wide), this group lacks access to non-essential but empowering consumer products and modern markets that the rest of the world has come to take for granted.

4. **Appropriate public policies can help address improved access to services, improved quality of life, and empowering resource-poor people – without necessarily raising incomes.** A well-designed inclusive growth agenda must address both well-being and human empowerment. People need access to essential services in order to achieve the basic level of human empowerment needed to participate in economic development productively. The message dominating policy discussions is: *inclusive growth is not just a moral imperative—it is smart economics*. An economy in which large numbers of its population devote their time, effort, and energy to the banalities of daily survival will never fire on all cylinders. Emerging economies continue to design special policies and programs that focus directly on the needs of the economically excluded, mostly through standard policy levers like tax and transfer mechanisms, subsidies, welfare and entitlements. But an agenda (such as inclusive innovation) which also facilitates the provision of access to essential goods and

services at affordable prices and helps to increase the purchasing power of the BoP will better equip them to participate economically, and will help reduce the injustice of income inequality by making the daily experience of those with lower incomes somewhat more like that of the better ones.

5. **“Inclusive innovation” seeks to expand access to essential goods and services, thereby improving quality of life, and enhancing economic empowerment through knowledge creation, acquisition, adaption, absorption, and deployment efforts targeted directly at the needs of excluded populations, primarily at the Base of the Pyramid (BoP).** An “*inclusive innovation*” is any innovation that helps expand affordable access to quality products and services which help create livelihood opportunities for excluded populations – on a sustainable basis and with significant outreach. Inclusive innovations may be newly-developed or disseminated goods and services, or the result of recombining or adapting existing technologies. They may be based on new research and advanced technologies, but also on traditional ways and low levels of technology. Furthermore, they may not necessarily result from traditional science and technology innovations as much as from organizational, workflow, process, business model, and delivery system innovations. As challenging as market conditions may be, they do not adequately explain the limited scale and scope of pro-BoP products, and the limited commitments of resources devoted to inclusive innovation. Market failures unquestionably form part of the story, and should guide and justify public policy interventions. This suggests key roles for governments, public sector agencies, private firms, universities, NGOs, foundations, BoP, and individuals, and a need to look beyond the high technology orientation of current innovation policies and practices.

Five elements of inclusive innovation- affordable access, high quality, low cost, sustainable business model, and extensive outreach- are fundamental.

6. **An “inclusive innovation strategy” is a set of policies which promote the sustainable production, dissemination and absorption of inclusive innovations by connecting excluded populations to a nation’s innovation ecosystem.** Given the BoP’s immense aggregate purchasing power, their needs can theoretically be satisfied on a sustainable basis by private firms working in conjunction with other actors in the innovation production process. However, failures in BoP markets result in the severe underproduction of goods and services based on inclusive innovations, and policies designed to promote “frontier innovation” do not adequately address those failures. Limited and low-cost public sector interventions–informed by a deep understanding of how inclusive innovations are developed, disseminated, and absorbed–will create a more optimal level of pro-BoP output. These interventions rely on public and private sector initiatives and global partnerships to create high-performance products and solutions that are affordable by resource-poor people.

7. **A coherent inclusive innovation strategy would complement frontier innovation efforts by improving access to essentials and increasing the purchasing power of the resource-poor – while also enhancing income-generating opportunities for BoP members.** Though a multi-pronged innovation agenda addresses the needs of the BoP, it also has a more distinctly economic rationale: overcoming market failures which lower the output of inclusive innovations. Inclusive innovations have been developed in both emerging and developed economies, but remain sporadic, operate on a limited scale and have a limited impact. Governments can help create a self-sustainable system that increases the volume of inclusive innovations, expands the market for low-cost and high-performance products, focuses resources and attention on the “resource poor or BoP” market segment, and makes the provision of products cheaper and more efficient, and thus more enjoyable by more and more people.

8. **Public support should focus on the creation of a supportive ecosystem and related infrastructure to promote inclusive innovation.** Public policy can enable fundamental investments and resource commitments to create a functioning innovation infrastructure that increases inclusive innovation output on a sustainable basis. The government's major focus should be to facilitate, support, incentivize and leverage the strengths of all stakeholders in order to create sustainable inclusive solutions with significant outreach at maximum efficiency with the least possible burden on the public resources. An inclusive innovation system should rely heavily on contributions from the private sector (including the financial sector), the research and academic community, NGOs, and global partnerships – as well as the BoP population itself. We require innovation (itself) in both *doing as well as delivering* inclusive innovation to the masses.

9. **It must be emphasized that while inclusive innovation is a very useful policy instrument to improve social inclusion and harmony, it is not a 'silver bullet'.** It is one important tool in the basket of many options available to policy makers and should be deployed along with other instruments in dealing with the issue of social inclusion and harmony. Such tools include, but not limited to: a supportive business environment, physical and ICT infrastructure (especially rural), sound FDI regime, protection of property rights, governance systems, strong institutions, participatory approach, direct subsidies, sound education system, labor mobility, market based competitive economic environment including encouragement of private sector, etc. For example, reform of the household registration (*hukou*) system holds the potential to unleash enormous welfare improvement for hundreds of millions of the rural poor in China, which cannot be matched by any other means including inclusive innovation. The same goes true for rural infrastructure, such as a paved road connecting a poor village to the main road.

The Landscape for Inclusive Innovation in China

10. **China has a strong enabling environment for inclusive innovation.** Elements of the environment include: (i) the government's commitment to create a harmonious society, reduce income disparities and improve access to basic services; (ii) a strong and nation-wide physical and ICT infrastructure; (iii) a well-developed innovation system; (iv) a growing private sector with strong manufacturing and reverse innovation capabilities; and (v) an enormous BoP market with huge potential purchasing power, providing new growth opportunities for the private sector and other actors to engage in inclusive innovation.

11. **Efforts to address disparities in China have been ongoing for over the past two decades, with the government launching several policy initiatives for reducing poverty and bringing economic growth to underdeveloped regions.** In recognition of the urgency to address the widening disparities, building a harmonious society has been placed at the top of the government agenda in the 11th Five-Year Plan (2006-2010). In September 2010 President Hu Jintao proposed an inclusive growth strategy aimed at reducing poverty, narrowing the rural and urban income gap and promoting equal access to basic social services for urban and rural poor, as well as for migrant workers. The 12th Five-Year Plan (2011-2015) marks a shift of creed from 'pursuing economic growth' to 'sharing benefits of development by its all people'. Consequently government spending related to broadening access to basic services has dramatically increased from 507 billion RMB to about 2.6 trillion RMB. In this context, inclusive innovation is of high relevance for the Chinese authorities but the concept is new to the Chinese government, from both conceptual and policy perspective. So far, China has emphasized frontier innovation, yet has recognized the importance of inclusive innovation in addressing increasing disparity between the rich and poor.

12. **Current government programs face the daunting challenge of expanding in scope, coverage, quality, and efficiency to sufficiently serve other disadvantaged groups, such as migrant workers.** In the coming years, fiscal and budget constraints will be a difficult hurdle to achieving universal and nationwide coverage, absent innovative ways of making social services scalable, financially sustainable, and delivered in effective and efficient manner. As the key provider of public services, the government could directly benefit from pursuing a well-articulated inclusive innovation strategy, for inclusive innovation could be a powerful tool to significantly reduce the burden on the fiscal budget and improve the supply of affordable quality basic goods and services. Pursuing an integrated and well-coordinated inclusive innovation strategy is also crucial to allow fiscal resources to be rationally allocated between sectors and target groups, according to national priorities and needs. That is precisely the rationale for pursuing inclusive innovation: leveraging fiscal expenditures to promote the development, deployment and dissemination of affordable high-performance solutions, thus help expanding essential social services at an affordable price to excluded populations.

13. **China has many initiatives and programs to promote inclusive innovation and social development, but no explicit inclusive innovation policies and strategies.** China has no single high-level national body to champion, formulate, support, and monitor implementation of inclusive innovation initiatives. The country has a large number of public support social programs, but China's current inclusive innovation system faces significant challenges – most government programs and policies are *ad hoc*, uncoordinated, and inefficiently operated. Private sector efforts are limited; universities and research institutions remain insufficiently focused on inclusive innovation; grassroots innovation is not well-supported and remains sporadic; international collaboration on innovation is insufficiently oriented toward inclusive innovation; and linkages between various actors are weak and in some cases nonexistent. It is not clear if these numerous government inclusive innovation-related initiatives have a wide outreach, adequately leverage the capabilities and comparative advantages of all stakeholders, sustainably produce pro-BoP products, and deliver the best possible outcomes and impact for the target population with minimal burden on public budgetary resources.

The International Experience

14. **Many governments such as Brazil, India, South Africa, Thailand, Vietnam, Mexico, and Uganda, have initiated programs promoting inclusive innovation.** Their efforts demonstrate an essential and facilitative role for national governments in an inclusive innovation agenda. Together, these countries, in total, have catalyzed inclusive innovation by financing or coordinating financing for research and technology development with particularly high impact on human empowerment; leveraged their role as a market participant in the provision of public goods; forged partnerships across sectors and globally; promoted information exchanges between the BoP and industry; strengthened networks of talent that produce inclusive innovations; and eased regulatory burdens while also advancing intellectual property regimes– with due attention to open-source alternatives, which allow inclusive innovations to be commercialized and sustainably produced by private sector driven markets.

15. **Current international approaches to inclusive innovation range from ad-hoc efforts by individual ministries, sub-national governments, and Research and Technology Institutes (RTIs), to more mature, focused and synchronized national programs.** Countries with a strong enabling environment and existing large-scale initiatives aimed at poverty reduction, improving STI infrastructure, and SME development, would benefit from a more comprehensive implementation of

inclusive innovation. – RTIs both in developing countries and developed countries – have served as well-springs of pro-BoP innovation. There is an increasing awareness and recognition of the role of science, technology and innovation (STI) in the pursuit of alleviating poverty in developing countries. The Millennium Development Goals (MDGs) have brought focus and a compelling, output-driven framework to policies leveraging STI for poverty eradication and human empowerment.

16. **For the private sector, inclusive innovation is emerging as perhaps the biggest business opportunity of the coming decade.** New models are emerging where the private sector is not only *‘doing well and doing good’* but *‘doing well by doing good’*. This is in stark contrast to the old worldview in which catering to the needs of the BoP was seen through the prism of philanthropy. That BoP markets remain under-developed and under-satisfied is increasingly seen as evidence of a lucrative potential. Indeed, most of the growth in consumer spending is expected to come from people in emerging markets, who have a much lower spending capacity than traditional middle-class consumers in developed countries, leading firms to first pursue inclusive products and then pivot higher up the curve to serve the emerging middle class – and even consumers in advanced economies. It is not only BoP – but the ‘new billion’ market as new consumers with rising incomes emerging from BoP (with aspirations for high quality products) that will be the consumers of inclusive innovation based products and services.

17. **Global Foundations such as the Bill & Melinda Gates Foundation, the Clinton Global Initiative, the Welcome Trust and others, are involved in funding inclusive innovation partnerships among different players.** Each of them support different domains and use different methodologies. These initiatives have drawn interest from the most advanced institutions, from Harvard to Yale to Oxford and Peking University. The ‘grand challenges initiative’ posed by the Bill & Melinda Gates Foundation is one of the most innovative initiatives in recent times, which is giving a much-needed boost to inclusive innovation. Globally, successful inclusive innovations have relied on collaboration between agents.

18. **There are several lessons that can be drawn from global inclusive innovation efforts such as:**

- Inclusive innovation is a very useful policy instrument to improve social inclusion and harmony, but it is not a ‘silver bullet’. It is one important tool in the basket of many tools available to policy makers, but it is by no means the solution to all social problems. Therefore, Governments need to consider deployment of all possible tools including inclusive innovation while designing strategies to deal with the issue of social inclusion and harmony.
- Given that the concept of inclusive innovation is relatively new, currently, there are no real best practices, or a country that has demonstrated the significant impact of a set of coherent and inter-linked policies to foster inclusive innovation. India is well head in this regard, but even India’s efforts are work-in-progress. Therefore, we lack clear evidence on how to make inclusive innovation happen from a systemic or policy stand point.
- The inclusive innovation process must harness all innovative processes: high-tech, low-tech, business models, process efficiency, and delivery models; and technologies can have uses not just for the BoP in developing nations but also for regular populations in the developed and developing nations.
- Sustainable adoption and outreach remains a considerable challenge for inclusive innovation efforts: just as inclusive ideas are underdeveloped, they are also under-commercialized.

There are numerous inventions either at the prototype stage or with limited commercial success at the BoP level.

- Solutions created with a holistic view of the ecosystem in which the innovation resides – and involve the BoP as both consumer of innovation and a participant in it – are more likely to be widely adopted.
- Like frontier innovation, successful inclusive innovations have relied on a handful of champions of the ‘More from Less for More’ (MLM) approach to doing business. Visionary industry leaders, such as GE’s Jeffrey Immelt, and Tata Group’s Ratan Tata, individual researchers such as MIT Professor George Whitesides, and leaders of public institutions have brought inclusive innovation from concept to reality.

Policy Options for Promoting Inclusive Innovation in China

19. **China can benefit from a sound public policy for pursuing inclusive innovation on a wide-outreach and sustainable basis with a reduced burden on public resources.** Experience in China and globally demonstrates that output of inclusive innovations relies heavily on a vibrant inclusive innovation ecosystem. Policies that harmonize efforts, facilitate partnerships across sectors, institutions, and borders, and coordinate financing can result in a superior generation, exchange and transfer of pro-BoP knowledge, and take innovations from conception to deployment and widespread adoption. The public policy instruments should be based on the principles of achieving wider impact, greater outreach, and deeper involvement of all stakeholders. The policy design should have provisions to encourage businesses to adopt commercially sustainable business models involving inclusive innovation in order to leverage the managerial and organizational efficiency, manufacturing capabilities, market knowledge, technical and industrial expertise and risk-taking capability of the private sector. The policy framework should also include independent and regular monitoring and evaluation mechanisms and aim to achieve maximum efficiency and sustainable production to deliver results while minimizing the burden on public resources.

20. **Through appropriate policy instruments and sound coordination among different agents of the inclusive innovation China could deploy appropriate tools suitable for Chinese conditions.** The Government may wish to design, adopt, experiment and adjust various options based on its own institutional systems, experience and outcomes. Potential options for the public policy interventions include the following.

- An integrated national inclusive innovation policy and required institutional systems.
- A facile regulatory system and supportive public procurement policy.
- A dedicated fund to support inclusive innovation including private risk capital for pro-BoP solutions.
- Incentives to leverage strengths and comparative advantages of all stakeholders, especially the private sector.
- Mandates for public research system to channel the very best technical and scientific expertise towards inclusive innovation.
- Dedicated support to grassroots innovators to deepen and expand their innovation capacity.
- Collaboration with national, regional and global STI organizations to leverage global talent, technology and resources.
- Grand Challenge and recognition for game changing inclusive innovations to target specific goals- encouraging risk taking, experimentation and recognizing failures.

- Independent and regular monitoring and assessment of policies and programs to maximize efficiency and impact, and benefit from lessons learned.

CHAPTER 1. INCLUSIVE INNOVATION: A CONCEPTUAL FRAMEWORK

“Inclusive Innovation” seeks to expand affordable access to quality basic goods and services for excluded populations – primarily those at the “Base of the Pyramid.”

I. The Context: Inequality of Access to Basic Services

1. **The “Base of the Pyramid”¹ is the world’s largest but poorest socio-economic group.** It comprises the 2.6 billion people worldwide—a majority of whom live in Asia—subsisting on less than US\$2 a day (PPP). Their size and means speak to substantial inequality even in fast-growing and prosperous nations: BoP members constitute 40 percent of the world’s population, but live on the cost of a Starbucks coffee or two packs of M&M chocolates. The immense size of the BoP poses significant challenges to poverty eradication efforts and social harmony. Given the fiscal constraints prevailing in most countries, social policies can only achieve nation-wide coverage if innovative ways are adopted to ensure that social support programs are efficient, innovative, scalable and financially sustainable.

Table 1: Poverty and Inequality Indicators: A Global Comparison

Indicators	China	Brazil	India	Indonesia	Japan	Mexico	Russia	Philippines	S. Africa	Korea	Thailand	Turkey	Vietnam
Population (million)	1,339	190.7	1,210	229.9	127.9	107.4	142.9	92.0	49.3	49.0	67.8	73.7	87.3
GDP per capita (current US\$)	4,393	10,710	1,477	3,039	43,161	9,580	10,440	2,132	7,280	20,757	4,679	9,712	1,172
Gini index	47.0	53.9	36.8	36.76	24.9	51.74	42.3	44.0	57.8	31.6	53.6	39.7	37.6
Income share held by highest 20%	47.8	58.1	45.3	44.9	35.7	56.2	48.9	50.4	62.2	39.3	58.6	45.8	45.4
Income share held by lowest 20%	5.7	3.3	8.1	7.6	10.6	3.9	6.0	5.6	3.5	7.5	3.9	5.6	7.3
Income share held by highest 10%	31.4	42.5	31.1	29.9	21.7	41.4	33.5	33.9	44.9	22.5	42.6	30.3	30.2
Income share held by lowest 10%	2.4	1.2	3.6	3.3	4.8	1.4	2.6	2.4	1.5	2.9	1.6	2.1	3.2
Poverty headcount ratio at US\$2 a day (PPP) (% of population)	36.3	9.9	75.6	50.6		8.1		45.0	35.7		26.5	9.1	38.4
Poverty headcount ratio at US\$1.25 a day (PPP) (% of population)	15.9	3.8	41.6	18.7		3.4		22.6	17.4		10.8	2.7	13.1
Rural population (as % of total population)	56.0	14.0	70.2	47.4	33.4	22.5	27.2	34.3	38.8	18.3	66.3	30.9	71.7

Source: World Development Indicators; Human Development Report; World Inequality Database.

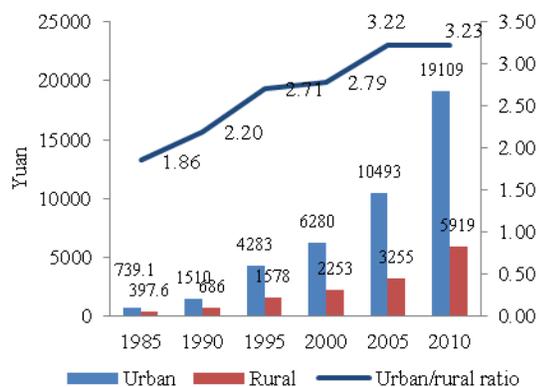
2. **China’s rapid and consistent economic growth over the past several decades substantially reduced the number of people living in poverty, but sharply increased income inequality.** The Gini coefficient² of income inequality increased from 38.2 in 1988 to 48.0 in 2007 (Figure 1), and urban-rural disparities in household income grew from 1.9:1 in 1985 to 3.2:1 in 2010

¹ Referred to as the “BoP” (also known as the Bottom of the Pyramid) in the literature and remainder of this report.

² The Gini index measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of zero represents perfect equality, while an index of 100 implies perfect inequality.

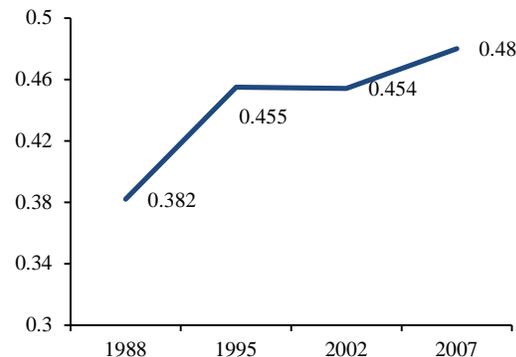
(Figure 2).³ In 2005, the richest 10 percent of households possessed 31.4 percent of all disposable income— 13 times higher than the 2.4 percent share held by the poorest 10 percent.⁴ Disparities between the coastal and the interior regions are also widening. The overall Gini Coefficient across regions rose from 0.12 in 1978 to 0.21 in 2007.⁵ In the 1980s, western China’s output per capita was over 50 percent of eastern China’s output; now, that figure is 41.5 percent. Indeed, China ranks 116th among 144 world economies in income equality.⁶

Figure 1: Rural-urban disparities in annual per capita disposable income in China, 1985-2010



Source: China Statistical Yearbook 2011

Figure 2: Gini index of income inequality in China, 1988-2007



Source:

Calculated using China Household Income Project Survey data

3. Income offers just one measure of inequality, China also has high inequality of access to essential goods and services. In China and all over the world, the “disadvantaged,” “economically excluded” or “resource-poor” (a group even larger than the BoP)⁷ lack access to the basic necessities of life such as clean water, sanitation services, affordable housing, food, basic health care, electricity, roads, basic education, and financial services (Table 2). Significant disparities in access between urban and rural citizens (Table 3) make the nature of the exclusion more visible, particularly when considering that over 90 percent of BoP members live in rural areas. Moreover, despite their extremely large aggregate purchasing power (well over a trillion US dollars per year world-wide), this group lacks access to non-essential but empowering consumer products and modern markets that the rest of the world has come to take for granted.

³ Income inequality in China, which climbed continuously over the past two decades, is showing some signs of flattening and possibly even decline.

⁴ Source: World Development Indicators 2011.

⁵ <http://www.instituteofideas.com/documents/Income%20Disparity%20in%20China.pdf>

⁶ Source: World Development Indicators 2011

⁷ Economic exclusion need not result only from low incomes. Other factors such as gender, ethnicity, geographic separation, illiteracy, age, and tribal status, etc., can have similar effects.

Table 2: Access to Basic Goods and Services

Indicators	Brazil	China	India	Indonesia	Japan	Mexico	Russia	Philippines	S. Africa	S. Korea	Thailand	Turkey	Vietnam
Literacy (%)¹	90	94	63	92		93	100	94	89		94	89	93
Financial inclusion (bank accounts per 100 people)²	107		82	51	717	120		57	84		145	166	
Water and sanitation													
Access to improved water source - urban (%) ³	99	98	96	89	100	96	98	93	99	100	99	100	99
Access to improved water source - rural (%) ³	84	82	84	71	100	87	89	87	78	88	98	96	92
Access to improved sanitation facilities - urban (%) ³	87	58	54	67	100	90	93	80	84	100	95	97	94
Access to improved sanitation facilities - rural (%) ³	37	52	21	36	100	68	70	69	65	100	96	75	67
Health Care													
Infant mortality rate (%) ¹	1.7	1.6	5.3	2.7	0.2	1.4	0.9	2.3	4.1	0.4	1.1	1.4	1.9
Life expectancy ¹	73	74	64	68	83	76	68	70	54	80	70	75	72
Dentists (per 10,000 people) ¹	11.5	0.4	0.7	0.6	7.4	14.2	3.2		1.3	5.0	0.7	2.4	
Physicians (per 10,000 people) ¹	17.2	14.2	6	2.9	20.6		43.1	11.5	7.7	19.7	3.0	14.5	12.2
Measles immunization, infants (%) ¹	99	94	71	82	94	95	98	88	62	93	98	97	97
DTP immunization, infants (%) ¹	99	97	66	82	98	89	98	87	69	94	99	96	96
BCG immunization, infants (%) ¹	99	97	87	93		90	96	90	81	96	99	96	97
Polio immunization, infants (%) ¹	99	99	70	89	99	89	98	86	70	95	99	96	97
Stillbirths (per 100 total births) ¹	1	1	2.2	1.5	0.3	0.5	1	1.6	2	0.3	0.4	1.1	1.3
Underweight children (%) ³	2	5	44	18		3		21			7	4	20
Transportation													
Roads paved (%) ³		54	49	59	80	35	80	10	17	79			48
Kilometers of roads per 100 sq km land ³	21	39	129	23	318	19	6	67		105	35	54	48
Communication													
Telephone lines (per 100 people) ³	22	22	3	16	32	18	32	7	8	58	10	22	19
Mobile phone subscriptions (per 100 people) ³	104	64	64	92	95	81	168	86	101	104	101	85	177
Internet users (per 100 people) ³	41	34	8	9	79	31	43	9	12	83	21	40	28
Energy													
Access to electricity (%) ³	98	99	66	65				90	75		99		98

Sources: ¹ WHO Country Statistics, ² CGAP, ³ WDI. 2011 and 2012

Table 3: Rural and Urban Disparities in BRICS Countries

Indicators	Brazil		China		India		Russia		South Africa	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Income disparities⁸										
Per capita consumption expenditure in US\$ ⁹	4,176	1,592	1,893	616	34	18	299	161	2,982	810
Poverty¹⁰										
Poverty headcount rate under US\$ ppp 1.25/ day (%)	13.0	34.8	2.0	26.0	36.0	44.0	7.4	21.2	39.3	77.0
Access to education¹¹										
No education (%)	13.0	27.8	5.2	13.8	18.7	37.2	0	0	6.8	18.9
Primary school (%)	36.9	51.1	58.1	79.2	22.7	29.0	6.0	15.0	35.9	50.4
Secondary school (%)	43.4	19.2	36.8	7.1	44.4	40.5	94.0	85.0	48.4	28.1
Tertiary education (%)	6.7	1.9	14.4	2.1	14.2				8.9	2.6
Access to health services¹²										
Newborn mortality rate (‰)	2.1	2.6	0.5	1.1	3.2	4.9			1.6	2.2
Infant mortality rate (‰)	4.2	6.5	0.6	1.7	4.9	7.1			3.3	5.2
Access to safe water ¹³	99	84	98.2	60.5	96	84	98	89	99	78
Access to electricity¹⁴										
Households with access to electricity (%)	97.8	88	100	99	93.1	52.5			88	55
Access to telecommunication Infrastructure¹⁵										
Number of telephones installed (per hundred households)	55.2		82.0	59.3	26.7	8.0			25.0	1.2
Number of mobile phones(per hundred households)			172.0	115.4					92.6	91.1
Households owning computers (per hundred households)	21.5		59.3	7.2			57.2	35.7	18.0	2.7
Number of color TVs (per hundred households)	93.1		132.9	104.0	73.2	30.1	99.0	99.0	89.4	67.4
Number of internet users (per hundred people)	16.0		35.2	11.7	29.1	4.0	38.8	17.4	14.3	1.5
Access to financial services¹⁶										
Number of bank branches per 100,000 people			18.03	12.68		4.79	8.11			

Source: China statistical yearbook; Rural household fix-sited survey 2000-2009; Urban household survey, 2006; CBRC rural finance service map, 2009; China urban life and price yearbook, 2009; "From poor areas to poor people: China's evolving poverty reduction agenda—An assessment of poverty and inequality in China," World Bank, 2009.

⁸ Data for Brazil are from 2001; data for China are from 2010 and from China statistical yearbook; data for India are from 2007; data for Russia are from 2009; data for South Africa are from 2005-2006. Data for Brazil are from the Pesquisa Nacional por Amostra de Domicílios (2007); data for China, India and Russia are from the BRICS Joint Statistical Publication 2011; data for South Africa are from the Income and Expenditures of Households survey. All are converted to US\$ using yearly average currency exchange rates from the IRS.

⁹ Data for Brazil are instead 2001 income levels.

¹⁰ Data for India, from 2005, are from UN ESCAP "Social Protection in Asian Cities" and data for China are from World Bank (2009); data for Russia are from 2006 and from World Development Indicators and measured by national poverty line; data for Brazil, Russia and South Africa are from "growth, employment and inequality in BRICS Countries: an overview," and measured by national poverty line.

¹¹ Data for Brazil (1996), India (2005-2006) and South Africa (1998) are from MEASURE DHS, weighting the separate statistics for the male and female population by the share of the population that is male and female from the World Development Indicators; data for Russia are from NOBUS (2003). Data for China are from 2005 and from 2005 population census survey.

¹² Data for Brazil (1996), India (2005-2006) and South Africa (1998) are from MEASURE DHS. Data for China are from 2009 and from China statistical yearbook.

¹³ World Development Indicators 2008 for Brazil, India, Russia, South Africa; data for China are from 2009 and from China statistics yearbook.

¹⁴ Data for Brazil, China, India, South Africa, from 2008, are from "the energy access situation in developing countries"

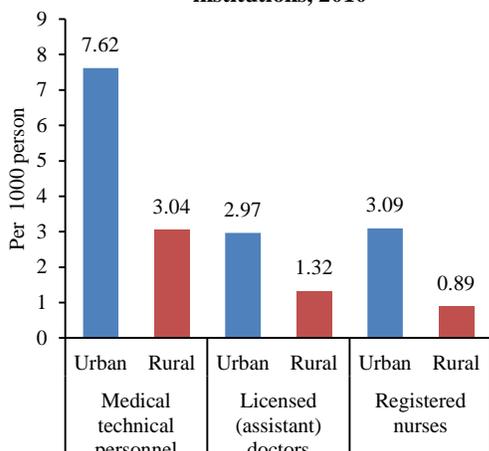
http://content.undp.org/go/cms-service/stream/asset/?asset_id=2205620

¹⁵ Data for Brazil (2005), India (2005-2006) and computers in South Africa (2005-2006) give the percents of households with access rather than the number per hundred households; data for the other South African statistics (2010) and Russia (2009, 2010) give the percent of individuals with access; data for South African internet users (2010) give the percent of individuals who have internet access at home. Data for Brazil are from the Pesquisa Nacional por Amostra de Domicílios, data for India are from MEASURE DHS and report on internet in India (I-Cube) 2011 and give the percent of individuals who are internet users, data for Russian televisions are from the Russian TV and Radio Broadcasting Network (2010), other data for Russia are from the Russian Longitudinal Monitoring Survey (2009), data for computers in South Africa are from the Income and Expenditure of Households survey (2005-2006), data for other South African statistics are from the General Household Survey (2010), and data for China is from 2008 and from Rural household fix-sited survey 2000-2009, China urban life and price yearbook 2009 and statistical report on Internet development in China 2009.

¹⁶ Data for China, from 2006, are from CBRC rural finance service map 2007 and PBC rural finance report; data for India are from 2009 and from financial access 2010 and measured by number of banking branches per 100,000 adults.

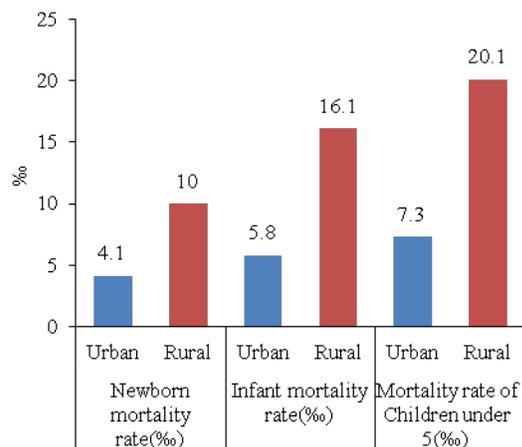
4. **Access to health resources and health outcomes in China vary widely across urban and rural areas and disadvantaged and advantaged regions.** In 2010, there were 7.62 medical technical personnel, 2.97 licensed and assistant doctors and 3.09 registered nurses per 1,000 people in urban areas, but only 3.04 medical technical personnel, 1.32 licensed and assistant doctors and 0.89 registered nurses in rural areas (Figure 3). Similar disparities can be seen in the newborn mortality rate, the infant mortality rate and the mortality rate for children less than five years of age and maternal mortality. For example, the newborn mortality rate in urban areas is 4.1 percent, compared to 10.0 percent in rural areas (Figure 4).

Figure 3: Medical technical personnel in health care institutions, 2010



Source: China Statistical Yearbook 2011

Figure 4: Infant Mortality rate, 2010



Source: China Statistical Yearbook 2011

5. **Differences in education attainment between urban and rural areas are also significant.** Although disparities between rural and urban areas have decreased after achieving nearly universal access to primary and secondary education, they remain significant for access to senior secondary and tertiary education. During 1999-2006, 84.5 percent of school-age urban students attended senior secondary school after graduating from secondary education, compared with only 25.2 percent for the rural population. Similarly, 58.7 percent of urban students transit from senior secondary school to college, but for rural students the ratio is only 24.4 percent (Table 4). According to data collected from 2009 national population sample survey data, among those populations age six or above, 20.29 percent of urban residents attend college, compared with only 5.87 percent in town and 1.46 percent in rural areas (Table 5).

Table 4: Education attainment in urban and rural areas, 1979-2006

Age cohort	1979-1984		1985-1991		1992-1998		1999-2006	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Completion of primary education	96.1	73.6	98.2	75.6	99.4	86.9	99.8	90.5
Transition from primary education to junior secondary education	92.4	65.1	94.5	71.1	97.6	89.1	99.7	93.2
Transition from junior secondary education to senior secondary education	53.7	13.0	64.6	17.6	72.7	24.1	84.5	25.2
Transition from senior secondary education to tertiary education	22.3	3.7	34.8	11.3	44.1	21.3	58.7	24.4

Source: World Bank staff calculated from CHNS database.

**Table 5: Rural-urban disparities in educational attainment
(Population age 6 and above), 2009**

	Urban	Town	Rural
College and higher level	20.29	5.87	1.46
Senior secondary school	24.17	14.84	8.26
Junior secondary school	35.59	44.66	43.44
Primary school	16.94	28.39	37.33
No schooling	3.01	6.24	9.50

Source: China population and employment statistical yearbook 2010

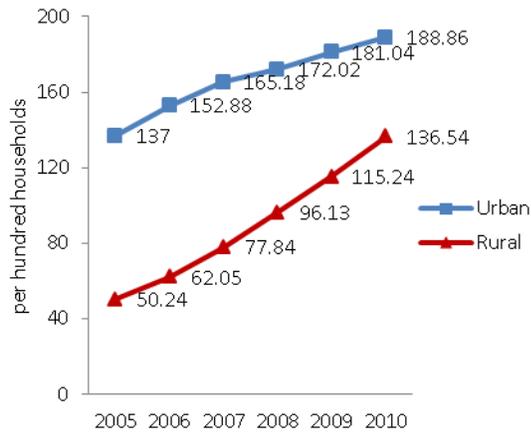
6. **Disparities in access to information technology in China are large – and widening.** In urban areas, there are 71.16 personal computers per 100 households, but in rural areas the number is only 10.37 per 100 households. Similarly, there are 188.86 mobile phones for every 100 households in urban areas, but in rural areas this falls to 136.54 (Table 6). During 2005-2010, the internet penetration ratio in rural areas increased 15.9 percent, compared with an increase of 33.1 percent in urban areas; and in 2010, 50.0 percent of the urban population had access to the internet, compared with only 18.5 percent for the rural population (Figure 6). Digital gaps also exist between advantaged and disadvantaged areas. In 2010, internet penetration reached 69.4 percent in Beijing and 64.5 percent in Shanghai. In comparison the penetration rate for Guizhou and Jiangxi provinces are only 19.8 percent and 21.4 percent, respectively.

**Table 6: Penetration rate of computer, mobile phone, telephone and Internet
(Per 100 households, 2000-2010)**

	2000	2005	2008	2009	2010
Computer					
<i>Urban</i>	9.7	41.52	59.26	65.74	71.16
<i>Rural</i>	0.47	2.10	5.36	7.46	10.37
Mobile phone					
<i>Urban</i>	19.50	137.00	172.02	181.04	188.86
<i>Rural</i>	4.32	50.24	96.13	115.24	136.54
Telephone					
<i>Urban</i>		94.40	82.01	81.86	80.94
<i>Rural</i>	26.38	58.37	67.01	62.68	60.76
Internet					
<i>Urban</i>		16.9	35.2	44.6	50.0
<i>Rural</i>		2.6	11.7	15.0	18.5

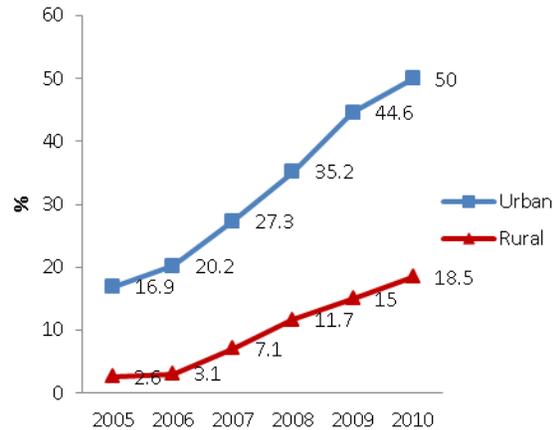
Source: China statistical Yearbook 2011

Figure 5: Penetration rate of mobile phone, 2000-2010



Source: China Statistical yearbook 2011
 Note: Penetration rate of mobile phone is measured by number of mobile phones owned by urban and rural households

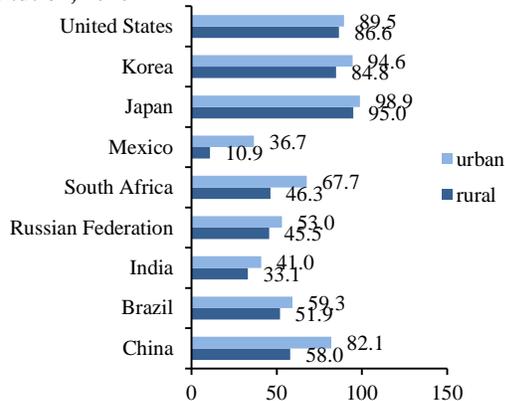
Figure 6: Penetration rate of internet, 2005-2010



Source: CNNIC Statistical Report on Internet Development in China
 Note: Penetration rate of internet is measured by percentage of surveyed population who are internet users

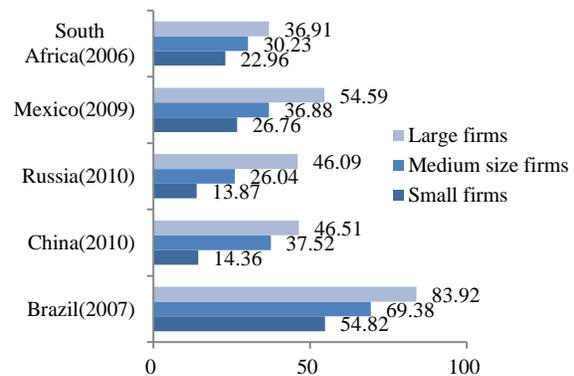
7. **China also has significant inequalities in access to financial services.** 82 percent of urban adults hold bank accounts at a formal financial institution, as compared with 58 percent in rural areas (Figure 7). Compared with medium and large-size enterprises, access to formal credit by small firms remains limited. (Figure 8).

Figure 7: Adult have an account at a formal financial institution, 2010



Source: World Bank Findex Survey

Figure 8: Percentage firms that have a line of credit or a loan from financial institutions



Source: World Bank Enterprise Surveys
 Note: small firms are defined as having 19 or fewer permanent employees, medium size firms 20 to 99 permanent employees, and large firms 100 or more permanent employees, following the definition in the Enterprise Surveys.

8. **Some 58 percent of China’s urban population and 52 percent of the rural population has access to improved sanitation facilities.** The gap is greater for access to clean water; 98 percent of the urban population compared to 60 percent of the rural population has access to an improved water source.¹⁷

¹⁷ Source: World Development Indicator 2011.

9. **People need access to essential services in order to achieve the basic level of human empowerment needed to participate in economic development productively.** Indicators of access to essential services provide insight into the well-being of the BoP and “resource poor” that are not sufficiently captured by reports of their income alone. Just as importantly, however, indicators of access measure human *capability*. Those without access remain too consumed with the continuing struggle for survival to take risks; too vulnerable to uncontrollable changes in their life to create and seize economic opportunities; and too disconnected from markets to sell or provide knowledge to them, or to consume and extract knowledge from them. The result is that BoP members are not just excluded from the *benefits* of economic growth, but also from the *ability to contribute* to it.

10. **A well-designed inclusive growth agenda must therefore address both well-being and human empowerment.** The message dominating policy discussions is powerful: *inclusive growth is not just a moral imperative—it is smart economics*. Perceived injustices breed social upheaval (as evident from the recent developments in the Middle East, Thailand, and lower-level disruptions all across the globe), and the periods of economic instability that inevitably ensue. Class-dominated politics often result in the deliberate adoption of wealth-reducing policies or the failure to adjust policies to accommodate growth opportunities presented by foreign direct investment (FDI), trade, and new technologies. Inequality increases the challenge of complementing export-led growth with growth in domestic consumption, as domestic markets struggle to penetrate all levels of society. Most importantly, an economy in which large numbers of its population devote their time, effort, and energy to the exigencies of daily survival will never fire on all cylinders. It will squander its most valuable resource—its people—and transform what should be a demographic dividend into a demographic liability.

11. **Policies can address issues of access, improving quality of life, and empowering resource-poor people—without necessarily raising incomes.** As emerging economies continue to design special policies and programs that focus directly on the needs of the economically excluded,¹⁸ they cannot simply wait for a “rising tide to lift all boats” while addressing income inequality exclusively through standard policy levers like tax and transfer mechanisms, subsidies, welfare and entitlements, and standard economic development practices focused on competitiveness. Those initiatives are unquestionably important. But an agenda which also facilitates the provision of access to essential goods and services at affordable prices and helps to increase the purchasing power of the BoP will better equip them to participate economically, and will help reduce the injustice of income inequality by making them more productive thereby generating incomes and improving livelihood.

¹⁸ Examples of such initiatives include micro-finance schemes, and cash support programs for the poor that are tied with certain conditions (such as keeping children vaccinated and in schools, pregnant mothers going to hospitals, and so on). A few years ago, India launched its NREGA program to provide guaranteed employment to the rural poor, and is starting to use a national ID system (“Aadhar”) as a foundation for more efficiently delivered and more effectively monitored cash transfer scheme (source:<http://in.news.yahoo.com/aadhaar-based-direct-cash-transfer-scheme-reduce-poverty-084408803-finance.html>, accessed December 15, 2012). Indeed, India is following the footsteps of countries like Brazil, whose conditional cash transfer program (“Bolsa Familia”) has distributed US\$7.8 billion to 12.7 million needy families covering some 53 million people—a quarter of the nation’s population. Indonesia is adopting a version of the Brazilian program and in October 2010 the Philippines launched its own initiative that will reach 2.3 million families. *Source: Newsweek Special Edition- Issues 2011.*

II. Inclusive Innovation: An Introduction and Basic Principles

12. **“Inclusive Innovation” seeks to expand access to essential goods and services, thereby improving quality of life, and enhancing economic empowerment through knowledge creation, acquisition, adaption, absorption, and deployment efforts targeted directly at the needs of excluded populations, primarily at the Base of the Pyramid (BoP).** It is inspired by the simple fact that truly inclusive growth will happen only through *participation*: the BoP must become consumers directly served by the world’s most sophisticated firms, users of the world’s best available know-how, innovators whose ideas become products used across the globe, and more productive workers and entrepreneurs empowered by unprecedented access to basic goods, services, skills, technology and information. Two key aspects help structure the concept of “inclusive innovation” and make it suitable for robust analysis and policy design: first, the characteristics which make an innovation truly inclusive (i.e., defining an “inclusive innovation”), and second, the objectives, content, and rationale behind an “inclusive innovation strategy,” which forms the basis for initiatives by governments, enterprises, universities, NGOs, and nonprofits alike.

13. **An “inclusive innovation” is any innovation that helps expand affordable access to quality products and services which help create livelihood opportunities for excluded populations—on a sustainable basis and with significant outreach.** Box 1 provides an explanation of the features which make innovations truly inclusive, are likely to have broad social impact, and can be achieved by innovative processes of any stripe. Indeed, the most important insight about the methods of production of inclusive innovations is their heterogeneity. Inclusive innovations may be a newly-developed or disseminated good and service, or the result of recombining or adapting existing technologies. They may be based on new research and advanced technologies, but also on traditional ways of doing things and low levels of technology. They may not necessarily result from conventional science and technology innovations as much as from organizational, workflow, process, business model, and delivery system innovations. This suggests key roles for governments, public sector agencies, private firms, universities, NGOs, foundations, and even individuals (including BoP members themselves) with disparate areas of expertise or lines of business, varying levels of sophistication and formality, and distinct client, donor, and consumer bases. In short, there is a need to look beyond the high technology emphasis of the current innovation policies and practices.

14. **It must be emphasized that while inclusive innovation is a very useful policy instrument to improve social inclusion and harmony, it is not a ‘silver bullet’.** Inclusive Innovation is one important tool in the basket of many tools available to policy makers, but it is by no means the solution to all social problems. Therefore, Governments need to consider deployment of all possible tools including inclusive innovation while designing strategies to deal with the issue of social inclusion and harmony. Such tools include, but not limited to: a supportive business environment, physical and ICT infrastructure (especially rural), sound FDI regime, protection of property rights, governance systems, strong institutions, participatory approach, direct subsidies, sound education system, labor mobility, market based competitive economic environment including encouragement of private sector, etc. inclusive innovation.

Box 1: Key Features of Inclusive

An “Inclusive Innovation” is **any innovation** that leads to **affordable access of quality goods and services** which help create livelihood opportunities for **excluded populations** – primarily at the base of the pyramid (BoP) – on a long-term **sustainable basis** and with **significant outreach**.

There are five key features of Inclusive Innovation:

1. Affordable access. “Affordability” obviously depends on the target consumer’s position in the economic pyramid, the type of product, and its value and the opportunities it may help create. But for the 2.6 billion people in the world earning less than US\$2 per day, what remains fixed is the notion that inclusive products cannot just be “low-cost,” but must be “ultra-low-cost” in order to credibly expand access. Appropriate, “ultra-low-cost” affordability thresholds thus represent extreme reduction targets that are immensely useful in the innovation process, definitive of true inclusiveness, and – incredible as it may sound – have already been met by products in a number of areas.

2. Sustainable production. In the long term, an inclusive innovation must promote affordable access by relying on basic market principles with which the private sector works comfortably, and not on continued government subsidies or procurement support. The crucial importance of this feature is obvious: higher output, better competition (i.e., competition induced by market-oriented players and not intermediated by political actors), lower cost to taxpayers, and – most importantly – the critical market check that ensures inclusive products provide a good value to consumers and represent a worthwhile social undertaking. It must be noted that the principle of long-term sustainable production does not negate – rather helps to highlight – the critical role of the government to establish and maintain a well-functioning inclusive innovation ecosystem capable of producing inclusive innovations at a socially optimal level. The role of the government, and the market failures which result in the underproduction of inclusive innovations and justify public intervention, are addressed in Section IV of this chapter, in paragraphs 24-26.

3. Quality goods and services which help create livelihood opportunities. A truly inclusive type of innovation cannot just produce low-performing, cheap, knock-off versions of rich country technologies, and market them to poor people—or in other words, use existing know-how to get “*less for less*.” Inclusive products must get “*more for less*” by innovating to overcome cost constraints so that the BoP can enjoy a sound level of quality of basic services as the more economically advantaged. This means harnessing sophisticated science and technology, or truly creative non-technological innovations, to invent, design, produce, and distribute – and reach a price-performance envelope that creates truly affordable access. The emphasis on “livelihood opportunities” refers to products which allow users to secure the necessities of life, and which have the kind of fundamental, empowering impact on the quality of life that would take unrealistic increases in income to achieve – if they could be practically achieved at all given other constraints. Inclusive products primarily help create economic opportunities for the resource-poor through the *ends* of the innovation – i.e., by increasing access to empowering goods and services – and not through the *means* of innovation – i.e., by income-generating participation in the innovative process. In important ways, this rationale invokes a return to the traditional case for innovation – its ability to produce breakthrough improvements in the quality of life – alongside the more contemporary objective of enhancing competitiveness.

4. Serves excluded populations, primarily those at the Base of the Pyramid. The 2.6 billion people with income levels less than US\$2 per day should be the primary beneficiary of inclusive innovation. They are economically excluded from sharing the full benefits of economic growth, as they often participate in shadow economies that are highly informal, underproductive, and isolated. They are also socially excluded for many reasons, at least one of which is the qualitative difference in their way of life relative to the more economically secure – particularly the emerging middle class which is beginning to define national identities in many countries. Alongside other pro-BoP policies, inclusive innovation can help mitigate these causes of economic and social exclusion.

5. Significant outreach. True inclusion can only happen if the benefits of inclusive innovation reach a large scale, i.e. a significant portion of the population. Depending on the product, the target population may only be a few hundred thousand, or a few million, though in some cases, it may reach hundreds of millions (e.g. low-cost incubators designed to assist premature babies). In all cases, however, inclusive innovations must be widely deployed to merit public support. They cannot simply remain “good ideas,” or be useful for only small groups of idiosyncratic consumers.

Inclusive Innovation is one important tool in the basket of many tools available to policy maker- but it is not the silver bullet. It needs to be deployed along with other policy instruments to deal with social inclusion and harmony issues.

Source: Ramesh A. Mashelkar and Vinod K. Goel, “Inclusive Innovation: More for Less for Many” (Manuscript, forthcoming).

Figure 9: Characteristics of Inclusive Innovations



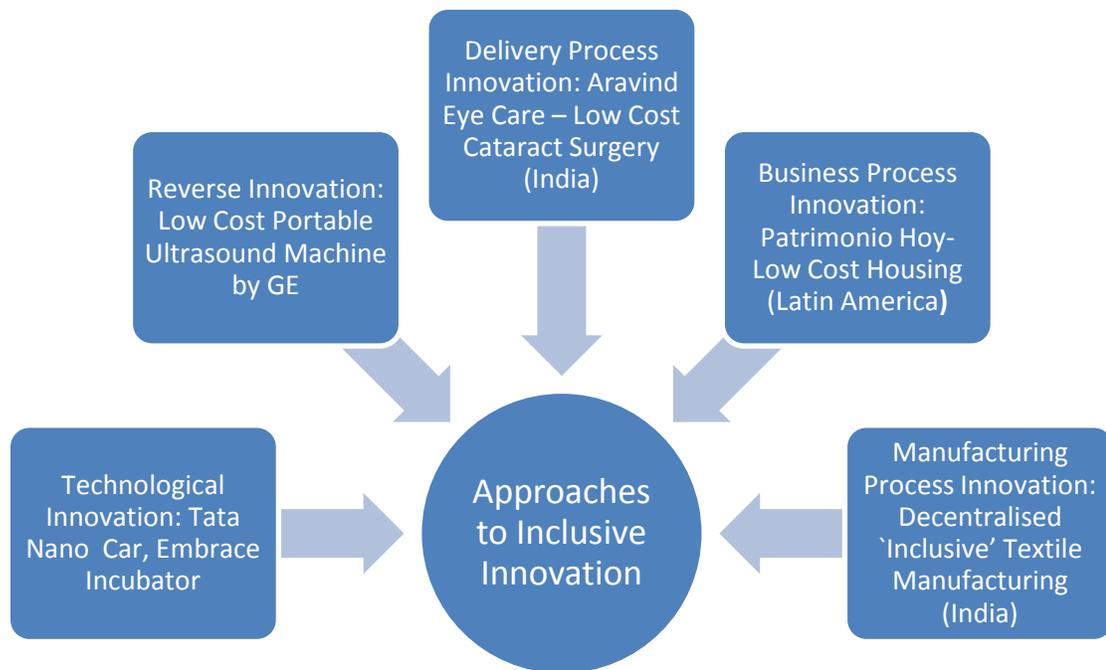
15. **Consider some inclusive innovations stemming from cutting-edge research and development of significant new technologies.** A novel brilliance photo-therapy treatment for newborn babies with severe jaundice costs 25 times lower than the comparable Western devices, and will help clinics treat each year over 20 million children, who suffer from jaundice. The Chotukool, a low-cost (US\$69) refrigerator uses high-end insulation to stay cool for hours without power, and consumes half the energy used by regular refrigerators, thereby increasing access to food and healthcare products such as vaccines and therapeutics. The US\$39 Aakash computer tablet is another potentially ground-breaking product resulting from new technologies developed by private firms in collaboration with public R&D institutions. This low cost computing-cum-access device with powerful features could revolutionize education in rural India. Though none of these innovations are yet widespread, they show promises that need to be backed by performance in the field – a problem of “*demonstration but not deployment*” that inclusive innovation policies can address.

16. **Other inclusive innovations involve fairly rudimentary or existing technologies – but can nonetheless produce a powerful impact.** For example, the low-cost (US\$100), foot-powered Kick Start Money Maker Irrigation Pump has enabled poor farmers in Africa to move from rain-fed agriculture to irrigated farming without having to invest in more elaborate commercial pumps that are more expensive (and rely on electricity). The Freeplay Lifeline Radio also adapted readily-available technologies for the harsh conditions and seclusion of rural South Africa. The sturdy, self-sufficient AM/FM/SW1/SW2 radio is easy to operate, has excellent reception, runs on self-charge or solar power, and has been used to provide information to hundreds of thousands in rural Africa for improved health, safety, education, agricultural productivity, and disaster mitigation. The Bici-Lavadora (MIT D-Lab), a portable, pedal-powered washing machine with an estimated prototype price of US\$127, stands to vastly increase the productivity of wash women, and bring some of the benefits of an appliance often taken for granted elsewhere in the world at low-cost and without reliance on electricity (if the prototype can be successfully deployed). Perhaps the most impressive “low-tech” inclusive innovations have come in the area of healthcare: the Jaipur Foot (US\$28)

currently supplied to 18 countries, and Jaipur Knee, for example, enhanced existing low-cost prosthetic designs with new materials and highly-tested refinements geared towards improving performance for patients and allowing local manufacturing to keep costs ultra low.

17. **Inclusive innovations also rely on workflow, delivery system, and business process innovation (and not just science and technology innovation) to lower costs and expand access.** For example, India’s Aravind Eyecare Hospital performs ultra-low cost (US\$30) cataract surgeries with quality that measures up to international benchmarks by making more efficient use of scarce (and highly-paid) surgeons: rather than having a surgeon perform the entire surgery, each medical personnel performs a specific task during the operation (Figure 10). Similar workflow innovations have been applied to perform low-cost open-heart surgeries (at a cost of US\$3,000) at the Narayana Hrudayalaya Hospital in Bangalore, India with success rates that match their western counterparts.

Figure 10: Approaches to Inclusive Innovation



18. **Other inclusive products use alternative delivery mechanisms designed to bypass some of the constraints that prevent current systems from penetrating excluded populations.** New vaccines that do not require refrigeration or that can be completed in a single dose, and the Embrace Incubator (costing US\$25) for premature babies that does not require electricity, offer a few examples. All of the examples discussed are a few of many existing inclusive innovations (some still at the development stage and others successfully deployed). A more complete account of existing accomplishments appears in Chapter 3, and descriptions of potential areas for inclusive innovation appear in Box 2 below.

Box 2: Inclusive Innovation: More from Less for More (MLM)

To How Many of These Questions Can Innovation Answer Yes?

- Can we make a hepatitis-B vaccine costing US\$20 per dose available at 40 times less?
- Can we make a comfortable, safe and fuel efficient car available not at US\$20,000 but at ten times less?
- Can we make an artificial foot costing US\$10,000 made available at 300 times less?
- Can we make a high-quality cataract eye surgery made available not at US\$3,000 but at 100 times less?
- Can we make a prostate treatment drug costing US\$10,000 available at a price that is 60 times less?
- Can we make a computer tablet available at US\$39?

Innovative methods that are **low-cost and high-performance** have already found solutions that allow the world to emphatically answer ‘yes’ to each of the above questions. Continued efforts and appropriate policies could further expand inclusive products, improving access and quality of life for resource-poor people in the following areas of life:

- Access to affordable technology- computers, mobile phones, internet.
- Access to education - access to information, remote access to class room and laboratory facilities, distance learning, online training, access to virtual libraries, books and journals, collaboration with other institutions in the country and abroad to expand education access fast and at lower costs.
- Access to financial services - financial inclusion, online banking, bill payment, delivery of micro-finance services, ATM machines, insurance and investments products.
- Access to health services - low cost diagnostics, therapeutics and vaccines, patient information, access to doctors, information about disease, child and maternity care, etc.
- Farmer services - information on crop patterns and prices, markets conditions, weather forecasts, use of fertilizers and pesticides, crop and livestock insurance.
- Town management - smart towns, access to internet and education services, crime and transport management, and reduction in pollution.
- Use of radio and television broadcasts (sometimes via satellites) for education, agriculture, entertainment, providing information on laws, emergencies and disasters, etc.
- Climate change - energy efficiency, use of renewable energy, use of solar lamps and solar cooking stoves, grid less electricity supply.
- Emergency and disaster management- forecasting tsunami, hurricanes, floods, storms; evacuation plans; and delivery of emergency assistance to victims.
- Access to government - information about policies, laws, rules and regulations, access to land, property and birth records, targeting of public services, etc.

Source: Ramesh A. Mashelkar and Vinod K. Goel, “Inclusive Innovation: More for Less for Many” (Manuscript, forthcoming).

19. **In addition to the above innovative methods, disruptive “mindsets,” like *Frugal Innovation* (or *Jugaad Innovation*), and *Reverse Innovation*, are gaining attention in the business world.** “*Frugal Innovation*” describes a method of “responding to limitations in resources, whether financial, material or institutional, and turning these constraints into an advantage.”¹⁹ It has been practiced successfully by large firms, both in developed markets (e.g., GE) and emerging (e.g., Tata Motors), and by startup entrepreneurs alike, resulting in inclusive products. Similarly, “*frugal science*” imagines scientific and technological innovation driven less by curiosity and more by the “pressing problems whose solutions require relevant science and technology know how,” and has already influenced research agendas in premier institutions worldwide.²⁰ “*Reverse Innovation*”

¹⁹ Kirsten Bound and Ian Thornton, et al, “Our Frugal Future: Lessons from India’s Innovation System” (Nesta UK July 2012), available at: <http://www.nesta.org.uk/library/documents/OurFrugFuture.pdf>; see also “Jugaad Innovation by Navi Radjou” Jaideep Prabhy and Simone Ahuja.

²⁰ See George Whitesides, “The Frugal Way,” forthcoming in The Economist’s “World in 2012” issue. Available at: <http://gmwgroup.harvard.edu/pubs/pdf/1136.pdf>.

leverages the low-cost and “frugal” mindset of workforces in countries like China and India to reach dramatic changes in the price-performance envelope unattainable by a workforce operating with “abundance,” and not an “austerity,” mindset.²¹ Several principles support these approaches to innovation. First, firms can benefit from seeking alternatives to high-cost and bloated traditional innovative processes. Second, they can benefit from innovating over constraint-induced hurdles, rather than avoiding those challenges by lowering product quality or changing the target market. Finally, **mindset matters**: accomplishing those tasks requires a frugal and flexible attitude, and output of inclusive innovation depends on approaches to business, and research that have yet to fully catch on in organizations – and yet to be fully understood. These principles provide extremely valuable lessons for innovative firms, but they do not address the points of failure in national innovation systems that keep BoP innovations limited in number and impact. That is the objective of an inclusive innovation strategy.

20. **An “inclusive innovation strategy” is a set of policies which promote the sustainable production, dissemination, and absorption of inclusive innovations by connecting excluded populations to a nation’s innovation ecosystem.** Given the BoP’s immense aggregate purchasing power, their needs can theoretically be satisfied on a sustainable basis by private firms working in conjunction with other actors in the innovation production process. However, failures in BoP markets (discussed in Section IV, paragraph 25) result in the severe underproduction of inclusive innovations, and policies designed to promote “frontier innovation” do not adequately address those failures. BoP members remain disconnected from typical innovation ecosystems primarily designed to pursue “frontier innovation.” Limited and low-cost public sector interventions—*informed by a deep understanding of how inclusive innovations are developed, disseminated, and absorbed*—will create a more optimal level of pro-BoP output. These interventions rely on public and private sector initiatives and global partnerships to create high-performance products and solutions that are affordable by resource-poor people.

21. **In a developing economy with a significant capacity for innovation, but with underserved rural economies reliant on agriculture and underproductive relevant to potential, an inclusive innovation strategy should equip a national innovation system to serve the following goals:**

- Promote innovations which provide greater access to the most fundamental basic services—like clean water, sanitation, education, health, food, electricity, telephones, and financial services—so they are produced at a more optimal level;
- Facilitate the creation, diffusion, absorption and deployment of knowledge to continuously enlarge the set of beneficiaries of new (and existing) BoP innovations;
- Provide opportunities for grassroots innovators to bring their ideas to the market (and participate in the gains enabled by their contributions) thereby democratizing innovation; and
- Improve competitiveness of agriculture, industry (especially small and medium enterprises, SMEs), informal businesses and farmers.²²

²¹Vijay Govindarajan and Chris Timble, “Reverse Innovation.”

²² For example, less than three percent of the Indian workforce is in the modern private sector, while roughly 90 percent is in the informal sector. This heterogeneity translates into a wide dispersion in productivity levels. The average productivity of finance-related businesses is 23 times that of agricultural activities. The least productive formal enterprises in auto components and textiles are hundreds of times less productive than the most productive firms in those sectors in India. Such differences are even starker among informal enterprises.

Source: *Unleashing India’s Innovation Potential: Towards Sustainable and Inclusive Growth*, Mark Dutz, Editor, 2007.

22. **The objective of an inclusive innovation strategy is not to simply bring a handful of discrete products to the market.** It is to forge lasting connections between resource-poor individuals and national innovation eco-systems, overcoming market failures in BoP markets and equipping innovation systems geared for other kinds of innovation to adequately serve them. Sections III and IV address the rationale for pursuing an inclusive innovation strategy, including the justification for, and shape of, appropriate public interventions. Section V makes clear that a strategy cannot be implemented exclusively through government initiatives: enterprises, research and technical institutions (RTIs), international financial institutions (IFIs), global partnerships, and foundations must all be included.

III. The Rationale: Addressing Multiple Dimensions of Inequality Through a Multi-Pronged Innovation Agenda

23. **Until recently, most discussions on innovation policy have focused on accelerating the pace of technological catch-up and encouraging innovation activities at the technological frontier, in order to enhance national competitiveness.** The current innovation strategy, however, seldom sheds light on the livelihood of the common people, especially those in rural areas where the poor and disadvantaged are concentrated. Given the persistent inequality and heterogeneity of emerging economies, the pursuit of “inclusive innovation” should complement “elite innovation” efforts in a multi-pronged and mutually supportive framework for innovation, so that innovation becomes a key driver for social equity and poverty alleviation, as well as increasing productivity and competitiveness.

Box 3: Frontier Innovation vs. Inclusive Innovation: Need for a Multi-Pronged Innovation Strategy		
	Frontier Innovation	Inclusive Innovation
Drivers	Curiosity-driven science and research	Applications-driven and cost conscious science and research
Driven by	Sophisticated research capabilities, popular among policy makers and STI community	Innovative entrepreneurs faced with challenge of scarcity and aspiration
Market	Well established route from idea to product to market	Newer routes to not yet established markets
Margins	High R&D investments recouped by long-lasting premiums (high margins)	High volume low margin products
Goals	Improving productivity and economic growth	Improving lives of people (access, productivity, and purchasing power), livelihood and social harmony.

24. **A coherent inclusive innovation strategy would complement frontier innovation efforts by improving access to essentials and increasing the purchasing power of the resource-poor – while also enhancing productivity and income-generating opportunities for BoP members.**

- (a) ***Improving access to essential goods and services.*** Promoting inclusive innovation can help in achieving the government goal of universal access to high-quality basic services in an efficient and sustainable basis. Countries must expand access to essential goods and services to extract significant returns from their most valuable assets—their people. The “*demographic dividend*”—a key ingredient for long-term success in many emerging economies—can be

achieved only when accompanied by reforms that enable working-age people to become economically productive. Indeed, in some regions where a high percentage of young people are at the BoP or otherwise economically excluded, theoretically favorable demographics (i.e., high ratios of working age to young and old populations) have been *negatively* correlated with growth.

Inclusive innovation programs promote efforts that enhance human *capabilities and productivity* thereby enabling more people to participate in economic development. Innovations that have drastically lowered the cost of health care treatments (e.g., jaundice treatments, prosthetics, surgery sterilizations, cataract surgeries) and preventative services (e.g., vaccines, immunizations, diagnostics, clean water systems) can introduce millions more to the workforce and make them far more productive members of it. Similarly, ultra low-cost pre-fabricated shelters and diffusion of knowledge in home construction and improvement can bring affordable, more stable housing to people whose homes are vulnerable to natural disasters and even everyday weather. Breakthroughs in rural-area financial intermediation have increased access to credit, while mobile phones, radios, and literacy-toolkits (computer based literacy system so powerful that an investment of US\$1.5 billion could raise literacy rates in Southeast Asia to OECD levels) have increased access to markets, skills and information.

Inclusive innovation can help accelerate progress in meeting the Millennium Development Goals (MDGs) by promoting the development, deployment and dissemination of low-cost health products for use by resource-poor people and in rural areas. For instance, under-five and infant mortality rates could improve significantly if the US\$25 non-electric Embrace incubator makes it to market and becomes readily available even in poorer and remote parts of the world.

Finally, governments commit considerable fiscal resources to programs designed to improve access to social services for the disadvantaged, with an increasing emphasis to expand the scope, coverage and quality of such programs, and to include more social groups.²³ However, given the huge number of BoP and fiscal constraints, social policies can achieve the universal and nationwide coverage with high-quality services only when innovative ways are adapted to ensure these programs are scalable and financially sustainable. That is precisely the objective of pursuing inclusive innovation, and government support for inclusive innovation can have a multiplier effect on increased access that direct purchases and investments cannot.

- (b) ***Increasing purchasing power and enhancing economic empowerment.*** Income inequality, even if reduced, will likely remain a persistent feature of even the most successful (and equitable) growth stories. Thus, any inclusive growth agenda must also directly address the quality of life affordable at very low income levels. Policymakers are rightly concerned about the purchasing power of the BoP, as evidenced by the uproar surrounding commodity and food price instability and inflation. But those issues present only limited opportunity for policy interventions because of their exogenous causes and the extremely large countervailing benefits of high growth and open markets.

²³Public policy, in medium and long term development and transformation of the Chinese economy—an international perspective (Chapter 7), by Edwin Lim, Ian Porter, Paul Romer and Michael Spence.

Inclusive innovation programs, on the other hand, can credibly help expand what even meager incomes can afford without altering or diluting pro-growth policies. What currently appears far from cost-effective for the private sector—and feats that seem impossible for the public sector given fiscal constraints—need not always be so. Applying current technology and know-how to targeted ends, and producing more of it for the precise purpose of lifting up the BoP, has already served millions across the globe. These programs invoke a return to the traditional case for innovation—its ability to produce break-through improvements in the quality of life—alongside its more recent place in development circles, where the primary focus has been enhancing national competitiveness and creating high paying jobs. Put simply, there must be a parallel track of development for the BoP that relies less on redistribution of gains, and more on the direct expansion of the bundle of goods and services against which we traditionally measure purchasing power—and at an ever-accelerating rate.

Consider for instance, the quality of life improvements that come with an affordable non-electric washing machine, a low-cost refrigerator, and non-essential but life-improving health care associated with “modern medicine.” Similarly, computer tablets, phones and radios provide entertainment, and allow excluded people to establish a more connected self-identity informed by participation in the larger national culture previously less accessible to them. Ultra low-cost hygiene products can make tough living conditions more manageable (and reduce the spread of disease). These products do not only make life more comfortable; they empower people. They facilitate economic activity and entrepreneurship by freeing up time, making labor more productive and improving health, and they dull the currently sharp distinctions between low-income and high-income people by increasing access to products that promote dignity, self-worth and identification with the broader society.

- (c) ***Reducing income inequality.*** The above efforts are the main focus of inclusive innovation, and complement current inclusive growth policies focused on reducing income inequality. Inclusive innovation programs can also help provide income-generating opportunities for BoP members—both as producers and consumers of inclusive innovations. With the right policies in place, the needs-driven innovation and creativity inherent in the BoP way of life can be brought to market, to the benefit of grassroots innovators (and society at large). At the same time, diffusion of knowledge to (and adaptation of products for use by) the resource-poor can enhance productivity, again improving earnings for BoP businesses, many of which are small, informal, and severely lag in their productivity potential. Take for example the previously discussed Money Maker Irrigation Pump, which increased incomes for low-income farmers by an average of US\$1,000 a year and has lifted almost a half-million people out of poverty.

In some countries, inclusive innovations can help build macro-economically significant industries and kick-start economic development. For example, the growing of medicinal and aromatic plants could be an attractive proposition to provide alternative means of livelihoods for the people of Afghanistan. This sector has high value-added potential by establishing thousands of small processing and distribution businesses, increasing the participation of women, increasing exports, and substituting domestic herbal medicines for expensive imported drugs.

The productivity enhancements made possible by some inclusive innovations can also help address stagnant income mobility, which remains an issue even in fast-growing emerging markets. Indeed, the probability of being stuck in a relatively low level of income has

increased in recent years in China.²⁴ Such trends have a multitude of causes, but persistent productivity dispersion demonstrates that producing and disseminating knowledge useful to the resource-poor remains one of several barriers to climbing the economic ladder.

Box 4: Inclusive Innovation- A tool in the public policy options basket

Some 40 percent of world's population (the BoP) lives on less than US\$2 per day. This BoP segment deserves good quality of life as the rest 60 percent do, because all life is important. To meet this challenge, nations need to provide affordable access to basic necessities of life (education, health, food, water, sanitation, etc.) to the BoP, and this has to be achieved despite the income inequality.

All the Governments want to achieve three objectives simultaneously and rapidly. First, improving the access to essential services. Second, increasing the purchasing power. And third, reducing the income inequality. But the progress has fallen well short of our aspirations.

Even today, several hundred million people go to bed hungry every night. Why? Nobel laureate Amartya Sen's research findings on Bengal famine (*Poverty and famines: an essay on entitlement and deprivation by Amartya Sen, Oxford University Press*) showed that the famine occurred not because there wasn't enough food grain; it occurred because people did not have money, or means, to buy it. Standard policies by the governments around the world are designed to increase the means of the poor --- be it through subsidies, entitlements, direct cash transfers and so on. These standard instruments help. But we need to go beyond 'means' and achieve the 'end', which is the quality of life. Further, we need to achieve not just 'growth' but 'inclusive growth' – and even more so, an 'accelerated inclusive growth'.

Such challenges can be met by taking, inter alia, recourse to 'inclusive innovation', which means affordable access of high quality products and services, which help create livelihood opportunities for excluded populations on a sustainable basis with a significant outreach.

In some way, 'inclusive innovation' will be good for the whole world, not just for the deprived world. A Hepatitis B vaccine that is 20 times cheaper, a high quality cataract eye surgery that is 100 times cheaper, a heart surgery that is 20 times cheaper look like dreams but they have been achieved through inclusive innovation. In all these cases, the quality of vaccine or surgery offered is as good (or even better) than what is offered in the developed world. So this is not just 'affordable access' but 'affordable excellence'. Can we imagine what impact such 'high quality affordable healthcare' can mean, not only for the poor but for the rich nations that are grappling with a significant proportion of their budgets being spent on exponentially rising healthcare costs!

To achieve the goal of true 'inclusive innovation', we will have to 'orchestrate' our actions not only on a national scale but at a global level. The orchestration will involve national governments, NGOs, private sector, research community, international development institutions, etc. Further not just technological innovations, but innovative combination of business model, workflow, system delivery and organizational innovations will have to be harnessed.

It is the synergistic combination of standard policies that the Governments currently use for including the economically excluded combined with 'inclusive innovation' that can help create a world, where we can make our dream of seeing a smile on the face of 7 billion people of the world come true, and sooner, rather than later.

IV. The Role of the Government: Building Alliances to Overcome Market Failures

25. **Though a multi-pronged innovation agenda addresses the needs of the BoP, it also has a more distinctly economic rationale: overcoming market failures which lower the output of inclusive innovations.** As challenging as market conditions may be, they do not adequately explain the limited scale and scope of pro-BoP products, and the limited commitments of resources devoted to inclusive innovation. Market failures unquestionably form part of the story, and should guide and justify public policy interventions:

²⁴Niny Khor and John Pencavel, 2010, "Evolution of income mobility, in the People's Republic of China: 1991–2002."

- (a) **Imperfect financial markets.** As with any innovative venture, risk permeates the inclusive innovation process. Risks can be higher or more difficult to quantify (i.e., more uncertain) in the context of inclusive innovation because of the drastic price-performance requirements involved, and the layering of risks from delivery and distribution (including consumer financing) challenges once a suitable product is developed.²⁵

In the context of risky ventures, not every positive net present value project receives funding. Financiers often avoid such projects, even when the payoffs, appropriately discounted by the risk (if known), are high. This problem is particularly acute when collateral (or hard, reasonably liquid assets even if they do not formally secure a loan) is unavailable, as the absence of collateral makes the chance of recovery in the event of a failure prohibitively small, and introduces prohibitively high costs of contracting and monitoring the efforts of innovators (to the extent their efforts are meaningfully observable at all). Unfortunately, these ventures offer little in the way of collateral, but have positive expected value, describe many innovative projects. Moreover, substitutes for collateral, such as reputation, legal enforcement, and observation of effort, are less available for many inclusive innovations, which are not necessarily driven by large, reputable, and sophisticated firms.

- (b) **Divergent social and investor risk appetites.** A related problem lies in mismatched appetites for risk: even if collateral (or appropriate substitutes for collateral) are available, many financiers simply will not undertake risky projects that are positive expected value if the probability of success is too low. Mechanisms which distribute risk across a wide range of investors mitigate this issue, but do not eliminate it, and introduce new inefficiencies in the form of higher agency and monitoring costs. The end result: projects which may succeed and produce huge social benefits are not undertaken – even assuming that those benefits can be fully captured by investors.
- (c) **Externalities inherent in any innovation.** The assumption that benefits from an investment can be fully captured fails in the context of many innovations, and more so for inclusive innovations. Innovations also produce public goods; that is to say, they produce knowledge, which is non-rivalrous and non-excludable. Intellectual property protections can help secure some, but not all, of the benefits of such knowledge for innovators, and, in any event, are insufficiently implemented in many parts of the world. The result, again, is an under-allocation of resources to innovative endeavors.
- (d) **Additional externalities from inclusive innovation.** Successfully deployed inclusive innovations produce other benefits in addition to knowledge that are not fully internalized by innovators. They promote economic development by improving access to essentials, raising productivity of resource-poor businesses, and decreasing barriers to entrepreneurship among

²⁵ A “more for less for many” strategy – more quantity and quality of goods and services, from less resources, for many people – often requires radical re-conceptions of existing business models, organizational structures, and product development, manufacturing and distribution processes. Slight changes to existing ways of doing business to serve the BoP do not always work—either the target is missed completely, or the end product are highly inferior in quality. To overcome that inertia requires initiative and investment, an acceptance of uncertainty, an appetite for risk—and considerably more experimentation and explanation to determine which pro-BoP business models work.

For example, lower-cost inputs do not explain why Indian telcos were able to introduce mobile phone service in India at a cost, orders of magnitude lower than in the USA. Rather, the telcos decided at the outset to adopt a high-volume low-cost strategy. That strategy prompted radically different decisions on when to “make or buy” than adopted by their Western counterparts, who dispersed the risk of up-front investments amongst various players involved in mobile service provision. The end-result was that service providers could charge rates far closer to the (ultra-low) marginal cost of adding a new user to a network, allowing cell phones to emerge as a powerful poverty-fighting and empowerment tool for the BoP, especially among ruralites in India.

the resource-poor. Benefits in social inclusion, and perceived social equity, enhance national well-being by satisfying people's desires to live in a more equitable society, by reducing the risk of disruptive social instability, and by increasing the likelihood that wealth-improving policies will be adopted (or reducing the likelihood that wealth-reducing policies induced by perceived unfairness will be adopted). Many inclusive innovations also take a "more from less for more" approach to delivering products, which allows a more acceptable trade-off between environmental damage and prosperity: extreme cost reductions generally involve extreme reductions in the use of resources and energy. It is worth noting that BoP, especially the rural population, is affected most from the adverse effects of poor climatic and environmental conditions.

- (e) **BoP market isolation: information asymmetries and innovation system failures.** BoP markets are currently small, poorly-served, dominated by the informal economy, unproductive relative to potential, and plagued by inefficiencies. Poorer people are often limited to goods and services that are more expensive and of lower quality—if they are available at all. Although the BoP market segment has substantial aggregate purchasing power (in the trillions of dollars), it is largely overlooked by more sophisticated firms, who generally focus on adapting traditional goods, services, business models, production and distribution processes for a lower price point by heavily compromising quality and performance. Most businesses have not yet succeeded in finding innovative approaches to creating and distributing low-cost high-quality products which individuals in this group can afford, and hence are unable to respond to the needs and demands of the disadvantaged or BoP segment in a profitable manner.
- (i) **Information asymmetry.** The problem is not one of businesses simply ignoring a latent market; BoP markets remain underdeveloped and harder to penetrate than traditional markets. Literacy, language, geographic separation (among other barriers) isolate many BoP, and burden the exchange of information (and physical goods) necessary for markets to function and develop in the first instance. So too does elite "capture" of sophisticated firms: though well-meaning, those in charge and otherwise participating in product development and marketing processes struggle to identify with, understand, and adequately serve people with whom they share little connection. Poor information flows are manifested in the reluctance and inability of consumers to try new products, and the ignorance of businesses with respect to the actual needs, environment and traditions of economically excluded people.²⁶

²⁶ Consider, for instance, some recent and very prominent pro-BoP products developed by large firms, which did not achieve desired scale because of, among other things, a basic lack of understanding of the needs and habits of the target consumer group. The Tata Nano, originally billed as a new "people's car" that would make auto ownership accessible to people of more moderate means, became a trendy second car for the more wealthy as the auto maker struggled to reach its target consumer. That consumer was disinclined to visit showrooms and trust new-age, seemingly "delicate" cars, and struggled to access standard bank financing (many prospective buyers were unsalaried). The "One Laptop Per Child" initiative faced similar problems; basic design of the PC and its software were poorly matched to local needs, cultures, and expectations, and the initiative was criticized for conceiving the billions-strong BoP as a monolithic group.

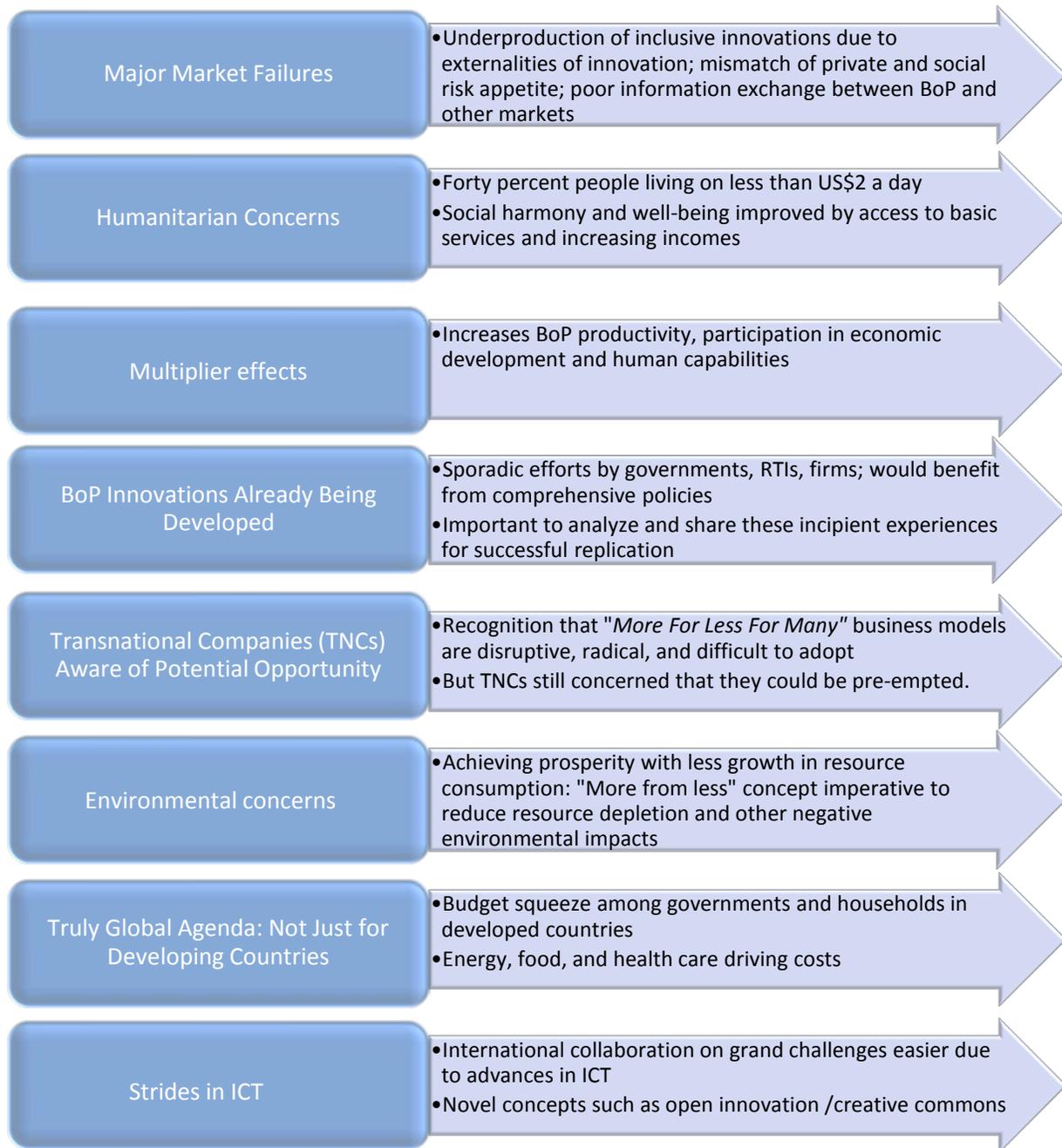
Though many critics allege that the problem was marketing failure—i.e., ambitious targets of a US\$2,000 car and a US\$100 laptop created lofty expectations that would not be met—in fact the problem was plain and simple market failure—poor information exchange between producers and consumers about their habits, traditions and living environment. The ambition to create new products aimed at the BoP should be celebrated: it spurs the radical thinking and changes needed to serve BoP markets, even if a few products miss targets along the way. Promoting and facilitating that information exchange can reduce such misfires in the future, and make sure that innovation—"the successful exploitation of a new idea"—truly runs from end-to-end (and addresses sales, delivery, marketing and financing, in addition to standard criteria for product design and development).

Thus, the information asymmetries at issue do not cause the kind of market-destroying opportunism behind problems like moral hazard and adverse selection. Rather, information exchanges between innovators (in industry, research institutions, and at home and abroad) and BoP populations remain so challenging that appropriate markets never launch in the first place. Producers of knowledge struggle to understand the needs of the BoP, resulting in an inability to identify opportunities to serve them, or to develop products that will be accepted by them. Similarly, BoP members, as repositories of traditional knowledge and needs-driven creativity, struggle to transform those assets into marketable products. Many of the failures regarding information exchange can be remedied by promoting the establishment of a well-functioning national innovation system that reaches the BoP, and treats its members as both consumers and producers of knowledge.

- (ii) **System failures.** A well-functioning innovation system generates incentives, builds competence, establishes platforms for experimentation, guides research, facilitates exchanges of information, articulates demand (and reduces uncertainty), and legitimates and promotes innovative endeavors. Networks are fundamental to innovation at all stages of the innovative process. Consider early-stage financing as an example: established networks of angel investors can more effectively syndicate (and disperse risk) to finance a risky venture, and can better match expertise and talent to merge technical skills, ownership, and control.²⁷ Currently, however, even highly sophisticated and well-formed innovation systems remain disinterested in inclusive innovation. But just like frontier and catch-up innovation, inclusive innovation also relies on strong networks of information, financing, technical expertise, and even social connections, to inform, incentivize, and guide the creative process, and to transform ideas into marketable products. Efforts to orient national innovation systems for inclusive innovation should increase the output and quality of inclusive innovations to a level more in line with the raw innovative capabilities of a country (i.e., its human capital, existing non-inclusive R&D infrastructure, and so on).

²⁷ Reduction of agency costs and merging skills, ownership, and control, explain why certain angel investors experience higher success rates than others. Indeed, cursory examinations of angel support for technology companies in the U.S. show that a 7x higher chance of success for a venture financed by a hands-on angel relative to ventures who use angels for financing only.

Figure 11: Drivers of an Inclusive Innovation Agenda



26. **To equip national innovation systems for inclusive innovation and overcome market failures, governments can facilitate the creation and enhancement of market-oriented alliances to tailor (and create) innovative products for unusual markets that balance the four A's: affordability, accessibility, availability and acceptability.** Inclusive innovations have been developed in both emerging and developed economies, but remain sporadic, operate on a limited scale and have a limited impact. A lack of systematic pro-BoP public policies has left too much of this work to be performed by philanthropists, rather than by those motivated by profit, even though many of these products could become very profitable. Governments can help create a self-sustainable system that

increases the volume of inclusive innovations, expands the market for low-cost and high-performance products, focuses resources and attention on the “resource poor or BoP” market segment, and makes the provision of products cheaper and more efficient, and thus more enjoyable by more and more people.

27. **Thus, public support should focus on the creation of a supportive ecosystem and related infrastructure to promote inclusive innovation.** Figure 12 illustrates the systemic functioning of the innovative process. But in many countries, the financing, intellectual property rights (IPR), and modes of skills, knowledge and technology transfers that strengthen the innovation chain and pave the path from ideas to products to markets simply are not present, particularly with respect to inclusive innovations. For example, the ecosystem that connects university research (which has produced many inclusive innovations) to markets is weak and does not penetrate the BoP in emerging economies. The constraints that hinder inclusive innovation also inhibit the diffusion of knowledge and the scaling-up of promising new products. Moreover, while an inclusive innovation agenda must promote new pro-BoP innovations, it must also scale-up innovations done in the ‘laboratories of life’–needs-driven “grassroots” achievements that remain isolated in scope, number and impact, but present promise if the inherent creativity of the resource-poor can be encouraged, accessed and successfully disseminated.

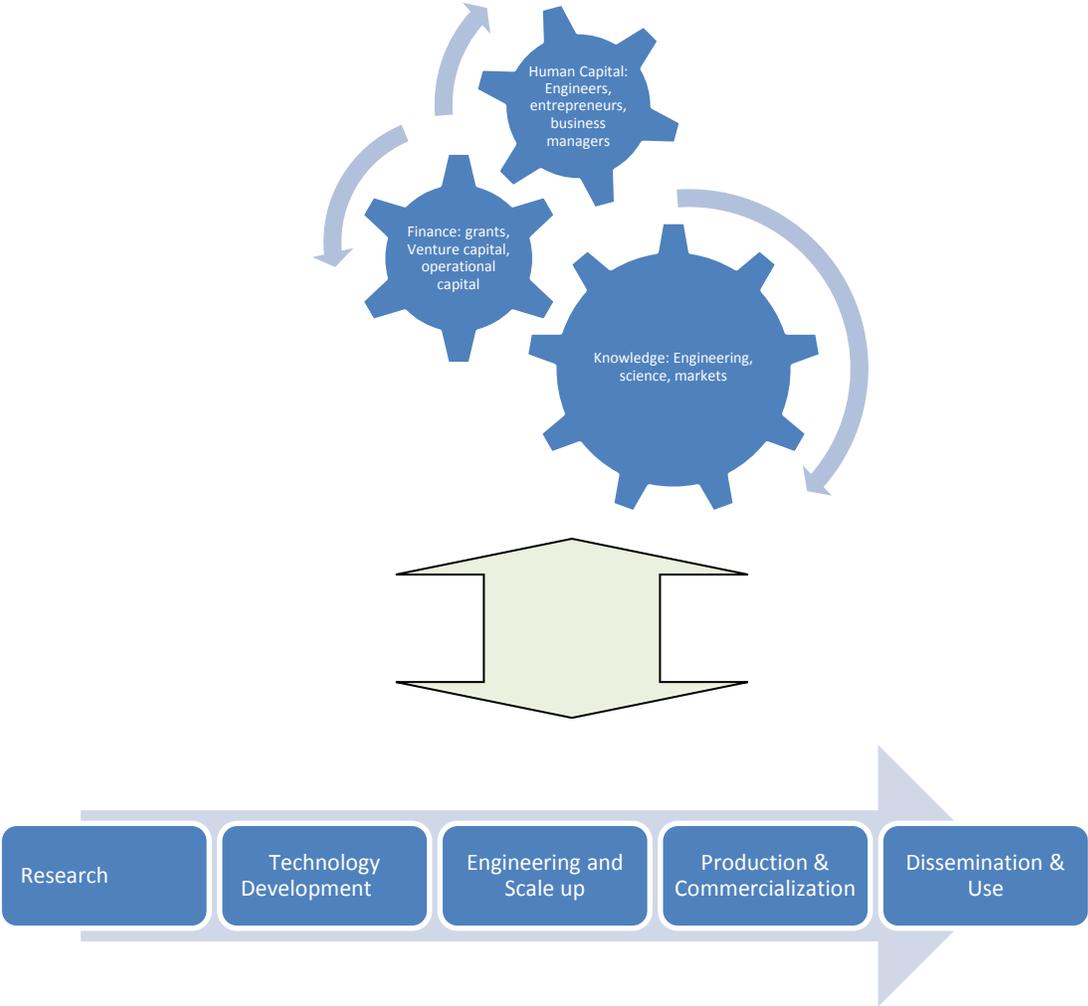
28. ***The Role of Public Policy.* Increased competition constitutes the most effective driver to stimulate innovation, but policy measures and innovation support mechanisms have an important role to play as well.** Public policy can enable fundamental investments and resource commitments to create a functioning innovation infrastructure that increases innovation output on a sustainable basis. Thus the main objective of innovation policy should be to create an innovation ecosystem that responds to the challenges of the 21st century, with a focus on inclusive growth. The ecosystem must be able to create, adopt, disseminate and scale-up pro-BoP innovations (including grassroots innovations) through incentives, value assessment, effective commercialization, use, financing, and pro-BoP IPR mechanisms. Due to the alliances necessary to serve the BoP markets, these policies must employ innovative public-private and global partnerships to leverage the strengths of each and develop, produce and distribute inclusive products on a wider scale and sustainable basis. The government’s major focus should be to facilitate, support, incentivize and leverage the strengths of all stakeholders in order to create sustainable inclusive solutions with significant outreach at maximum efficiency with least possible burden on the public resources.

29. **The term “inclusive innovation” can, and often is, interpreted in different ways:** (i) Innovation to make products and services more affordable, and to support their delivery to the poor. This category could also include innovations that address attributes other than cost, for example quality or transparency (in the case of public services); (ii) Innovation whose source lies in the informal sector, also referred to as “grassroots” innovation; and (iii) Innovation that increases the productivity of the BoP, or enables them to widen their income-generating abilities. While the BoP represents an important and untapped market opportunity, from a public policy perspective, the focus of inclusive innovation ought to be on income and productivity-generating opportunities, that will enable the BoP to increase their productivity, widen the range of income-generating activities they can participate in, and in that way enhancing their standard of living.

30. **Another important domain of inclusive innovation is that which helps generate (or preserve) public goods, whether local or global.** For example, the BoP often depend on environmental and ecosystem resources. Innovations that help maintain or enhance non-market

ecosystem services may play a particularly important function for the BoP; especially the rural poor, who have a stronger dependence on such local environmental and ecological resources than the urban middle-class. The economic rationale for supporting innovation that helps generate local (and global) public goods is particularly compelling. Poorer households have lower consumption because of lower purchasing power, and at times due to the lack of access. Policy interventions for access vis-à-vis affordability are likely to be different– for example, the latter might require direct income supplementation, whereas the former might require market creation or institutional change.

Figure 12: Functional Inputs and Innovation Stages



31. **Specifically, government policies should perform the following functions to address the points of weakness in inclusive innovation ecosystems:**

- (a) **Coordinate and provide financing, particularly early-stage financing and financing to scale-up proven products.** The segment of the innovative process where significant risk threatens to sink viable projects is longer in inclusive innovation because of the challenges of distribution, newness of markets, and adoption of products by BoP members. Thus, public support for financing may need to be present at later stages than in typical high-tech innovation. Indeed, several examples exist of promising, inclusive products that cost little to

make and serve vital functions, but have yet to be marketed to the resource-poor. Instead, they remain in a proof of concept stage, or get deployed for use as lifestyle items by more affluent consumers.

- (b) **Demand-side support.** As providers of essential goods and services – both through social welfare programs and in their traditional role as suppliers of public goods – governments remain uniquely equipped to collaborate with other actors in the innovation ecosystem to lower costs, improve quality, and improve access to essentials, including public services. Thus, they should consider limited direct support for innovations in areas like water provision, sanitation, electricity production and transmission, transportation, and other areas. Using instruments such as grand challenges, sponsored research, and procurement guarantees, governments can lend demand-side support to innovators, decreasing the risk and uncertainty of projects.
- (c) **Orient public research institutions (and non-public ones which use public funds) toward inclusive innovation.** Many countries sponsor or directly perform research in areas of national importance through state-run R&D labs and partnerships with universities. Programs directed at providing livelihood opportunities could result in the direct production of viable inclusive innovations, while also building capacity in these institutions for inclusive innovation, and promoting linkages with industry and BoP members that facilitate transfers of promising inclusive technologies. Similarly, a publically-supported Inclusive Innovation Academy – a think tank focused on amassing and disseminating information on BoP needs, potential solutions, and promising approaches to design and delivery of BoP products – could marshal a country’s academic resources in the numerous disciplines relevant to inclusive innovation.
- (d) **Promote grassroots innovation.** Grassroots innovators have important role to play in the inclusive innovation domain. They typically try to address a local problem or respond to specific resource constraint. Governments might consider establishing a central agency responsible for outreach to BoP grassroots innovators (e.g., India’s National Innovation Foundation); soliciting, documenting, and sorting through submitted innovations; marshalling assistance from technical experts to push promising ideas at least to a proof of concept phase; facilitating patent and licensing arrangements and generally coordinating technology transfers to interested parties.
- (e) **Jumpstart networks and facilitate collaboration across sectors.** In the long-run networks oriented around inclusive innovation should self-assemble. But the government can leverage its institutionalized connections to jumpstart an inclusive innovation ecosystem (or re-orient an existing innovation system for both inclusive and frontier innovation). For example, the government may create a high-level body like an Inclusive Innovation Council to interface with government agencies at all levels, as well as firms, labs, and universities. It can also promote agglomeration – another driver of innovation – through land use policies and the creation of parks and clusters geared towards inclusive innovation. Similarly, government sponsored inclusive innovation portals can streamline procedures and assist interested firms in securing available public support, and expose them to other relevant non-public initiatives.

Figure 13: Instruments to Promote Inclusive Innovation

Instruments to promote inclusive innovation						
Public Policy	Inclusive Innovation Council	Inclusive Innovation Academy	Inclusive Innovation Fund	Inclusive Innovation Centers	Inclusive Innovation Clusters	Innovation Portal

V. Other Agents and Their Roles

32. **A national inclusive innovation agenda should invite contributions from all stakeholders.** Well-designed public policy can create a supportive environment that incentivizes and equips all stakeholders to participate in inclusive innovation at their full potential. But an inclusive innovation system must rely heavily on contributions from the private sector (including the financial sector), the research and academic community, NGOs, and global partnerships – as well as the BoP population itself.

33. **Private Sector. Large companies can use their considerable technological, organizational and marketing capabilities to create and deliver products for the BoP people—and turn a profit for their efforts.**²⁸ They benefit from collaborations with other companies and R&D organizations. Low-cost surgeries, mobile phone services, agricultural equipment, automobiles and electronic devices are a few areas where firms have successfully developed pro-BoP products. In addition to standard research and development, these firms disrupted tried-and-true business models, modified organizational structures and created and sourced new capabilities. Their examples demonstrate that other companies can follow suit by establishing a clear vision, setting “stretch” targets, exercising entrepreneurial creativity within constraints, and focusing on people rather than short-term increases in shareholder value (with confidence that profits will come later).²⁹

34. **Smaller businesses and start-ups also have a role to play as suppliers and users of inclusive innovations, and as intermediaries facilitating exchanges between the large firms and the BOP.** These firms have been particularly successful in adapting existing technology and products to the BoP market. Small businesses that are often informal and highly unproductive may also adopt inclusive innovations to increase their incomes and lower prices for the mostly BoP consumers they serve. Small local firms also have powerful information advantages which enable them to facilitate the distribution of products, skills and information to resource-poor people. For example, this advantage has already been leveraged by India’s largest private sector bank ICICI, which uses local outfits for loan assessment and monitoring, while transferring risk to the broader financial system, thus increasing access to credit and other financial services in underserved areas.

35. **Universities and the R&D Community. In developing countries, academic and R&D institutions have a special responsibility to support inclusive growth and social equity.** Governments support them with the clear objective that their activities and programs benefit society

²⁸C. K. Prahalad, *The Fortune at the Bottom of the Pyramid*, 2004.

²⁹C.K. Prahalad and R.A. Mashelkar, *Harvard Business Review*, July-August 2010.

as a whole. As repositories of knowledge and given their immense research capabilities, these institutions must develop solutions for the BoP as they promote growth and competitiveness through “high-end” innovation. Indeed, universities may also benefit financially from inclusive innovation, just as they do with frontier innovation. Institutions should also recognize that inclusive innovation can serve core educational functions in ways that traditional innovation does not by promoting a diverse educational experience, merging multiple areas of study, and fostering greater participation in product design and development by more students.

36. **Global Partnerships.** International organizations and foreign governments can provide funding, technical assistance, technology transfer and capacity building to help generate, acquire, adapt, produce and disseminate inclusive innovations. They can also enhance innovation capability in developing countries through cooperation and twinning arrangements that strengthen local capacities to develop and implement inclusive innovation. International Finance Institutions (IFIs) like the World Bank should take the lead in promoting inclusive innovation agenda in developing countries in collaboration with other IFIs such as ADB, AfDB, IFAD, IDB, etc. They can leverage their convening power to bring IFIs, donors, philanthropists, patient capital, business, NGOs together and facilitate strategic partnerships. IFIs can also help promote and leverage global partnerships among the R&D community – from developing and developed countries alike. The Global Research Alliance (GRA) offers a good example of a global partnership amongst public R&D institutions from diverse countries such as India, South Africa, Australia, Germany, Finland, and the USA, which is now becoming a knowledge partner in the World Bank-supported inclusive innovation program in Vietnam and other countries.

37. **Importantly, developed countries should realize that they have a stake in this agenda as well.** Though inclusive innovation focuses on addressing the needs of the “resource poor,” it can also be useful for wealthier people in poor countries as well as people in developed countries. There is no reason that the US\$28 Jaipur Foot or the US\$25 Embrace Incubator cannot find demand in OECD countries—there is nothing inherently “poor” about these innovations. The key features of these innovations are that they are: (i) very low cost; (ii) created or invented with an eye on the needs of the BoP; and (iii) have performance characteristics that are roughly equal to or greater than the performance of more expensive products initially designed and invented for wealthier customers. Nowhere else are the successes of inclusive innovation more relevant to these nations than in the area of health care: not only does lack of access to health care describe a form of first-world exclusion, but the soaring cost of that care has become the single most important fiscal challenge facing the United States today. Global trade and competitiveness frameworks also have implication for inclusive innovation. For example, technology transfer has traditionally been framed in terms of technology maturing in the North, and then being transferred to the South. Inclusive innovation presents the possibility that in many instances the first point of market entry for technologies may well be in the global South.

38. **NGO Community.** The NGOs can promote development of inclusive products by raising and administering funds, identifying the needs and habits of the BoP and screening ideas and prototypes to determine their fitness and impact for BoP communities (information exchange function), and coordinating projects. Many NGOs are quite small but if they focus in the niche areas, their impact could be significant. NGOs could also play an advocacy role in bringing appropriate messages to the policy makers at different levels of the government.

39. ***The “Excluded,” “Resource-Poor,” and “BoP.”*** **Excluded and disadvantaged individuals must function as more than just users of inclusive innovations.** They must communicate their needs and problems in appropriate forums and work with the other stakeholders to ensure that the solutions created fit their needs and cultural traditions. They must also improve the diffusion of knowledge and skills (from BoP to outside firms and vice-versa) by interfacing with firms, NGOs and the research sector seeking to reach their communities. Moreover, many in the BoP are innovators themselves. Their “grassroots” efforts must be commercialized to maximize their impact (and provide income and incentives for further innovation).

CHAPTER 2. THE LANDSCAPE FOR INCLUSIVE INNOVATION IN CHINA

I. The Enabling Environment to Promote Inclusive Innovation in China

40. **China has a strong enabling environment for inclusive innovation.** Elements of the environment include: (i) the Government's commitment to create a harmonious society, reduce income disparities and improve access to basic services, providing sound motivation and fiscal resources to pursue inclusive innovation; (ii) a strong and nation-wide physical and ICT infrastructure, facilitating private sector and other actors to pursue inclusive innovation in underdeveloped areas; (iii) a well-developed innovation system, providing the knowledge base, human capital and research and development (R&D) capacity needed to promote inclusive innovation; (iv) a growing private sector with strong manufacturing and reverse innovation capabilities, providing the capacity to develop, produce and deploy low-cost high-performance products to reach BoP customers; (v) an enormous BoP market with huge potential purchasing power, providing new growth opportunity for the private sector and other actors to engage in inclusive innovation.

Government Commitment to Addressing Disparities

41. **Efforts to address disparities have been ongoing for over past two decades, with the government launching several policy initiatives for reducing poverty and bringing economic growth to under-developed regions.** In 1986, the central government initiated the China Poverty Alleviation Program, which targeted 592 designated poor counties, and revised the Program in 2001 to focus on over 148,000 villages.³⁰ From 2001 to 2007, on an average about 28 billion RMB has been provided annually by the central government for poverty alleviation programs.³¹ By the late 1990s, there was increased realization that non-coastal regions lagged behind the coastal region. As a response, the government initiated the "Western Development Strategy" in 1998,³² continuing with the "Plan on Revitalizing Northeast" in 2003, which invested billions of dollars in the under-developed western and northeastern regions.

42. **Recognizing the urgency to address the widening disparities, building a harmonious society has been placed on top of the government agenda in the 11th Five-Year Plan (2006-2010).** In September 2010 President Hu Jintao proposed an inclusive growth strategy aimed at reducing poverty, narrowing rural and urban income gap and promoting equal access to basic social services for urban and rural poor as well as migrant workers. The 12th Five-Year Plan (2011-2015) marks the shift of creed from 'pursuing economic growth' to 'sharing benefits of development by its all people', which is reflected in the key initiatives in different sectors, like social security, education, health, transportation infrastructure, sanitation and agriculture.

43. **Consequently, government spending related to broadening access to basic services has dramatically increased.** From 2005 to 2012, the central government spending in budget related to people's livelihood—agriculture, social security, education, health and affordable housing—has expanded from 507 billion RMB to about 2.6 trillion RMB. As such, government spending related to

³⁰ This is partly in recognition of the dispersed nature of poverty, and the fact that many of the poor did not live in the designated poor counties, and the designated poor counties also have many non-poor.

³¹ "From poor areas to poor people: China's evolving poverty reduction agenda- an assessment of poverty and inequality in China," World Bank report, 2008.

³² For an overview of China's Western Development Program, see Goodman, D. S. G. (Ed.) (2004), China's campaign to 'open up the West'—national, provincial and local perspectives, the China Quarterly special issues.

social welfare represents more than 40 percent of total government expenditure in budget in 2012, compared to 25 percent in 2005 (Table 7). With these efforts, significant progress has been achieved in reducing poverty and promoting equal access to basic services³³.

Table 7: Central government spending related to social welfare budget (RMB billion)

	2005	2006	2007	2008	2009	2010	2011	2012
Total central government spending on social welfare	507	608	836	1078	1425	1630	2081	2597
- Healthcare	8.3	13.8	66.4	83.2	118.1	138.9	172.8	203.5
- Education	38.4	53.6	107.6	156.2	198.1	216.0	296.4	378.1
- Social security and employment	162.4	201.0	230.3	276.2	335.1	358.2	441.4	575.1
- Affordable housing					49.3	99.3	129.3	211.8
- Agriculture and subsidies to rural farmers	297.5	339.7	431.8	562.5	725.3	818.3	1040.9	1228.7
Total budgeted central government spending	2025	2348	2687	3543	4386	4666	5436	6412
Government spending on social welfare as a % of total government spending	25.0	25.9	31.1	30.4	32.5	34.9	38.3	40.5

Source: http://www.gov.cn/2008lh/content_913007.htm, various central government budget reports.

44. **However, current government programs face the daunting challenge of expanding in scope, coverage, quality, and efficiency to sufficiently serve other disadvantaged groups, such as migrant workers.**³⁴ Fiscal and budget constraints will place a difficult hurdle for achieving universal and nation-wide coverage, absent innovative ways of making social services scalable, financially sustainable, and delivered in effective and efficient manner. That is precisely the rationale for pursuing inclusive innovation—leveraging fiscal expenditures to promote the development, deployment and dissemination of low-cost and high-performance solutions and thus expand essential social services at an affordable price to excluded populations.

Strong Physical and ICT Infrastructure

45. **China has strong nationwide physical and ICT infrastructure which facilitates BoP businesses, especially in underdeveloped areas.** Lack of infrastructure is a significant barrier keeping companies from entering the BoP market: as building infrastructure for BoP is a resource- and management-intensive task, few local entrepreneurs have the resources to create this infrastructure.³⁵ In China, however, strong government efforts have created most of the infrastructure needed for BoP business. For instance, 61.3 percent of villages are covered with solid roads, and rural households with access to electricity reached 97.4 percent by the end of 2009.³⁶ Significant progress has been achieved in providing universal access to ICT infrastructure. Most villages have access to broadcasting and TV, telephone, mobile networks and internet.³⁷ Alongside

³³ Between 1981 and 2008, the share of population earning below US\$1.25 a day fell from 84.0 percent to 13.1 percent and more than 600 million people were lifted out of poverty. The coverage rate at county level by the New Rural Cooperative Medical System has expanded from 21.7 percent in 2005 to 95.0 percent in 2011. Free compulsory education in rural areas which was implemented in 2006, achieved nationwide coverage in 2008. Benefitting from the national wastewater treatment project, the rural population with access to clean water has increased from 56.6 percent in 2005 to 84.7 percent in 2010.

³⁴ See Chapter 7: Public policy, in medium and long term development and transformation of the Chinese economy—an international perspective, by Edwin Lim, Ian porter, Paul Romer and Michael Spence.

³⁵ Prahalad & Hart, 2002.

³⁶ Source: Rural household fix-sited survey 2000-2009.

³⁷ The overall coverage of broadcasting and TV increased from 88.3 percent to 89.0 percent during 1998-2009. Nationwide, the villages with over 20 households with electricity access have been connected with broadcasting and TV by 2010. The administrative villages

the hardware infrastructure, government agencies and other actors have also established various rural information service stations to provide farmers with comprehensive, low-cost and accessible information services.³⁸ The presence of such infrastructure facilitates widespread adoption of ICT based inclusive innovation products and services. For instance, rural farmers could make a phone call and access internet to acquire agricultural, market, and technical information through rural information hotlines and platforms launched by local governments, thus improving agricultural productivity and raising farmers' income.

Well-Developed National Innovation System

46. **China has excelled in mobilizing resources for science and technology on an unprecedented scale and with exceptional speed, which provides the huge potential and capability for inclusive innovation.** China has main components of a national innovation system for pursuing inclusive innovation, including strong public sector institutions, universities, research institutes, enterprises, financing mechanisms, (Box 5). If oriented towards inclusion, the existing innovation system could also be deployed to work on the needs and problems of the excluded population. For example, two institutes of the Chinese Academy of Sciences (CAS)–Shenzhen Institute of Advanced Technology and Technical Institute of Physics and Chemistry– are already working on developing low-cost medical solutions for rural areas. These endeavors can benefit from the considerable intellectual capital the Chinese innovation system possesses that could be potentially deployed to work on the technological problems of the excluded.

Box 5: Key Actors of the Chinese National Innovation System

The Chinese government plays an important role in providing a favorable environment for innovation and offering stable resources for certain areas of research. The central government initiated some S&T programs to support the most important basic research (Table 18). The National Natural Science Foundation is an important tool leveraged by the government to promote basic research in various areas. Companies are allowed tax deduction for 150 percent of their R&D expenditure.

The higher education system in China has expanded considerably during the last decade from 1,054 institutions of higher education in 1995 to 2,358 in 2010. With almost 700 higher education institutes involved in R&D, a few of these, such as Tsinghua University, enjoy international reputation as major research-oriented universities. Compared to their counterparts in other countries, Chinese universities have two main distinctive features: a greater relative number of enrollments in science and engineering disciplines, which provide a larger base for related research activities; and a strong orientation towards applied research. Over the last decade, Chinese universities have become the fundamental knowledge source and the key bridge in industry-science linkage.

Public research institutes play a key role in supporting basic and strategic research, as well as mission-oriented research, mainly in natural sciences and high-technology-related disciplines. The Chinese Academy of Sciences, the country's most prestigious research institution network, is the national academy for the natural sciences of the country.³⁹ The China Academy of Agriculture Research also has a wide spread network on R&D institutions.

Businesses have become active R&D players, now performing over 70 percent of total R&D activities (with 17 percent by foreign firms), up from under 40 percent in 1990. At the same time, the share of public research institutes engaged in R&D has declined from almost half of total to less than one-quarter over the same period (Table 9).

Source: OECD Review of Innovation Policy: China (2007)

with telephone access have increased from 89.2 percent in 2004 to 100 percent by 2010; it grew to 94 percent for villages with more than 20 households. The proportion of towns connecting with internet has risen to 99.3 percent, and 91.5 percent for administrative villages by 2009. Source: Rural household fix-sited survey, 2000-2009.

³⁸For instance, led by Ministry of Industrial and Information Technology (MIIT) and Ministry of Science and Technology (MOST), 11,724 county-level and 107,695 village-level information service stations were established by 2011. Jointed with local governments, China Mobile and China Telecom established 118,000 and 180,000 rural information service stations by 2011. As a result, each county and administrative village could be covered by the information services stations.

³⁹The CAS, headquartered in Beijing with institutes all over the country, with over 50,000 staff has 12 branch offices, 117 institutes, more than 100 national laboratories and national engineering research centers, and some 1,000 field stations throughout the country. These CAS branches and offices are located in 20 provinces and municipalities throughout China. CAS has invested in or created over 430 science- and technology-based enterprises in eleven industries including eight companies listed on the stock exchanges.

Table 8: National S&T programs, million RMB, 2005-2010

Programs	2005	2006	2007	2008	2009	2010
973 basic research	983	1,354	1,645	1,900	2,600	4,000
Key technologies R&D program	1,624	2,888	5,423	5,066	5,000	5,000
Torch program	70	108	139	152	228	220
Spark program (1988 for rural SME)	117	102	150	200	219	200

Source: China Statistical Yearbook on Science and Technology, 2011.

Table 9: R&D expenditures of different actors, billion RMB, 2005-2010

Sectors	2005	2006	2007	2008	2009	2010
R&D Institutes	51.3	56.7	68.8	81.1	99.6	118.6
Universities	24.2	27.7	31.5	39	46.8	59.7
Enterprises	163.0	213.5	268.2	338.2	424.9	518.5
Large and Medium-sized Enterprises	125	163	211.2	268.1	321	401.5

Source: China Statistical Yearbook on Science and Technology, 2011.

47. **China is now a major S&T player with R&D spending increasing by over 20 percent annually since 2005 and reaching US\$112 billion in 2010.**⁴⁰ The R&D input/GDP ratio has more than doubled in a decade and reached 1.76 percent in 2010 (Table 10). China ranks second in the world after the United States in the number of researchers. A total of 218 national priority labs cover all the major basic science fields. Continuous improvement of national innovation system has resulted in a rapid increase of innovation outcome. For instance, China now stands at 2nd place in terms of scientific research publications and 1st place in term of patent applications by residents (Table 11).

Table 10: China's R&D input and output, 2005-2010

	2005	2006	2007	2008	2009	2010
R&D Expenditure (US\$ billion)	38.7	47.5	58.5	73.0	91.8	111.7
R&D Expenditure as % of GDP	1.32	1.39	1.4	1.47	1.7	1.76
Growth rate of R&D (%)	24.6	22.6	23.5	24.4	25.7	21.7
R&D personnel- full-time equivalent (000)	136.5	150.2	173.6	196.5	229.1	255.4
Number of PhD graduates (000)	27.68	36.25	41.46	43.76	48.66	48.99
Domestic patent applications accepted (000)	38.32	47.03	58.65	71.71	87.76	110.94
Domestic patents granted (000)	17.16	22.39	30.16	35.24	50.18	74.06
International patent applications (000)	17.33	21.05	24.52	28.98	31.46	39.12
International patent granted (000)	5.33	5.78	6.79	9.37	12.84	13.51
No of papers by Chinese scientists and technicians taken by SCI (000)	63.15	71.18	79.67	95.51	108.81	

Source: China Statistical Yearbook on Science and Technology, 2006-2011; World Intellectual Property Indicators, 2006-2011.

⁴⁰ Worldwide spending on R&D amounted to US\$1.1 trillion in 2007 with spending by Asian countries surpassing that of the EU and approaching that of the USA (NAS 2011: <http://www.nsf.gov/statistics/seind10/pdf/seind10.pdf>)

Table 11: Key education, technology and innovation indicators in selected countries

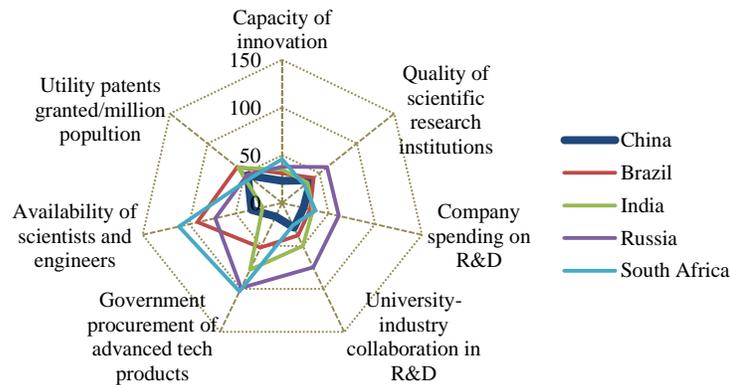
Indicator	India	China	Korea, Rep. of	Brazil	Russian Federation	United States	Japan	South Africa
Resident patent applications, 2010 (000)	7.26	293.07	131.81	2.71	28.72	241.98	290.08	0.82
No of scientific & technical articles, 2009 (000)	19.92	74.02	22.27	12.31	14.02	208.60	49.63	2.86
Current expenditure on education, 2009 (% GNI)	3.07	1.8	3.94	4.82	3.54	4.79	3.19	5.43
School life expectancy, 2009 (years)	10.83	11.72	16.99	14.02	14.26	16.76	15.21	
Pupil-teacher ratio, secondary	32.70	15.46	17.98	17.14	8.47	13.76	11.97	25.05
Tertiary enrollment, 2009 (% gross)	16.23	25.95		36.07	75.89	94.81	59.02	
Researchers, headcounts /million people, 2008	137	1,071	6,286	1,100	2,581	4,663	7,038	821
Gross expenditure on R&D, 2009 (% of GDP)	0.76	1.70	3.36	1.08	1.25	2.79	3.45	0.93
Quality of scientific research institutions, 2011 (1=very poor; 7= best in their field internationally)	4.51	4.31	4.82	4.14	3.84	5.83	5.54	4.67
University/industry research collaboration, 2011 (1= do not collaborate; 7= collaborate extensively)	3.82	4.53	4.66	4.20	3.49	5.71	5.06	4.62
Number of venture capital deals/tr PPP\$ GDP, 2011	51.0	32.3	45.6	10.0	7.2	243.3	6.4	16.2
Domestic resident patent application/bn PPP\$ GDP, 2010	1.99	28.96	89.90	1.24	13.01	16.66	67.1	1.56
Number of scientific & technical articles, 2009 (per bn PPP\$ GDP)	5.47	8.16	16.31	6.14	6.61	14.97	12.1	5.67
Number of domestic trademark registrations /bn PPP\$ GDP		119.71	32.95	21.93	28.81	11.25		65.53
High-technology net exports as share of total net exports, 2010 (%)	4.84	30.06	24.04	3.57	1.35	14.76	16.2	2.16

Source: The Global Innovation Index, 2012; World Development Indicators, 2012

48. **China leads the BRICS countries in STI capacity and is catching up fast with OECD countries.** With a comprehensive national innovation system, China ranked 29th in innovation index and was top ranking among BRICS in key innovation indicators (Figure 14). Indeed China has made tremendous efforts to mobilize its S&T human resources in order to upgrade the technological level of its economy, and has become a key player in the global competition for talent (Table 12). Moreover, the STI supporting entities like consulting company, information service business and Venture Capital, etc., are booming as well. Besides basic research, China is rising also in industrial R&D- 5 out of top 15 firms from emerging economies in terms of R&D investment are from China (2011).⁴¹

⁴¹ Source: Monitoring Industrial Research: The 2011 EU Industrial R&D Scoreboard, European Commission (2011), and OECD Science, Technology and Industry Outlook, OECD (2012).

Figure 14: Ranking of BIRCS countries in the innovation index



Source: The Global Competitiveness Report, 2011-2012, World Economic Forum

Rapidly Growing Private Sector with Strong Manufacturing Capability

49. **China’s private sector is increasing its presence in the national innovation system, which provides a solid basis for businesses to pursue inclusive innovation.** Official estimates indicate that the number of S&T-based private firms⁴² increased from just 7,000 in 1986 to 150,000 in 2006. Among large and medium-sized industrial enterprises, R&D expenditures by private enterprises were only 10.5 billion RMB in 2006, 63 percent of that of state-owned enterprises (SOEs), but increased to 41.3 billion RMB in 2010, and exceeded that of SOEs in 2010 (Table 12). Furthermore, the number of domestic invention patent applications of large and medium-sized Chinese private industrial enterprises dramatically increased from 1,885 in 2006 to 8,659 in 2010.⁴³ Many Chinese private firms are catching up in technological capabilities, and some are approaching the international technological frontier, such as Huawei and ZTE in the ICT industry, Suntech Power in solar technologies, and Dalian Machine Tool Group in engineering.

Table 12: R&D expenditure of large and medium sized enterprises, billion RMB, 2006-2010

	2006	2007	2008	2009	2010
State owned enterprises	16.5	18.2	26.9	32.2	39.2
Private enterprises	10.5	14.8	23.4	32.2	41.3
Foreign owned enterprises	44.4	61.5	72.9	86.7	104.8

Source: China Statistical Yearbook, 2011

50. **China possesses immense capacity for producing low-cost and high-performance physical products, led by its strong manufacturing capabilities and the availability of a low-cost and high-quality labor force.** The integration of the low-cost manufacturing capability with the R&D capacity provides possibilities to co-create inclusive innovation. Inclusive innovation needs to break the mass production process involving sophisticated machinery, extensive automation and high capital expenditure, and radically re-combine it to better suit the needs of the BoP and characteristics of the local resources. A growing number of private firms are now targeting and successful tapping into the BoP market to reach BoP customers. Those enterprises that are close to the BoP have a natural advantage in understanding the needs of BoP and identifying business opportunities. Credit

⁴²By official count S&T-based private firm is defined as private firm that focused on technology acquisition, technology transfer and industrialization, with certain amount of expenditure on R&D and R&D personnel, and should have certain S&T outputs and results such as patents and new products.

⁴³China statistical yearbook, 2011.

Ease in financial sector, Haier in home appliances industry, and Tsinghua Solar in energy sector, are some successful examples. Many local champions have at their core an innovative business model that taps the pool of low-cost manufacturing capability instead of relying on automation to provide low-cost solution. For example, BYD broke the automation production line of battery manufacturing to half automation and half labor-intensive processes, thus driving down the prices of batteries dramatically, enabling low-cost battery solutions for those products that need battery as key component.

A Large BoP Market with Rising Aspirations and Purchasing Power

51. **China has an enormous BoP market with rising aspirations huge potential purchasing power.** Measured by income of US\$1.25 per day (2005 PPP), there were 173 million people living below the poverty line in 2005 in China and if measured by US\$2 per day (2005 PPP), the number of BoP stand at 394.6 million. By either criterion, China is currently the second largest national concentration of BoP after India, and represents more than 13 percent of the global BoPs.⁴⁴ BoPs in China are concentrated in rural areas.⁴⁵ Furthermore, some 250 million rural migrant workers represent another important excluded group. While large number of rural workers have migrated and settled in the cities, they fare considerably worse than local residents (due to household registration (hukou) system) in nearly all non-income measures of welfare, including the quality and costs of housing, access to education, and access to social assistance programs.

52. **The BoP market in China is also growing as its members consume more, demonstrating the huge potential for inclusive innovation.** From 2005-2010, consumption expenditure of low income rural households has increased from 1,548 RMB to 2,535 RMB. As incomes rises, the share spent on food declines, while the shares for transportation and telecommunications, household facilities and health services grow rapidly. The large BoP market (with rising aspirations and increasing purchasing power) provides a new growth opportunity for the private sector to engage in inclusive innovation to expand scale, reduce costs, and improve quality of products. The BoP markets can also provide companies with increased understanding of issues and needs that companies can help address. Once firms approach this market focusing on the BoP consumers' interests and demands, it can foster competition, and enhance competitiveness leading to significant growth of the sector due to large profits. It is not only BoP – but the 'new billion' market as new consumers with rising incomes emerging from BoP (with aspirations for high quality products) that will be the consumers of inclusive innovation based products and services.

II. The Status of Inclusive Innovation Programs and Initiatives in China

Government Programs and Initiatives

53. **The Chinese government has made concerted efforts to foster the creation and dissemination of innovations relevant to the rural population.** A prime example is the Spark Program, which was launched in 1986 and aimed at diffusing advanced and applied technology for development of agriculture and rural areas (Box 6). The Spark program alone has had an average of

⁴⁴ This does not include some disadvantaged groups that have a higher income but lack access to basic necessities of life, such as clean water and sanitation service, affordable housing, quality education, health care and modern financial services.

⁴⁵ According to a recent World Bank assessment (World Bank report, 2009, "From poor areas to poor people, China's evolving poverty reduction agenda"), estimated by the income level using the World Bank poverty line of 888 (1124) RMB per person per year at 2003 rural (urban) prices, 93.3 percent of the BoPs are in rural areas, 5.9 percent are migrants working in urban areas for six months or more a year, 0.8 percent urban residents.

150 million RMB (or US\$23.7 million) funding earmarked by the central government in the past consecutive five years. Programs and initiatives were also launched for the healthcare sector in the later 1990s to diffuse practical technology to rural hospitals and clinics. Recognizing the large gap between rural and urban area in utilizing information technology, various distance education and e-health programs were initiated by the government from the early 2000s to channel superior medical and educational resources to the countryside.

Box 6: Spark Program in China

The Spark program was initiated by the Ministry of Science and Technology (MOST) in 1986 and soon spread to virtually every province all around China. Its name came from the Chinese proverb “A single spark can start a prairie fire,” meaning that the spark of science and technology will extend over the vast rural areas of China. The primary objective was to help transfer and diffuse technology and knowledge to rural areas and thus stimulate the development of local agricultural and other industries and benefit the rural farmers and rural households.

The development of the Spark program went through three stages. Before 1994, the Spark program mainly focused on supporting town and village enterprises (TVEs) through grant funds, technology training to the farmers, and solving of local technology problems using know-how from research institutes. Several dramatic changes happened around 1994, when the main funding for Spark programs started coming through bank loans and capital raised by participants, and not from government agencies, and the program began to support private enterprises and rural entrepreneurs. Also, local governments started playing a leading role in selecting, implementing and supporting the programs. In recent years, the range of the Spark program has become quite comprehensive. Some newly launched projects are granted funding by the Spark program, including promoting rural ICT, promoting the rural science and technology commissioner projects, providing technological training to rural farmers and entrepreneurs, supporting the establishment of rural technology parks and rural industrial cluster, promoting the creation and dissemination of technology for the poor, and so on.

During the “11th Five-year” period (2006-2010), 57,000 projects were established, with a total investment of about RMB 194 billion. The program once accounted for a high percentage of the government’s expenditure on R&D in the late 1980s and early 1990s, but in recent years, the central government provides only a small fraction (an average of 150 million RMB) to support some major projects, which are usually recommended by the local Ministry of Agriculture (MOA) and local Ministry of Science and Technology and decided by the central MOST. Although the local governments provide some matching funds, most of the capital raised for the programs comes from the banks and private enterprises.

Source: Unleashing India's Innovation: Toward Sustainable and Inclusive Growth (chapter 4), edited by Mark A. Dutz, World Bank, 2007; interview with China Rural Technology Development Center, MOST.

54. **As building a harmonious society has been placed on top of the agenda of the Chinese government, more efforts have been devoted in promoting innovation concerning to the excluded.** During the 11th FYP, various programs covering a wide range of sectors including sanitation, health, education, transport, energy, ecological environment, were launched to serve excluded populations (Table 13). Strengthening technology development for improving livelihoods has been assigned a featured role in the 12th FYP on National Scientific and Technology Development (2011-2015). Some of the defined priority areas are strongly related to inclusive innovation, including strengthening the promotion and diffusion of agricultural technology and developing national IT health system.

Table 13: Various government programs aimed at promoting innovation for the excluded

Sector	Champions	Year Initiated	Initiatives	Practices
Health care	MOST, MOH	2008	<ul style="list-style-type: none"> Organizing the regional coordinated distance Health IT Initiative 	<ul style="list-style-type: none"> Deep brain stimulation for Parkinson’s Disease; Multi-slice spiral CT; automatic biochemical analyzer; electrical impedance tomography
Sanitation, Ecological, and environment	MOST, MEP	2006	<ul style="list-style-type: none"> Drinking water purification technology Air pollution control technology Recycling of waste electronics 	<ul style="list-style-type: none"> Purification catalyst for auto exhaust gas
Education	MOST, MOE	2006	<ul style="list-style-type: none"> Pilot project for Public Education by Utilizing Digital Education 	<ul style="list-style-type: none"> Building a public education platform for a life-long learning society
Energy	MOF, MOST, NEA	2009	<ul style="list-style-type: none"> Golden Sun Program - building photovoltaic power plants in remote area without electricity access 	<ul style="list-style-type: none"> The Program covers Gansu, Qinghai, Tibet, Xinjiang, Inner Mongolia, Hunan and Yunnan with a total installed capacity 31,095 KW
Agriculture	MOST, MOA	2009	<ul style="list-style-type: none"> S&T special commissioner to create start-ups with farmers in the countryside 	<ul style="list-style-type: none"> More than 170,000 special commissioners sent to counties across the country
Agriculture	MOST	2006	<ul style="list-style-type: none"> National S&T project for increasing crops yields 	<ul style="list-style-type: none"> Additional yields totaled 48 million tons in the 11th FYP
ICT	MOST, MIIT	2010	<ul style="list-style-type: none"> Rural ICT access in Shandong and Hunan province 	<ul style="list-style-type: none"> Building a provincial-level ICT platform to provide comprehensive rural services

MEP—Ministry of Environment Protection; MIIT—Ministry of Industry and Information Technology; MOA—Ministry of Agriculture; MOF—Ministry of Finance; MOH—Ministry of Health; MOST—Ministry of Science and Technology; Ministry of Education, NEA—National Energy Administration

Source: Authors’ summary based on MOST news briefings on strengthening technology development for improving people’s livelihood.

55. **The government has mobilized public funding to support innovation for the excluded, including grants targeted at basic research and funding devoted to the commercialization and diffusion of innovation.** For example, at least 200 million RMB of government funding (which is the main funding sources) were granted to support the biology, medical and health engineering departments in Shenzhen Institute of Advanced Technology (SIAT) for the research on low-cost medical services in 2010. Meanwhile, the government is gradually transforming from being the sole funding provider towards a model that induces private sector investment in specific areas. For example, in 2010, while the agricultural technology commercialization fund received an investment of 493 million RMB from the central government and a matching fund of 89 million RMB from local government, it has also successfully attracted 2,836 million RMB of capital from banks and private enterprises.

56. **Fiscal policy has also promoted the private sector’s entry into BoP markets.** For instance, a policy called “selling home appliances to the countryside” was launched in 2007. The program offers 13 percent subsidy for rural residents to buy TV, refrigerator, cell phones and other home appliances. The central government contributes 80 percent of the amount of total subsidy and the provincial government contributes the rest. In 2010, 77.18 million sets of subsidized products were sold in the countryside, with a total value of 173.23 billion RMB. Refrigerator and TV rank top

and take up 61 percent of total sales value.⁴⁶ Due to the subsidy program, products with features of inclusive innovation like low-cost solar heating equipment are now penetrating into the rural market and thus becoming accessible to BoP. In 2010, some 3,000 companies with 3 million employees were working on the solar industry, which resulted in a total turnover of solar thermal products of around 600 million RMB.

57. **The Chinese government usually partners with local enterprises (mostly SOEs) in implementing inclusive innovation programs.** The Information Network Platform for Rural Area (INPRA) program provides a successful example for cooperation between the government and the enterprises. The program was first initiated in 2004 by the Ministry of Industry and Information Technology (MII) and the Ministry of Agriculture (MOA), with the purpose of improving farmers' access to information technology. The ministries formed a partnership with China Mobile and both actors were assigned tasks and responsibilities taking into account their competencies and resources advantages so as to create a clear rationale for their cooperation. By the end of 2008, the INPRA cover 97.35 percent of the rural areas and the users of INPRA exceeded 40.36 million. The business turned profitable in 2009, despite the large initial investment of 19.5 billion RMB.⁴⁷

58. **The government also plays the role of coordinator to foster and facilitate the collaboration between firms and research labs of universities.** A typical example is the rural science and technology commissioner project initiated by the MOST and MOA. Under the program, the government incentivizes experts, professors, researchers and PhDs to the countryside to commercialize their innovations, and build agricultural technology parks.. In this way, the science and technology commissioner mobilized by the government serves as intermediary between research institutes and enterprise, thus facilitating close linkage between research and production. The rural science and technology commissioner project started in Nanping City, Fujian Province in 1998 rapidly spread nationwide in early 2000s. By the end of 2011, there were about 170,000 science and technology commissioners nationwide who had benefited over 50 million rural households.⁴⁸

59. **The government also supports technology parks and business incubators to produce and commercialize innovations.** Various agricultural science and technology parks have been established to promote the industrialization and commercialization of agricultural innovation. They are the showcase creation and synthesis of agricultural technology, transformation caused by technology achievements, and modern agricultural production. These parks combine technologies and capital, and spur agricultural production by attracting leading agricultural enterprises to organize farmers to engage in high-value production. For example, an Agricultural Technology Park was built in 2009 in Tianjin suburb with initial investment of 150 million RMB, coming from capitalizing on the real estate boom by the village. This Park aims to build a platform to attract leading agricultural enterprises to organize rural farmers to engage in high-value production of mushrooms. While the Park provides land and plants, the enterprises with modern agricultural technology are brought in to promote the industrialization and commercialization of agricultural innovation.

60. **In addition, government procurement has been used to elicit a supply response to promote inclusive innovation.** During the past years, the scope and scale of public service

⁴⁶ Various websites of government agencies, http://www.gov.cn/gzdt/2011-01/05/content_1778858.htm
http://www.moa.gov.cn/ztl/lsczc/201103/t20110325_1955090.htm

⁴⁷ Genia Kostka and Jianghua Zhou, "Entering China's low-income market: success factors for multiple-actor- partnerships," Working Paper, 2012.

⁴⁸ http://www.most.gov.cn/ztl/qgkjtpygz/kjtpxdxal/200911/t20091102_73947.htm; presentation materials by Jia Jingdun, Director General of China Rural Technology Development Center.

purchasing in China has dramatically expanded.⁴⁹ As a result, some products related to inclusive innovation have been brought into the government procurement schemes. For instance, in provinces like Shanxi, Hubei and Shenzhen, the multi-functional diagnostic bed for village clinics that was invented by Shenzhen Institute of Advanced Technology has been introduced into the government procurement list for community health service equipments. The “first buy” scheme guarantees bulk purchase thus making it attractive for private sector to produce inclusive innovation products. In April 2009, Changshu municipal government contracted with Jiangsu Loongson Menglan Technology Company to purchase 10,000 sets of low cost Loongson computers⁵⁰ for digital classroom of middle and primary school. Subsequently, under the funding supporting from MOST, MOF and MOA, Jiangsu provincial government plans to spend 350 million RMB to purchase 150,000 sets of computers, which would be used for multimedia teaching in local rural schools.

University and Research Institute Initiatives

61. **In China, research institutes and universities have played important role to support inclusive innovation.** As important performers of R&D and repositories of knowledge their strong research capabilities enable them to provide suitable technology required by inclusive innovation. For example, the Tsinghua Green Leap Research Center was founded in 2009 jointly with Cornell University, USA, to act as a node of international BoP network to promote research on BoP in China. The Chinese Academy of Sciences has listed the low-cost medical system as one of the strategic items in its ambitious plan of ‘Innovation 2020.’ Over 30 research institutes affiliated with the CAS have been involved in the study of medical equipment and health services, especially for Shenzhen Institute of Advanced Technology, Suzhou Institute of Biochemical Engineering and Technology, and Shanghai Advanced Research Institute who devoted themselves to the research on low-cost medical services (Box 6). Thanks to the indigenous medical chip developed by the SIAT, the prices of diagnosis and monitoring equipments installed in the rural clinics are down dramatically. For example, the multi-function diagnostic bed costs 35,000 RMB (US\$5,500), while the imported examination equipment applied in the big hospitals can be as high as ten million RMB. However, the program is operated mostly by SOEs and these costs could be further reduced by active participation of the private sector.

62. **At the same time, universities and research institutes also benefit from inclusive innovation.** For example, SIAT has been granted over 80 patents in low-cost medical equipment, and has become an important actor in this industry. Participating in inclusive innovation gives SIAT a good reputation. The Natural Science Foundation Committee (NSFC) funded one project related to inclusive innovation since 2009, and the Ministry of Education, and the National Social Science Committee (SSFC) also began funding similar projects since 2009. Furthermore, the practice of inclusive innovation can provide diverse educational experience. For example, Credit Ease was selected as the case for Chinese MBA Case Competition in 2009 and 2010.

63. **Furthermore, China has created a large public agricultural research system, including 1,237 agricultural R&D institutes and 888 agricultural universities or technology colleges.** The agricultural research system covers a wide range of areas to develop new species of crop varieties

⁴⁹ Among others, the public service purchasing now cover breed and agricultural machinery, essential drugs and vaccines, textbooks, and cloud computing.

⁵⁰ The Loongson computer, originally invented by the Institute of Computing Technology of the CAS, was praised as a “CPU for the poor” on its merits of low cost and low power consumption. The first batch of low-cost PC priced at 1,599 RMB (about US\$250) in 2006, and the 12 inch laptop on trial costs only 2,000 RMB, based on low-cost Longson-2E CPU that are invented by the Institute of Computing Technology.

that could enhance the productivity of small rural households (Box 7). For example, Super-hybridization rice and dwarfing-sterile wheat have been cultivated. The experiment on high yield breeding has given successful results and has been adopted by farmers. The adoption of advanced technologies has led to increased efficiency of production. For example, since disease-free sweet potatoes based on tissue cultivation technology were planted in 50,000 hectares in Shandong province, China, the production has increased 30 percent-40 percent.

Box 7: Low-Cost “Marine Terminal” Suitable for Village Clinics

The “marine terminal” developed by Shenzhen Institute of Advanced Technology have two main components: a portable diagnostic bag and a multi-function diagnostic bed. The **portable diagnostic bag** is also called multi-parameter physical check-up bag; it is suitable for rural and pastoral regions where people are sparsely distributed. It can perform 7-lead EKG test, conduct 11 types of urine analyses, measure blood pressure and blood oxygen, monitor breathing, temperature and pulse. The bag is also equipped with a blue-tooth module, which can be used to transfer data of the physical check-up to the multi-function diagnostic bed once the village doctor returns to the clinic.

Multi-function diagnostic bed suitable for village clinics. This equipment is suitable for relatively densely populated rural areas. It includes a multi-function diagnostic bed, a multi-parameter check-up instrument, a general diagnostics system and related medical software. It combines all basic diagnostic functions including blood analysis, urine analysis, 12-lead EKG, non-invasive blood pressure and blood oxygen, monitoring, and general testing (sight, color blindness, internal medicine, surgery, ophthalmofundoscopy and otoscope). In addition, it is equipped with a doctor workstation software system and a resident health digital record system. The whole set of equipment can meet rural residents’ basic medical diagnostics needs and alleviate the serious equipment shortage in rural areas at a low cost of 35,000 RMB. With this system, farmers only need to pay about 30 RMB for a physical check-up, and a dozen tests can be done within 10 minutes. These beds are sold in over 20 provinces including Jilin, Shandong, Sichuan, Jiangsu, Guangdong, Shanghai, and have been listed in the “community health service enhancement” equipment procurement list by governments of Shaanxi, Hubei, and Shenzhen. Although new, the equipment is widely used over 1000 villages, and over 30 million rural people benefit from it. There are still 500,000 villages to be covered by such equipments.

Xinjiang Low-cost Health Service Demonstration Project. Xinjiang is located at the northwestern corner of China, with a population of 21 million, of which 12 million live in rural areas, and many belong to minority ethnic groups with very poor health service. Targeting this problem, the Xinjiang Physics and Chemistry Institute of CAS works with SIAT, Xinjiang Northwest Star IT Company to provide grassroots clinics with basic health service systems that are standardized, low-cost, reliable, and easy to use and maintain. The project aims to demonstrate the system in over 50 village/community clinics and over 10 township hospitals before extending more widely all over Xinjiang. The project also includes components on the collection of health data and statistical analysis of health data at grassroots level using “cloud services” and centralized storage. These components constitute an “Internet of things” in the health sector, which, on the basis of traditional medical equipment and information system, brings health care intelligence, intelligent data acquisition, and data storage into health and medical service. The project helps apply available technology to practical use, serving the economic and social development of Xinjiang.

Diagnosis-by-Cell Phone. Compared with traditional medical technology, cell phone-based devices have many advantages such as mobility, wireless communication, internet service, multimedia, data storage, data management and calculation, sensor technology as well as good user experience, so they represent the future of the emerging bio-medical engineering systems. The joint medical technology group formed by researchers from the Technical Institute of Physics and Chemistry, CAS and Tsinghua University has made many laboratory discoveries that are nearly ready for commercialization. For example, cell phones can be used to perform long-term monitoring of patients, which is a very important issue for diseases that requiring close monitoring. Because of lack of proper devices, it has long been difficult to treat snoring. Now, as long as the patient has a sound sensor attached to his body, the sensor can record the intensity and scale of the snoring and transfer the data via his cell phone real-time or as scheduled. For sports medicine, a physical sensor attached to shoes can record the intensity and frequency of one’s exercise and can even reconstruct a person’s activities of the whole day.

Sources: How far is low-cost health service from us, The Southern Daily, March 23, 2011; www.cas.cn

64. **Another important role of the universities and research institutes is to partner with companies to promote the adoption of new inclusive technologies.** The form of the partnership could be university spin-offs and university-industry technology alliances through joint research or technology license. The case of the former situation is Tsinghua Solar, which is a spin-off of Tsinghua University to promote the solar thermal technology of Tsinghua University to rural areas. And the case of the latter situation is illustrated by the partnership between SIAT and Shenzhen

Kangva Technology Company. As important performers of R&D and repositories of knowledge, their strong research capabilities enable them to provide suitable technology required by inclusive innovation. However, these efforts remain ad-hoc and have not yet realized their full potential. These institutes could be prolific in developing solutions for inclusive innovation if they integrate the frontier technology with the specific demands of the excluded, and seek broader participation from the private sector.

Private Sector Initiatives

65. **Despite the challenges of limited market information, missing knowledge and skills, inadequate market infrastructure and restricted access to financial services, many companies are promoting inclusive innovation in China.** The solutions that make these innovations possible are diverse and several patterns and principles emerge from analyzing the Chinese cases that were interviewed and from numerous discussions with experts and with companies currently engaged in inclusive innovation. Examples from the case studies include businesses that provide services—such as health care, electric power generation and credit to the excluded; and businesses that deliver innovative and affordable products tailored to the requirement of the BoP, such as cell phone, solar thermal system and appliances, enhancing the livelihood of the excluded. The framework includes: (i) adapting technological innovation to provide affordable and acceptable products; (ii) reconfiguring value chain and leveraging local resources to build up local capabilities; (iii) finding creative ways to overcome infrastructure and other constraints; and (iv) combining capabilities and resources with other organizations to co-create inclusive innovation solution.

66. **Adapting technological innovation to provide affordable and acceptable products.** The Chinese companies are designing products for the BoP market rather than offering the same products as those in the mature markets of developed economies. They are leapfrogging technologies to create inclusive business models with strikingly lowered costs and successful product adaptations. For example, MediaTek specializes in system-on-a-chip solutions for wireless communication, which lowers the technical barriers for manufacturing and cutting down the cost significantly. As a result, cell phones could be priced as low as US\$20, and were widely adopted in both the BoP market in China and in other developing countries. MediaTek stands second after Qualcomm among all the worldwide semiconductor companies in the field of mobile phone chipsets. The electrical bike is manufactured by many local companies. In the electrical bike, a battery is used to replace the traditional engine of motorcycle, and the architecture is simplified, thus lowering the price to the point that is affordable for the BoP groups. Haier invented affordable washing machines that specifically cater to the needs of rural users, including additional functions that target at the need of washing vegetables and unfavorable infrastructure conditions (unstable voltage). The Tebian Electric Apparatus Co developed a small-scale photo-voltage system that could be carried by a camel during the day to generate and store electricity while using the camel to carry other goods; the stored solar energy could then be used to support home appliances at night. Similar products are provided by Trina Solar, another PV manufacturer in Jiangsu. And similar patterns are emerging in the wind turbine industry, where companies such as Goldwind provide small-scale off-grid wind turbine solutions for the farmers. Access to energy, in turn, allows for more efficient production methods and the ability to use other products and services, preparing the ground for more inclusive business models.

67. **Reconfiguring the value chain and leverage the local resources to build up local capabilities.** For example, the solar thermal companies and appliance companies in China changed the traditional supermarket-based distribution model in rural areas, and embedded deeply into the

local networks to get the fine-grained information, making operations efficient and building trust among consumers. The diffusion of solar thermal system in China's rural market is a good example of such circumstance. The Nanjing Jiukang Biological Science and Technology Development Company cultivated a new species of Neem with grafting technology which could live in a relatively high-latitude area, enabling it to be planted in almost half the area of China. The company applies the "company+farmers" model to sourcing from local farmers. The Shunhua Duck Development Company uses a "company+associate+farms" model to rent lakes or reservoirs to build farms for duck raising.

68. **Finding creative ways to overcome infrastructure and other constraints.** The Global View firm provides cloud-computing-based online training solution to enable rural areas to set up a low-cost online training system, providing education and training for the excluded. Haier has addressed the problem of unstable voltage environment of the rural grid, by developing home appliance that can adapt to the electricity of wide range of voltages. The Himing solar company that provides solar thermal system went a long way around China to provide training in solar energy, to inspire the potential demand and generate brand awareness and at the same time enhancing trust in the brand. Credit Ease, a financial services company that provides person-to-person micro-credit through an internet-based system, introduced the micro-credit model from Grameen Bank that connects the BoP with money from urban areas using an internet-based platform. The company cooperates with local anti-poverty organizations to provide financial literacy programs to its credit clients or basic accounting and even business management skills to its small business borrowers.

69. **Combining capabilities and resources with other organizations to co-create inclusive innovation solutions.** To succeed in dealing with challenges of doing business with BoP and other excluded, different actors are forming partnerships to develop rights, products, services, and delivery mechanisms. Non-traditional partnerships are especially important to share cost, capabilities and knowledge, filling gaps of the existing system. While companies take the lead in designing and executing inclusive innovation, the other actors are often an integral part of the process. For example, GE partnered with local government to achieve the Health Imagination strategy.⁵¹ GE provides affordable customized solution for rural hospitals with localized supply chain, and the government helps GE to promote the products and provide training for rural doctors to operate the products provided by GE. Similar partnerships exist in Siemens' SMART strategy.⁵² The partnership between Shenzhen Kangva Technology Company (Kangva) and Shenzhen Institute of Advanced Technology is another example. Kangva (a State Owned Enterprise- SOE) was set up in 2008, for manufacturing and marketing of a low-cost medical system developed by SIAT. SIAT is responsible for basic research and part of the application research, and Kangva is responsible for process innovation and commercialization. For commercialization, Kangva also cooperates with branches of CAS and local governments to promote the application of the products in rural clinics.

Grassroots Innovation Initiatives

70. **In China, there are numerous innovations originated by people at the grassroots level, i.e., made by the poor and for the poor, covering a wide range of areas, including agriculture, healthcare, energy, transport, household utilities and public security.** Grassroots innovators are

⁵¹ GE unveiled its plan of 'Health Imagination' in 2009 to develop innovative technologies with the intention of capitalizing on the growth of healthcare needs in emerging economies. The plan will invest US\$300 million over 6 years to develop 100 affordable medical devices. 50 products with multi-functions and user-friendly interface will be promoted around the globe by lowering costs to 15 percent.

⁵² Siemens initiated the so-called 'SMART' strategy representing the acronym of 'Simple, Maintenance-friendly, Affordable, Reliable and Timely to market' in 2006 to provide low-cost medical solution for rural areas.

informal innovators such as small farmers, students, mechanics, artisans, retired workers or entrepreneurs. Similar to innovation in the formal sector, grassroots innovations also include technological, and organizational innovations.⁵³ Many of the grassroots innovators address the specific needs of the poor that are often ignored by the formal sector (see Box 8). In most cases, grassroots innovators are not business-oriented. They generally innovate for varied purposes, such as out of innate interest, to improve livelihood and production conditions, to help others, or to reuse waste materials. A large number of grassroots innovators are thus in the public domain and can be freely used by individuals or organizations.

Box 8: Grassroots Innovators for Addressing the Specific Needs of the Poor People

Burglar Alarm. In 2001, Zhao Tongxiang and his few electrician associates in Da Zhang village, Beichen District, Tianjin, made a burglar alarm for transformers. The burglar alarms sold on the market were so expensive that the village leaders asked them for help. They developed a simple burglar alarm device that cost only about 100 RMB, much cheaper than the similar products sold in the market. The local government organized on-the-spot meetings in Da Zhang to diffuse the innovation, and later on more than 20 villages in the district adopted it.

Onion Field Pollination. The excessive application of fertilizer and pesticide killed honey bees so farmers had to pollinate by hand. The “double-smell” Chinese onion, which smells of garlic and onion, remains in bloom for about one month. The artificial pollination period is therefore longer and requires more work. The farmers in Tianjin developed a technique that consisted of keeping rotting materials in the onion field to attract flies which pollinated similar to bees. The innovation was adopted due to its zero cost, and high efficiency.

Hill-drop Planter. In 1988, Lu Shengzhan, a village high school student in Hua county, Henan province, invented a hill-drop planter which could be used with tractors for sowing. The small tractors were widely used at the time, but the traditional seed-drills, which had been used in China for more than 2,000 years, could not be used with them. Lu observed how hard his parents worked on manual seeding and this motivated him to create the innovation.

Source: Center for Innovation and Entrepreneurship, Tianjin University of Finance and Economics (TUF), Tianjin, China.

71. **Many grassroots innovations are incremental innovations that are based on modifications of existing products.** They are brought about by innovators recombining existing technologies to match local conditions and solve specific problems. Some contemporary innovations are generated when different individuals or communities find different solutions for the same problem. Each one of them may be sub-optimal. But when pooled together, some of them may show synergistic effect and the formulations so developed may be completely new. A good example is the invention of the rainfall collection system in the Loess Plateau which is based upon a modification and development of the traditional rainfall collection system.⁵⁴ Many innovators use concepts or features well-known in one domain for solving a problem in a totally unrelated domain. Such applications often prove to be very useful for solving persistent problems or the current problems they are facing. For example, grassroots innovations around bicycles include a plough used for seeding, weeding, hoeing, and applying fertilizer; a power device to draw water from wells; power-aided bicycles to convert kinetic energy into electrical energy; a bicycle breathing machine (an impressive innovation that helped save a 15-year-old village girl’s life in Anyang, Henan Province).

72. **There are also collaborative grassroots innovations in which many people come together to solve their own or somebody else’s problem.** For instance, the ubiquitous farmers’ research associations in China aim at promoting collaborative innovations. Some grassroots innovators complement, and contribute to, formal research activities. Non-row corn harvesters developed by the

⁵³For selected grassroots innovation initiatives, see China Innovates: Selected Chinese Innovation published in Honey Bee Newsletter (2009-2011).

⁵⁴This grassroots innovation was developed in the early 1990s, by the farmers in Zhidan County, Shaanxi Province. The details of this are available in Dr. Bin Wu’s book (2003, Routledge): Sustainable Development in Rural China: Farmer innovation and self-organization in marginal areas, pp. 143-148.

rural farmer Guo Yufu, which can harvest corn with variable row spacing, have been sold in many provinces of China.⁵⁵ The winter production technology, without additional heating, of greenhouse cucumbers invented in the early 1980s by two farmers in Liaoning Province, has been diffused throughout China. Wang Heng, a farmer in north China's Shanxi Province, developed a waterproof cement-like material that could set within 6 seconds in water and was strong enough to withstand a water flow of 660 cubic meters per second. This was a breakthrough in underground waterproof projects and his products have been widely used in China and introduced to many other countries, such as Japan, Bangladesh, Republic of Korea and Morocco.

73. **Government plays a role in promoting and scaling up grassroots innovators.** For instance, both the MOA and MOST have their own budgets for programs promoting and scaling up technological innovation, to which the grassroots innovators' organizations, such as collectives, research associations, research institutes, companies and others, can apply either individually or jointly with the formal sector. While Guo and Wang set up companies to scale up their businesses, they applied for grants from the government science and technology (S&T) supporting programs and successfully got several rounds of financing for upgrading and scaling up their innovations. The diffusion of many grassroots innovation products also benefits from formal technology diffusion channels, as in the case of the diffusion of greenhouse technology, which was mostly provided by the public agricultural technology extension system. Some government initiatives have already been institutionalized. For instance, a particular category in the annual National S&T Award has been set up for grassroots innovators since 2004. The annual National Invention Exhibition is jointly organized by the China Association for S&T, cooperating with local government. Alongside this exhibition, awards at several levels are given to the innovators.

74. **Some government programs support grassroots innovation by applying patents for the innovation, bridging grassroots innovators with government, enterprises or potential investors, to participate in grassroots innovators exhibitions and prizes.** The media plays a very important role in grassroots innovators' diffusion. For example, the Encyclopedia to Getting Rich致富经), a program by CCTV which focuses on introducing the experience of successful rural entrepreneurs, has helped diffusion of many successful grassroots innovations. There is also some collaboration between domestic and international research institutes in diffusing grassroots innovation in China. For instance, Tianjin University of Finance and Economics (TUFE), together with SRISTI (Society for Research and Initiative for Sustainable Technologies and Institutions, India), has taken measures to develop and adopt institutional mechanisms for scouting, documentation and dissemination of grassroots innovators, which would enhance the capacity of government and other stakeholders in exploiting grassroots innovators. It has also created an online platform for incubating grassroots innovators, which filed more than 3,000 grassroots innovators case studies and about 100 grassroots innovators videos.⁵⁶ In addition, the students at TUFE also help grassroots innovators on marketing and applying for supports from government and other related organizations.⁵⁷

III. Key Issues and Challenges in Promoting Inclusive Innovation in China

The Institutional and Policy Framework

⁵⁵In the past, the corn harvesters could only be used for the harvesting of the corn with fixed row spacing.

⁵⁶<http://202.113.129.59/index.asp?action=show&typeid=3>

⁵⁷For example, in 2010 a student team helped Wang Jinting, a laid-off worker who developed a new painting technique by adding the pigment of pearl color into the sand paintings, to make a profit of nearly 80,000 RMB. They also helped Wang get local government support and upgrade his business from a workshop of two to a formal enterprise of more than 30 employees.

75. **There are many inclusive innovation initiatives and programs in China, but no explicit inclusive innovation policies and strategies.** The Chinese government has an explicit objective of promoting inclusive growth, but incorporation of inclusive innovation with an integrated approach remains a challenge. There are many initiatives, with participation of different agents, but in the absence of well-articulated goals, objectives and strategies on how to promote and operationalize inclusive innovation throughout China, the efforts of various actors remain fragmented. Several ministries, agencies and local governments have made a deliberate effort to foster the creation and dissemination relevant to the excluded, which are indirectly contributing to inclusive innovation. However few programs concern all the key elements required for inclusive innovation– the intended beneficiaries, quality, affordability, outreach and commercial sustainability. Some government policies play a role in supporting and stimulating inclusive innovation, but in general, absence of dedicated funding, fiscal incentives, public procurement and other supporting instruments to provide specific incentives, inclusive innovation initiatives are unable to reach their full potential. Lack of efforts to leverage private sector and other sectors to engage in inclusive innovation, also mean increased burden on the government to push the initiatives. What is required is innovation (itself) in both *doing as well as delivering* inclusive innovation to the masses.

76. **While some programs involve collaboration and coordination, others are fragmented and unstructured, causing a considerable degree of overlap and gaps in functions and responsibilities among various government agencies.** For example, innovation in agriculture sector is the focus of government strategy and is championed by Science & Technology Department of the MOA, and rural department of MOST and promoted by multiply government agencies. At the same time, other and perhaps equally important elements, such as access to water, energy, education, medical services, are not fully addressed. Inclusive innovation requires a coordination mechanism among relevant government agencies, but the present government structure currently lacks an effective coordination mechanism and a high-level coordination body.

77. **There is some collaboration between national bodies dealing with STI and poverty alleviation policies, but in general, the science, technology and innovation (STI) policies are isolated with poverty alleviation policies.** China has no high-level national body to champion, formulate, support, and monitor implementation of inclusive innovation initiatives. Some mechanisms exist, including the State Council poverty alleviation leading group office for championing the process of formulating the poverty alleviation plan, with various ministries including MOST. However, the Ministry in charge of poverty alleviation does not emphasize mobilizing the power of STI to solve the problems faced by the poor, nor does it closely collaborate with ministries dealing with science, technology and innovation. The lack of a clear and integrated inclusive innovation strategy has significant implications for fiscal resource allocation. As the key provider of public services, government could directly benefit from pursuing a well-articulated inclusive innovation strategy, for inclusive innovation could be a powerful tool to significantly reduce the burden on the fiscal budget and improve the supply of basic goods and services. Pursing an integrated and well-coordinated inclusive innovation strategy is also crucial for it to allow fiscal resources to be rationally allocated between sectors and target groups, according to national priorities and needs.

The Effectiveness of Government-Driven Policies and Programs

78. **The government programs and policies mostly take a top-down approach, with limited involvement of other relevant stakeholders, especially the private sector, in their planning and design.** As building a harmonious society has been placed on top of the agenda of the Chinese

government, certain criteria and standards, including the intended beneficiaries, the quality and affordability of goods and services have been increasingly taken into account by the policy makers in program design. Some programs and initiatives have already produced immediate results in outreach and scale, and are contributing prominently to the inclusive growth agenda.⁵⁸ But the priority areas and approaches are usually determined by government officials, without a solid understanding of the real need of BoPs and the viability of the business model. This could lead to problems, as illustrated in the case when a municipal government launched a project to provide affordable computers to rural farmers. The designers did not recognize that: rural farmers are reluctant to use the computer; many of the software programs are not compatible with the installed Linux operating system; and the additional installed agricultural and distance education software did not fully meet their needs.

79. **Moreover, government tends to directly intervene in the provision of the products and services, instead of creating a supportive environment and spurring the active participation of private sector and other stakeholders.** The current government-driven programs heavily rely on government financing and fiscal subsidies, as shown in the massive agricultural and rural ICT programs. Further, while the participation of the private sector is improving slowly, the public sector still plays a major role in the design and implementation of such programs. This approach denies the government benefiting from private sector resources including management skills, technology, finance, efficiency and risk-taking capabilities. This is not a long-lasting sustainable solution, as it brings a heavy burden on the government budget. Once fiscal revenue decreases, resulting from a slowdown in economic growth, the government will no longer be able to maintain ongoing projects which are not self-sustainable. There is considerable room to improve the efficient use of public resources to promote inclusive innovation in China.

80. **Last but not least, performance monitoring and evaluation of public programs is quite weak.** Especially for the government-dominant projects, systematic and independent monitoring and evaluation of outcomes and impact are still limited. The official statements tend to emphasize inputs—such as how much has been invested and how many subsidies been disbursed—rather than results on the ground and outcomes. Further, in many cases the intended beneficiaries of fiscal subsidies are not well-defined, and welfare improvement is not subject to continuous monitoring and evaluation. In the distribution of subsidies, policy makers are not required to make a clear cost-benefit analysis of the supported operations.

The Coverage and Sustainability of Private Sector Initiatives

81. **Compared with the top-down initiatives dominated by governments, private sector-based inclusive innovation initiatives in China are often more efficient and effective.** These programs are mostly driven by economic incentives which encourage private companies to pursue optimized utilization of resources. However, many inclusive innovations initiated by the private sector have limited outreach and demonstrate unclear potential of scalability. Although some of the inclusive innovation products have successfully tapped into some areas, the coverage of private-sector-based inclusive solutions is rather low. The scalability of many inclusive innovations is restricted due to the limited resources of the companies and the region-specific factors that affect the effectiveness of the business model. For example, the P2P (person-to-person) micro-credit provided by Credit Ease covers only a few villages in China, and the low-cost medical equipment provided by

⁵⁸ For instance, it is estimated that under the Spark Program, over 40 million rural households receive training and under the S&T commissioner project, there were about 170,000 science and technology commissioners nationwide which had benefited over 50 million rural households.

SIAT and Kangva covers only 1,000 villages out of some 500,000 villages in China. The scalability of the inclusive business model is unlikely to improve without the participation of other actors.

82. **Furthermore, the financial sustainability of some inclusive innovation businesses is still to be verified.** Some companies, such as MTK, demonstrate the commercial success and financial sustainability of their business model, but the economic sustainability of some others is unclear. For example, Jiukang designs a seemingly-good business model, but the profit-making potential of the business is still unclear, because the company got the license to produce pesticide only in 2010, and the large-scale commercialization of products has not yet started. A similar problem happened with the low-cost medical equipment provided by SIAT and Kangva. The 35,000 RMB low-cost diagnosis bed could only make a profit if the sales volume achieved 20,000 equipments per year. However the scale nowadays is much less than the threshold, which means SIAT has to invest more money for the commercialization of products in the future.

The Orientation and Incentives for Universities and Public Research Institutes

83. **There are limited number of universities and research institutes dedicated to inclusive innovation.** There are some universities and public R&D institutions whose missions are oriented to agriculture, energy and health, and some focus on technology problems of social groups with a state or regional scope. The solar thermal system by Tsinghua University and low-cost medical equipment by SIAT, offer some typical examples. Most R&D institutions in China are still focused on frontier innovation and less geared towards inclusive innovation, although inclusive innovation could also be aligned with frontier innovation, as illustrated in the case of low-cost medical equipment by SIAT. There are also limited incentives for universities and public R&D institutes to engage in inclusive innovation. Although developing and diffusing practical technology has been incorporated into the evaluation system for professors in some agricultural research institutes, the current evaluation system of universities and research institutes still emphasizes publication in top journals, which promote ranking of the universities in the world education system. Therefore, professors and researchers focus more on frontier innovation where international publication is easy. Inclusive innovation, which has a more social impact, is not compatible with this evaluation system. As a result, professors and researchers have little motivation to engage in inclusive innovation.

84. **Although some products and technologies related to inclusive innovation have been developed, the transfer, commercialization and deployment have been weak.** For instance, it was 20 years after the invention of the key technology of the solar thermal system that the system started diffusing rapidly in rural China. The large-scale commercialization of low-cost medical equipment by SIAT has not started yet. There is still little involvement of private and other actors to find a sustainable business model to diffuse and commercialize inclusive innovation research. The end result is that the impressive investment in S&T resources has not yet been translated into inclusive innovation. The public support system for R&D and some aspects of the institutional arrangements of the National Innovation System do not yet sufficiently encourage the deepening of R&D efforts for inclusive innovation and their translation into innovative outcomes. The top-down philosophy is still dominant, and real needs of the excluded are not fully considered in inclusive innovation research. In the existing programs, the roles and responsibilities are by and large still on the research teams, rather than aligned with the strategic objectives of the institutes. The involvement of low-cost medical system research into the “Innovation 2020” of the CAS in 2010 provides a good example of strategic integration of inclusive innovation into the strategic objectives of research institutes. However such strategic activities are rare among other research institutes and universities.

Regulatory and Institutional Barriers

85. **There are many regulatory constraints which hinder the development and deployment of inclusive innovation products and services in China.** Recognizing the importance of developing market-based solutions for innovation, much effort has been devoted to address the innovation climate bottlenecks and to facilitate private sector engagement in innovation relevant to the poor. However the environment is still not fully conducive. For example, (i) many regulations constrain the private sector to engage in inclusive innovation. Companies like Alibaba and Credit Ease cannot win support from the banking watchdog for data sharing on credit information; (ii) the private sector is outweighed by its state-owned counterparts in entry access and competition policy. The Person Handset System (PHS), first called ‘cellular data for the poor’ by the Japanese, was introduced by UTStarcom in the mid-1990s and soon widely spread in the following ten years, leveraged by its extreme low costs. The data path occupied by PHS was announced to be converted to TD-SCDMA by the MIIT in 2007, and the PHS has been forced to exit the market; (iii) some low-cost innovations are considered of bad quality, and the government tries to hinder such innovation rather than to guide their development into quality BoP products. Shanzhai cell phones and electric bicycle are the typical cases facing such dilemma; and (iv) innovators, particularly grassroots innovators, are unable to capitalize on their IP due to limited awareness of the importance of IP, and legal procedures to get a patent. Also, many grassroots and other innovators are not able to pay for the patent costs and recurring fees for maintaining the patent.

Government Support for Grassroots Innovation

86. **The government support with dedicated funding and programs focused on grassroots innovators are limited, while many government S&T programs and policies aim at facilitating research by grassroots innovators.** Some organizations are engaged in promoting and diffusing grassroots innovators development, but overall, incentives, policies and institutions are not adequate. For example, the S&T training provided to farmers improves their scientific understanding and creative ability and improves their living conditions by the application of S&T advances into their agricultural production. Although it is not common, some farmers’ research institutes and companies have been granted government S&T projects. For example, although MOA and MOST have their own budgets for technology upgrading and extension programs, to which the grassroots innovators’ organizations, such as collectives, research associations, research institutes, companies and others, can apply, the grassroots innovators have to compete with scientists from the formal sector in project applications, disregarding the fact that farmers, as a disadvantaged group, are relatively less able to compete. Although there have been numerous grassroots innovation activities, many valuable innovations tend to be isolated from each other. It is well known that the poor in one area, especially in the poorest areas, suffer from the same problems and could benefit from the solutions that emerge in other places. But currently, most of the grassroots innovations are applied on a limited scale, and diffuse only spontaneously and informally.

International Collaboration in Inclusive Innovation

87. **China is actively participating in some global public innovation activities, but overall, the collaboration among Chinese and global STI institutions remains limited.** At present, there are several examples of international cooperation to develop innovation targeted at the needs of the poor, including the Bill & Melinda Gates Foundation, which is granting funds to the China Pharmaceutical Group to invent a low-cost Poliovirus vaccine. Some foreign-aid projects are also contributing to the global agenda for inclusive innovation. The low-cost and high-quality drug

produced by the Fosun Pharma and delivered to African countries is a typical example. Nevertheless, most bilateral and multi-national cooperation in China still focuses on frontier innovation, and international collaboration on inclusive innovation remains sketchy.

Early Stage Capital for Inclusive Innovation

88. **Although the supply of risk capital has been rising in China, the patient capital for smaller innovative firms which are trying to scale up is still scarce.** The growth in venture capital (VC) investment in China has been rapid in recent years, and thus China has surpassed many OECD countries when compared on a percentage of GDP basis.⁵⁹ However, most investments by VC funds are still focused in firms at the growth and expansion stage, with only 40.9 percent of all new deals and 27.6 percent of investment amount for growth stage firms in 2011.⁶⁰ While there is little constraint to capital supply in China, allocation efficiency and increase in supply of patient capital to support inclusive innovation firms in need of risk capital and new entrants attempting to commercialize promising ideas is quite weak.

89. **Early stage capital for areas related to BoP is even more limited.** VC investment in China is increasingly focusing on some high-tech industries, especially on new emerging strategy industries.⁶¹ Information technology was the leading industry recipient of VC investment in China, and clean technologies, telecommunication, electricity and optoelectronic device, machine building also have a sizeable part of the VC investment portfolio.⁶² However those industries that are more likely to target at BoP customers, including agriculture, health and education, receive little risk capital. The Chinese government is actively involved in promoting state-sponsored VC funds. Since 1998, some 31 Guidance Funds have been established with a total amount of RMB 31.9 billion (US\$4.7 billion).⁶³ The government guideline fund usually has specific tasks of promoting the creation of early-stage funding for SMEs in specific technologies, identified by the government as being strategic to the countries.⁶⁴ However, most of such funds are dominated by the public sector, and do not provide much support to enterprises developing innovative solutions for the BoP.

⁵⁹The VC investment in China represented 0.171 percent of GDP in 2011. Meanwhile, the average level for the top 5 OECD countries is only 0.110 in 2008 and 0.042 in 2009.

⁶⁰ Source: Ventral Capital Development in China 2011

⁶¹ Including (a) information technology; (b) advanced materials, e.g., nanotechnology; (c) high-end manufacturing clean technology and energy-saving; (d) bio-technology/Life sciences as applied to health, agriculture and alternative energy; (e) new energy

⁶² See the Domestic VC investment amount by industry in 2011 by Zero2ipo research center 2012.01 (www.zdbchina.com)

⁶³ Data from zero2ipo, "Government Guidance Funds Grow Rapidly in China," May 28, 2010, [http://www.zero2ipo.com.cn/en/n/2010-5-28/2010528110953.shtml?highlight=guidance funds](http://www.zero2ipo.com.cn/en/n/2010-5-28/2010528110953.shtml?highlight=guidance%20funds). Exchange rate based on May 2010 from www.oanda.com/currency/historical-rates/

⁶⁴ At the central level, the Ministry of Finance (MOF) and Ministry of Science and Technology (MOST) established a guideline fund in July 2007 for promoting VC investments in small and medium-sized technology enterprises. In October 2009, the China Venture Capital Funds for Emerging Industries (VCFEI) were introduced to provide capital at the start-up to middle stages of high-technology company creation and development.

CHAPTER 3. INCLUSIVE INNOVATION: THE INTERNATIONAL EXPERIENCE

90. **Like China, many countries are engaged in inclusive innovation.** Their experiences demonstrate a wide breadth of types of inclusive innovations – and of the innovative processes, technologies, agents, and policies responsible for their development and deployment.

National Government Initiatives

91. **Many governments such as Brazil, India, South Africa, Thailand, Vietnam, Mexico, and Uganda, have initiated programs promoting inclusive innovation⁶⁵.** Their efforts describe an essential and facilitative role for national governments in an inclusive innovation agenda. Together, these countries, in total, have catalyzed inclusive innovation by financing or coordinating financing for research and technology development with particularly high impact on human empowerment; leveraged their role as a market participant in the provision of public goods; forged partnerships across sectors and globally; promoted information exchanges between the BoP and industry; strengthened networks of talent that produce inclusive innovations; and eased regulatory burdens while also advancing intellectual property regimes– with due attention to open-source alternatives, which allow inclusive innovations to be commercialized and sustainably produced by private sector driven markets.

92. **Current approaches to inclusive innovation range from ad-hoc efforts by individual ministries, sub-national governments, and RTIs, to more mature, focused and synchronized national programs.** Ad-hoc policies limit themselves to solving discrete national problems. For example, the Ministry of Health in Uganda mandated that government health care centers use the K1 auto-disposable syringe, which limits the retransmission of blood-borne disease by nature of its being non-reusable. The mandate complements Uganda’s efforts at HIV prevention, and also demonstrates the effectiveness of directives as a policy instrument aimed at promoting greater adoption and dissemination of certain BoP innovations. Countries with a strong enabling environment and existing large-scale initiatives aimed at poverty reduction, improving STI infrastructure, and SME development, would benefit from a more comprehensive implementation of inclusive innovation.

93. **More comprehensive approaches vary in their maturity and scope.** In 2005, South Africa’s Department of Science and Technology instituted a program on “Science and Technology for Social Impacts,” to advance the poverty-reduction mission of the country’s 2002 National Research and Development Strategy⁶⁶ which called for the provision of greater access to “innovations that accelerate development and provide new and more effective solutions than those utilised previously.” Currently, the program funds inclusive initiatives through South Africa’s National Research Foundation, in partnership with South Africa’s numerous public research councils, primarily focused on creating sustainable livelihoods for farmers by leveraging the country’s biodiversity and indigenous knowledge with technology to develop plant-based pharmaceuticals.

94. **Like South Africa, Thailand’s public research councils are engaged in a series of discrete pro-poor initiatives – which are expected to be complemented by a more comprehensive approach as the National Science Technology and Innovation Policy Office makes inclusive innovation a key component of its decade-long National Science Technology**

⁶⁵ The status of inclusive innovation in China is discussed in Chapter 2.

⁶⁶ http://www.info.gov.za/otherdocs/2002/rd_strat.pdf

and Innovation Policy and Plan (2012-2021). By emphasizing the extension of science, technology, and engineering knowledge to address well-being of those at the BoP, Thailand seeks to balance between competitiveness-oriented and social-well-being-oriented objectives in its national innovation policy. In the meantime, Thailand has existing initiatives (but limited in scope and impact) which enable inclusive innovation, primarily through the Thailand Institute of Scientific and Technological Research (TISTR), a public R&D council. The Village Fund and People's Bank, Thailand's rural financing initiatives, support TISTR efforts seeking to adapt technology for rural use. Similarly, TISTR's "Royal Highland Project" seeks to enhance the productivity of rural women by developing energy-saving fertilizers and facilitating transfers of technology for mushroom cultivation. And Thailand has long since initiated (with considerable disruption due to periods of political instability) a "One Village, One Product" concept (called "One Tambon, One Product"), which provides assistance (technology, management, and financing) for villages to create products based on indigenous and traditional knowledge and connect them to markets at home and abroad.

95. **Similarly, in Vietnam, the Deputy Prime Minister, the Minister of Science and Technology, leaders from major R&D organizations, universities, and the private sector are committed to cementing inclusive innovation as part of the country's STI reform agenda, and the Government of Vietnam has requested the World Bank's assistance in strengthening Vietnam's capacity to pursue inclusive innovation.** The World Bank is supporting these efforts through several initiatives, which include (i) the creation of a policy paper, (ii) support to adopt, upgrade, and develop inclusive technologies; and (iii) efforts to strengthen the technological capabilities of small and medium enterprises (SMEs). The Vietnamese authorities are concerned with widening disparities especially between urban and rural areas, and the fact that many ethnic minorities have not benefited from its economic success, and view inclusive innovation as a means to not only address these disparities but also to enhance enterprise competitiveness and private sector development and achieve middle income status.

96. **At the other end of the spectrum is India's national inclusive innovation program – a multipronged and coordinated effort aimed at comprehensively fostering inclusive innovation.** Given its robust technological base, vibrant private sector, enormous size of the BoP, and daunting challenges of inequality, it is unsurprising that India has taken concrete steps to formalize and institutionalize the mission of inclusive innovation. Though imperfect and with ample room for improvement, a comprehensive approach stands to produce a larger volume of innovations and systematically connect the BoP to the existing innovation ecosystem. The Prime Minister of India released the new Science, Technology and Innovation Policy on January 3, 2013, where inclusive innovation agenda finds a specific emphasis.⁶⁷

97. **The program builds from efforts to strengthen India's overall innovation ecosystem: the Indian Government set up a National Innovation Council (NInC) with the objectives of creating an innovative India⁶⁸ and facilitating the setting up of State Innovation Councils in each State.** As of end 2012, 19 states have constituted State Innovation Councils and central ministries have set up 19 Sectoral Innovation Councils to contribute to developing the innovation roadmap for the decade. The NInC has already launched (or plan to launch) a series of initiatives aimed at promoting creativity and nurture innovations, such as:

- Establishment of India Grand Challenge Awards.

⁶⁷ www.dst.gov.in

⁶⁸ <http://innovationcouncil.gov.in/>

- Creation of a separate scholarship stream for Inclusive Innovation
- Setting up an Innovation Centre in each District Institute of Education and Training to enhance teacher training and enable them to become facilitators of creativity and innovative thinking.
- Creation of a National Innovation Promotion Service to replace/add to National Service Scheme in Colleges to use college students to identify local innovations.
- Establishment of 20 Design Innovation Centres co-located in the Institutes of National Importance.
- Establishment of Innovation Clusters in various sectors and universities across the country, where innovation would be seeded through Cluster Innovation Centres.
- Creation of a joint EU-India prize for inclusive innovation.

98. **The Council then addresses inclusive innovation as a separate prong alongside frontier innovation, to connect the national innovation ecosystem to serve BoP needs.** In November 2011, the NInC launched the India Inclusive Innovation Fund. The Fund (with a goal of US\$1 billion in size), to be a public-private partnership, seeks to promote enterprises engaged in developing inclusive solutions and will combine commercial and social returns. To maximize its impact, this Fund will be seeking potential investees from various sources, including both public and private sectors in India and abroad. The Fund will solicit interested enterprise through *open broadcast*: the outreach publicity activity surrounding its launch and initial operations is expected to attract a high level of demand from innovative enterprises. It will tap *Angel and venture capital networks* with established investments in early and mid-stage SMEs, using institutionalised social-venture interest communities to provide an important source of potential investees. Given the developmental focus of the Fund, *community organisations* (such as non-profits and NGOs) are expected to prove a rich source of entrepreneurs and enterprises, given appropriate mentoring and incubation support.

99. **To support grassroots innovators, whose needs-driven creativity and indigenous knowledge can spur inclusive products while also creating income-generating opportunities, India's Department of Science and Technology, established the National Innovation Foundation (NIF) a decade ago.** The main goal of NIF is to provide institutional support in scouting, spawning, sustaining and scaling up grassroots and green innovations and helping their transition to self-supporting activities. In 2010, NIF became a grant-in-aid organisation of the Department of Science and Technology, Government of India⁶⁹. NIF has also partnered with other NGOs, research councils, industry associations as well as micro finance organizations, thereby harnessing the infrastructural, financial and intellectual resources of these organizations. The core functions of the National Innovation Foundation include the following:

- screen, document and verify the claims about these innovations through various networks of scientific and other institutional initiatives;
- formalize research into traditional knowledge;
- share the innovations permitted by the knowledge providers to be put in public domain;
- help in prior art search so that innovators can maintain their competitive edge; and

⁶⁹<http://www.dst.gov.in/>

- provide assistance to grassroots innovators to enter into licensing arrangements with entrepreneurs for transferring technologies.

100. **The NIF provides technical as well as limited financial support to the potential innovations for various incubation activities.** But NIF's operations and resource base is small thus limiting its activities and impact. Serious challenges remain in the screening process, and in fostering further development of good ideas to the point at which they can be commercialized. Nonetheless, NIF has been able to build up a database of more than 160,000 ideas, innovations and traditional knowledge practices from over 545 districts of the country, filed 500 patents (including seven in USA and a PCT application) of which thirty five patents have been granted in India and four in USA, and, through its Micro Venture Innovation Fund, it has provided risk capital to over 175 projects, which are at different stages of incubation.

101. **Indian research performing councils, like the Council of Scientific and Industrial Research (CSIR)⁷⁰, Indian Council of Medical Research (ICMR),⁷¹ and Indian Council of Agricultural Research (ICAR),⁷² are making inclusive innovation a central component in their 12th Five Year Plan.** An initiative, called CSIR-800, tasks CSIR to develop and deploy inclusive innovations for the 800 million Indians whose income levels are less than US\$2 per day. These Councils operate research institutes and financially support research at universities and network projects involving scientists from each other's institutes as well as from industrial research centers and the private sector. Under this Program, efforts have been made to associate concerned national laboratories or other specialist S&T institutions with each major Program so as to build-in expert input, utilize national S&T infrastructure and link it up with grassroots S&T interventions/initiatives. One example is the collaboration between the ICMR and the NIF, which aims to achieve synergy between India's premier apex institution for medical research and informal, non-codified and non-classical health-related indigenous knowledge. The collaboration focuses on drug development from grassroots traditional knowledge-based practices that incorporate either use of new medicinal plants not reported in any Indian codified literature or new use of already mentioned medicinal plants or in the case of multi-herb formulations, one of the ingredients should satisfy either of the above two conditions. ICMR works towards validating the safety and efficacy of the practices that are claimed to have therapeutic value by grassroots healers. This partnership between the formal R&D and the informal R&D sectors of India is a novel experiment in the field of applying science and technology for social and rural development.

102. **The Indian Government has also leveraged its role as a market participant in providing goods to foster inclusive innovation, as illustrated by the case of *Aakash: A Low Cost (US\$35) Computer Tablet from India*.** On July 22, 2010, India unveiled a computer tablet,⁷³ the "Aakash," with a goal to be "good enough" to serve educational needs at the cheapest price possible. The device was developed as part of the country's aim to link 25,000 colleges and 400 universities in an e-learning program. Projected as a "US\$35 laptop", the device will be procured by the Government of India and distributed to university students—initially at US\$50 until further orders are received and projected eventually to achieve the target US\$35 price.⁷⁴ The tablets are also proposed to be

⁷⁰ www.csir.res.in

⁷¹ <http://icmr.nic.in/>

⁷² <http://www.icar.org.in/>

⁷³ <http://www.gizmag.com/refridgerator-rural-india-chotukool/13680/>

⁷⁴ In 2000, the CSIR launched a grand challenge program- the 'New Millennium Indian Technology Leadership Initiative'- focusing on addressing the needs of a broad cross-section on Indian society. For example, the grand challenge of moving from US\$2,000 laptop to

distributed in millions in schools by the Government of India at half the price. In addition to support from public R&D organizations and universities to facilitate development at the early stages, the government mandate and procurement policy served to focus attention on a BoP need which, if solved, would have high social impact, and of course drastically reduced the risk of development and guaranteed significant outreach. Indeed, Aakash components are ultimately produced by private firms through competitive bidding processes.

Research and Technology Institutes (RTIs)

103. **Research and Technology Institutes (RTIs) – both in developing countries and developed countries – have served as well-springs of pro-BoP innovation.** There is an increasing awareness and recognition of the role of science, technology and innovation (STI) in the pursuit of alleviating poverty in developing countries. The Millennium Development Goals (MDGs) have brought focus and a compelling, output-driven framework for policies leveraging STI for poverty eradication and human empowerment. As discussed above, public research councils and laboratories in some developing countries have focused on both exploring frontiers of knowledge as well as serving the needs of the BoP. Their output, to date, includes, among other products, adapting plant- and other bio-material for pharmaceutical and cosmetic use (India, South Africa), improving agricultural output for rural women (Thailand), and developing large, floating fishing cages to dramatically decrease costs of entry and increase productivity for trout farmers (South Africa). Other regional institutes, in partnership with universities, public labs, private firms, and local governments, have assembled to address regional problems: For example. The Water Institute of Southern Africa supports research into water and sanitation solutions in Southern Africa through grants, awards, issue-research and publications. Moreover, these public institutes have formed global alliances to launch initiatives aimed at solving common problems (Box 9).

US\$200 laptop (realized through the launch of ‘DSK Mobilis’, originally created through the ‘Mobilis’) eventually led to Aakash (US\$39 laptop) in 2011. In this case, the journey of US\$2,000 to US\$200 to US\$35 laptop took place through a national grand challenge initiative.

Box 9: The Global Research Alliance

The Global Research Alliance (GRA), a virtual alliance, is a network of nine of the world's most prestigious knowledge-intensive technology and innovation organizations with a goal of creating "A Global Knowledge Pool for Global Good". It has a capacity to undertake projects with a magnitude and complexity that transcend the capabilities of any single organization. It includes organizations of the Northern and Southern hemisphere with more than 60,000 scientists and engineers. The Alliance partners perform basic and applied research, technology transfer and commercialization, and specialize in the implementation of innovative commercially and socially viable solutions. GRA has within its ranks highly innovative members who amongst other breakthroughs have developed: MP3 player, Xerox copying technology, carbon fiber composite wings for light combat aircraft, space satellite, drought resistant millet, mesh networking for rural internet provision, the World's first 'flu drug, low cost HIV and tuberculosis drugs, an open-source drug discovery platform, etc.

Value Proposition of the GRA

- The core competences and fields of focus of each of the constituent members of the GRA cover a wide range of topics, from agriculture to life sciences, engineering, environment and aerospace. The Alliance partners perform basic and applied research, and specialize in the implementation of innovative solutions for a wide array of customers.
- The Alliance has developed collaborative initiatives in many areas such as:
 - Water and Environment, such as the development of science based water scenarios for Africa;
 - Climate Change, such as development of innovative adaptation strategies for climate change;
 - ICT, such as the development of innovative mesh networks for internet access in rural areas;
 - Health, such as a development of a portable clinical epidemiological laboratory; and
 - Energy such as the investigation of energy as a catalyst for rural development.
- In these collaborative areas the range of skills, resources, experience, scientific excellence and credibility that the GRA and its constituent members bring to the table are virtually unrivalled.
- Through the abilities and track record of its members, the GRA has a proven ability to undertake large, highly complex projects that range from developing technologically innovative projects, to implementing commercially and socially viable solutions.
- GRA teams have the ability to synergies the innovative, cutting-edge science and technology skills of its members into a holistic approach to global challenges.
- The GRA and its constituent members count amongst their stakeholders' governments, non-government organizations and private corporations all around the world.

104. **In developing countries, support for inclusive innovation also relies heavily on mixed structures and the existence of complex web of interlinking between different actors of the national innovation system.** The responsibility of planning, funding and directing research is generally not assigned to a particular council/agency. This finally results into self-assembling networks, which come together depending upon the needs of the scientists or the markets depending upon who initiates the dialogue. Although the drivers of such efforts vary from country to country, the objectives of such policies essentially find common grounds in job creation, upliftment of disadvantaged population, growth and development, education and health for all and enhancing the quality of life of the commons. There also appears to be increased focus on special groups such as women and children. The Low Cost Tea Bag Water Purifier – is an example of a high-tech inclusive product created by mixed structures.

105. **Eugene Cloete, Dean of the Faculty of Science at the Stellenbosch University and Chair of Stellenbosch University's Water Institute, developed a decentralized point-of-use technology**

that reverses the action of the common tea bag to purify water on an individual basis.⁷⁵ Instead of infusing water with flavor, the sachet sucks up toxic contamination when fitted into the neck of a water bottle, using ultra-thin nano scale fibers to filter out contaminants, and active carbon granules to kill bacteria. The filter requires no infrastructure and thus helps communities that have no water-cleaning facilities to use it to purify dirty water. Each bag costs around three South African cents (just under half a US cent). It is affordable, clean, environmentally friendly, and can be used anywhere – and has been successfully commercialized (the “Life Straw,” US\$20), for use in outdoor expeditions in developed countries, and, with support by NGOs, for distribution among the poor and disaster areas. Lack of access to safe drinking water contributes to the staggering burden of diarrheal diseases worldwide, particularly affecting the young, the immuno-compromised and the poor. Nearly one in five child deaths – about 1.5 million each year – is due to diarrhea. In fact diarrhea kills more young children than AIDS, malaria and measles combined. Drinking contaminated water also leads to reduced personal productive time, with widespread economic effects. It is not enough to treat water at the point-of-source; it must also be made safe at the point-of-consumption. However, large scale sustainable deployment of such products remains a challenge.

106. **In developed countries, leading universities and research centers have established dedicated labs and departments focused explicitly on inclusive innovation.** D-Lab⁷⁶, for instance, is a program at the Massachusetts Institute of Technology (MIT) in the US seeking to improve the quality of life of low-income households world-wide through the creation and implementation of low cost technologies. D-Lab’s portfolio of technologies also serves as an educational vehicle that allows students to gain an optimistic and practical understanding of their roles in alleviating poverty. D-Lab’s output to date has been very promising, and includes a stove run on rurally-ubiquitous pine needles and a portable, pedal-powered washing machine. MIT has also sponsored an innovation competition, allocating grant money to projects aimed at serving BoP needs (Box 10). These efforts, while laudable, still have remained at the laboratory level and large-scale deployment continues to be a challenge.

Box 10: MIT IDEAS Global Challenge

MIT IDEAS Global Challenge, a program of the Public Service Center, is an annual invention and entrepreneurship competition that awards up to US\$10,000 per team for innovative service projects that positively impact underserved communities. Through IDEAS (“Innovation, Development, Enterprise, Action, and Service”), teams of MIT students and their collaborators work with a community partner to design and implement innovative projects that improve the quality of life in BoP communities around the world. Since its founding in 2001, IDEAS has awarded roughly US\$500,000 to more than 90 teams exploring myriad off-grid water, electricity, and sanitation solutions; technology applications for secluded retailers; low-cost medical devices and prosthetics; medical diagnostics and solutions to behavioral problems limiting the effectiveness of treatment regimes; SMS-based tools for field research; among others.

<http://web.mit.edu/mitpsc/whatwedo/ideas-competition/index.html>

107. **Some university initiatives focus on specific sectors, such as ultra-low cost health solutions.** Another MIT initiative, the Innovations in International Health Program, focuses explicitly on ultra-low cost health solutions. The program has already developed a low-cost, solar-powered autoclave that offers rural health facilities which cannot rely on electricity the ability to sterilize instruments onsite; an ultra-low cost method of promoting compliance with TB treatment regimes (the “X Out TB”); and a do-it-yourself medical device creation kit designed to unleash frontline innovation by on-the-ground medical professionals in developing countries.

⁷⁵<http://www.scidev.net/en/news/nano-tea-bag-purifies-water.html>

⁷⁶<http://d-lab.mit.edu/>

108. **Other initiatives in developed country research institutions deploy talent in design, a profession and area of study which has proven to be exceptionally socially-conscious and focused on all aspects of the innovation process, from identification of BoP problems, through production of solutions, delivery, scale, and post-hoc impact studies.** For instance, Stanford University's Hasso Plattner Institute of Design,⁷⁷ a research alliance with the University of Potsdam, Germany, integrates business and management training with traditional engineering and product design education. Alongside its research into solutions for high-income consumers, the Design Institute has launched impressive inclusive innovations such as the "Embrace" blanket, which functions as an ultra-low cost infant incubator (Box 11),⁷⁸ and solar-powered LED lighting. Similarly, D-Rev, a non-profit research organization in San Francisco, USA, applies principles of design to tackle the needs of those making less than US\$4 a day, in partnership with business schools, aid organizations, foundations, and private firms. Its projects include ultra-low cost jaundice treatments, prosthetic knees, solar solutions, and pasteurization solutions.

Box 11: The "Embrace," Infant Incubator from the Stanford Institute for Design

During the 'Entrepreneurial Design for Extreme Affordability' class in 2007 at the Hasso Plattner Institute of Design⁷⁹ in Stanford University, USA the concept of creating a low cost incubator for infants emerged. Each year, 20 million premature and low-birth-weight babies are born. In developing countries, mortality for these infants is particularly high because of a lack of access to incubators due to two reasons. First, the new incubators are very expensive, costing about US\$20,000. Even if access is provided through donations, their operation requires training. The Embrace team, comprising of graduate students, began their studies in Kathmandu, the capital of Nepal. They realized that in order to save the maximum number of lives, their design would have to function in a rural environment. It would have to work without electricity and be transportable, sanitizable, culturally appropriate, and most importantly, also it had to be very inexpensive.

To achieve these objectives, the team thought outside existing paradigm of incubators and developed a solution that costs only US\$25⁸⁰ i.e., about a thousand times cheaper than the conventional incubator. They used principles of material science and developed an ultra-low cost incubator which looks like a sleeping bag which is wrapped around a premature infant, and a pouch of phase-change material (PCM) keeps the baby's body at exactly at the right temperature. This temperature can be maintained for up to four hours. After four hours, the PCM pouch could be recharged by submerging it in boiling water for a few minutes.

109. **In the Netherlands, universities, R&D organizations, business schools and enterprises have partnered to support the BoP Innovation Centre (BoP Inc),⁸¹ a Dutch non-profit entity supporting solutions in food systems, energy, water and sanitation.** Founded with the support of TNO (Netherlands Organization for Applied Scientific Research, a GRA member), in partnership with Wageningen University and Research Centre; SNV - a non-profit and international development organization; and The Innovation Co-Creation Lab (ICCL), a joint-venture between top business schools and a number of global companies, the group strengthens the inclusive innovation enabling environment in developed countries. It provides incubator support (space, connections to funding, field experience), disseminates knowledge (publishes reports, and hosts events), and conducts studies on discrete BoP issues which might be addressed through technology.

110. **Even in the absence of formalized institutes and dedicated centres, researchers in elite universities, are taking personal initiatives in conducting research on BoP solutions.** For example, Harvard Professor George Whitesides – the world's most-cited scientist – has developed

⁷⁷http://en.wikipedia.org/wiki/Hasso_Plattner_Institute_of_Design

⁷⁸<http://embraceglobal.org/>

⁷⁹http://en.wikipedia.org/wiki/Hasso_Plattner_Institute_of_Design

⁸⁰http://extreme.stanford.edu/impact/embrace_02.html

⁸¹<http://www.bopinc.org/index.php/en/about-us/strategic-partners>

low-cost paper based diagnostics (costing under one US dollar) for the poor with the prospect of improving them with cutting-edge technology. He has established a non-profit ‘Diagnosis for All’ to promote deployment of this technology all over the world. It was that awareness that prompted MIT Innovations in International Health’s X out TB, an initiative of MIT’s Innovations in International Health program.⁸²

Private Sector Firms

111. **For the private sector, inclusive innovation is emerging as perhaps the biggest business opportunity of the coming decade.**⁸³ New models are emerging where the private sector is not only doing well and doing good, but doing well by doing good. This is in stark contrast to the old worldview in which catering to the needs of the BoP was seen through the prism of philanthropy. The perception that inclusive innovation is part of corporate social responsibility is changing. That BoP markets remain under-developed and under-satisfied is increasingly seen as evidence of a lucrative potential – and not as a reason to ignore them in favor of higher priced market segments.

112. **Indeed, most of the growth in consumer spending is expected to come from people in emerging markets, who have a much lower spending capacity than traditional middle-class consumers in developed countries, leading firms to first pursue inclusive products and then pivot higher up the curve to serve the emerging middle class – and even consumers in advanced economies.** By 2030, the size of the emerging middle-class – those earning US\$4 to US\$20 a day– will triple to around 49 percent, or 725 million people, and may exceed for the first time the number of those earning under US\$4 a day. That explosion of consumer demand–spread across a range of low- and middle-income segments–can allow businesses to experiment with different scaling strategies. Indeed, inclusive innovation by firms in STI-proficient developing countries which are able to satisfy the performance requirements of the markets of the advanced world can pose a particular threat of competition to the local private sectors of developed countries–a fact not lost on multinationals loathe to be shut out of the market. Hence General Electric’s decision to “disrupt itself”⁸⁴ (Box 12).

⁸²<http://iih.mit.edu/work.htm>

⁸³ ‘The India Idea’ L.K. Sharma (Ed) Wisdomtree (2011), (www.wisdomtreeindia.com)

⁸⁴<http://hbr.org/2009/10/how-ge-is-disrupting-itself/ar/1>

Box 12: General Electric's Value Portable Ultrasound Machine

BoP innovation may not necessarily come out of altruistic motivations or by companies focused exclusively on the BoP. They can arise from multinational businesses with enormous R&D prowess keen to penetrate the BoP market with a profit motivation. Also such innovations are not necessarily low-tech, they can be very sophisticated. This point is well illustrated by General Electric's Low Cost Portable Ultrasound Machine⁸⁵. Though GE Healthcare had a significant share of the market in the ultrasound segment in affluent parts of the world it did not enjoy such success in developing countries. GE Healthcare's China team provided some interesting insights. Since most of the population in China relies on low-tech hospitals in rural areas for primary care, it was important to have an ultrasound machine that was not just low cost but also high performance, and portable. Hence, a radical departure involving a disruptive innovation was required.

From this challenge was born the compact ultrasound machine that is the growth engine of GE's ultrasound business in China today. The compact ultrasound was built from scratch, although it drew heavily from an existing R&D effort from product-development center in Israel. A revolutionary new architecture—one that shifted most of the muscle inside an ultrasound machine from the hardware to the software was created. The software-centric design made it easy to adjust the machine—for example, to improve the interfaces—after observing how doctors worked with it. The GE team also set out to learn how less sophisticated and rural doctors reacted to the machines, in order to increase its adoption. Based on this analysis of customer needs, GE designed simpler keyboards, and created built-in presets for certain tasks. It adopted a marketing strategy that emphasized training, offered online guides, and tracked customer satisfaction. In 2002, GE introduced its first compact ultrasound machine for US\$30,000. After several iterations, GE finally created a model in 2007 that sold for as low as US\$15,000, less than 15 percent of the cost of GE's high-end ultrasound machines. Despite its somewhat lower performance, it has been a hit in rural clinics, where doctors use it for simple applications.

Though primarily meant for the developing world, it generated a demand in the developed world for applications where portability is critical or space is constrained. Six years after their first launch, compact ultrasounds were a US\$278 million global product line for GE, gaining even greater traction during the recession of 2007-2009. In 2011, GE established its first global Customer Innovation Center in Chengdu, in China's western regions. The Center focuses on primary care products for the healthcare systems of emerging markets, and brings product development teams closer to the customers they serve by creating an open, customer-centric innovation ecosystem. The GE experience is now being emulated by other private sector players in high-income countries. For example, Siemens in India is working on 42 products designed for emerging markets. These include a solar powered X-ray machine and a fetal heart monitor. Some of the private sector companies in developed countries are preparing for the imminent arrival of reverse innovation⁸⁶.

113. **Examples of private sector successes in inclusive innovation worldwide mirror in process those accomplished in China.** They use technological innovation, adapt existing technology or apply recombinant innovation, deploy business process innovation, bypass or overcome the constraints in infrastructure, financing, and information exchange which isolate BoP markets, and are often the result of partnerships with universities, public labs, NGOs, governments, and unique partnerships – i.e., through open-source and crowd-sourced development – with other private sector players, facilitated by collaborative IP arrangements.

Technological Innovation

114. **Universities are not the only agents using cutting-edge research to develop inclusive products – private firms are doing it on their own as well.** As illustrated in Box 12, GE has already produced high-tech, high-quality, and ultra-low-cost health care solutions for developing countries. Various affiliates of the Tata Group are similarly using high-end research for low-cost markets. The Nano car offers one example of creating a vehicle for the masses, and using that technology to serve higher-end market segments. Through Tata's Research, Development and Design Centre, Tata Chemicals has produced an ultra-low-cost water purification system, the Tata Swatch. Like the Life Straw, the Swatch uses nano-filters to point-of-use filtration, but its filters are not for individual use.

⁸⁵ <http://www.gereports.com/reverse-innovation-how-ge-is-disrupting-itself/>

⁸⁶ 'Reverse Innovation,' V. Govindarajan, Jeffery Immelt and Chris Trimble, Harvard Business Review, October, 2009.

Box 13: Recombinant Innovation

Firms are also taking existing technology and designing it for the BoP segment. AEDC – the Low Cost Zinc-Air Fuel Cells for Rural Electrification – is one such example. Fuel cell technology has been around for about 100 years. Papsdorf, a German mechanical engineer, undertook this challenge of designing fuel cells in a way that is affordable, reliable and usable in rural areas. Convinced of the potential of zinc-air fuel cell technology for rural electrification while working for a Canadian automotive components firm,⁸⁷ Mr. Papsdorf founded Alternative Energy Development Corporation (AEDC) in South Africa in the year 2000. He designed an inexpensive plastic housing to hold the fuel cell made up of a plastic bag that contains the zinc anode and electrolyte liquid. His patented design can be assembled in about two minutes, produces uninterrupted power for up to 240 hours, and when the anodes no longer function, they can be replaced in the field without special tools within 15 minutes. These fuel cells produce energy that can be used for lighting homes, for operating normal household devices such as refrigerators and sewing machines. AEDC has electrified entire villages rather than single dwellings. In addition, in each village it generally trains two technicians to ensure the sustainability of the project, as the technicians handle the anode exchanges when the power of the fuel cell is depleted. AEDC Fuel cells have no moving parts, create energy 24 hours a day, have no carbon footprint and when the energy source is depleted, the zinc oxide residue left behind by the zinc anodes can be recycled or used as fertilizer in vegetable gardens. Since, the fuel cells replace the use of candles or the burning of paraffin or kerosene they reduce the health hazards of inhaling the fumes as well as accidental fires. The 12-volt zinc-air fuel cell can power and light a home for 31 days before a replacement of anodes is required. The costs can be competitive with those of candles and paraffin.

Box 14: Business Process Innovation: Reconfiguring the Value Chain and Leveraging Local Resources to Build-up Local Capabilities

CEMEX, a Mexican building materials company, started its “Patrimonio Hoy” microfinance program in 1998, which continues to support more than 300,000 low-income families by financing materials purchases, providing technical advice and overseeing the entire process of low-cost housing construction from start to finish. The catalyst was a standard business motivation: CEMEX noted that low income customers had more stable rates of (often necessity-driven and inelastic) demand, rather than on unstable high-earning customers. Moreover, the market was largely untapped – a dearth of financial, technical, and social (marketing) intermediaries kept it underserved by sophisticated providers like CEMEX. Thus, to reach BoP consumers, the company deputized enterprising women in target communities to develop a distribution, marketing, and financing network, and created a complete housing solution – rather than just raw materials. The local agents (called “socios”) are responsible for monitoring progress and continuity of the program in their location, and recruitment of other program participants, and benefit from distribution margins and commissions. To assist program participants, CEMEX also fixes prices of volatile materials during the 70-week program – a particularly useful term for poorly-capitalized and –diversified BoP consumers. Thus, CEMEX revamped essential business process decisions to allow it to serve the BoP market: it entered into completely new lines of business, made different decisions on in- or outsourcing, and developed local resources from scratch. The successful program is expanding coverage to reach more low-income people in Mexico, Colombia, Costa Rica, Nicaragua, and the Dominican Republic, and hopes to reach over 750,000 families during the next five years.

⁸⁷ www.changemakers.com

Box 15: The Telecom Industry Revolution in India

The telecom industry revolution in India, specifically in wireless communication, is another example of providing ultra-low-cost services by fundamentally altering industry standard business models. By shifting fixed costs to operating costs, and making the customer pay per use instead of by subscription, Indian telcos achieved an exponential reduction in costs relative to many overseas competitors. At the outset, Bharti Airtel⁸⁸ decided to risk pursuing a model based on high volume and low-margins. It thus shifted the focus from Average Revenue Per User (ARPU) to contribution per minute and from vertical integration to outsourcing, and operationalized these concepts in a systematic fashion. It outsourced all functions – including critical, but costly, parts of the supply chain – but six, and focused on clever contractual arrangements which allowed the company to incentivize quality while still profiting from growth. It also cooperated with competitors on necessary passive infrastructure which conferred no competitive advantage. For distribution, Bharti Airtel rapidly piggy-backed on existing small Indian retailers, and established an ecosystem of application developers with low costs of entry to allow phones to be used. Airtel has become one of the most benchmarked firms in the telecom industry and many telecom firms are now trying to imitate the Airtel innovation. Indeed, the Indian telecom industry now adds around 20 million subscribers per month, the cost of a minute of a cell phone time is less than one US cent, the lowest in the world, and the cost of one text message has dropped down to as little as two by thousandth of a US dollar, and a mobile handset is available for as little as US\$20.

115. **Existing models of service delivery of can also be reconceived to increase affordability and access to the BoP.** Aravind Eye Care, a low cost Cataract Surgery provider, and Narayana Hrudayalaya (Box 16), a low cost Heart Surgery provider, are two examples of such delivery process innovation in medicine. Started by G. Venkataswamy⁸⁹ with a mission to eliminate ‘needless blindness,’ Aravind Eye Care has managed to bring down the cost of cataract surgery to US\$30 – 100 times lower than the US\$3,000 cost in the USA. Instead of increasing the number of surgeons, Aravind Eye Care increased output per surgeon drawing from principles of fast-food chain McDonalds, i.e., delivery of products of fixed quality in diverse regions through an assembly line operation manned with a highly trained staff. Manpower costs were dramatically reduced through creative means: Aravind Eye Care hired paramedical staff with lower educational qualifications than those in other institutes, hired them from rural and backward areas and yet gave them far more responsibility than the other institutions did. Aravind Eye Care also addressed the problem of outreach: it developed a dual delivery method which seeks out and brings in patients to the hospital through a highly-optimized logistical system, and also brings health care to the patients by organizing outreach camps and conducting surgeries for thousands of patients. The Center avoided the high cost of imported ophthalmic supplies by establishing its own manufacturing unit, which managed to bring down the cost of lenses from US\$100 to US\$2. The end result: a comparison of the data on some post-surgery parameters shows that Aravind Eye Care outperforms Royal College of Ophthalmic Surgeries in UK; the outfit performs 300,000 surgeries per year, and, by partnering with hundreds of hospitals, is now spreading its model to other countries.

⁸⁸ ‘Innovation’s Holy Grail,’ C.K. Prahalad & R.A. Mashelkar, Harvard Business Review, July-August 2010

⁸⁹ <http://www.aravind.org/>

Box 16: Narayana Hrudayalaya Low Cost Heart Surgery

Dr. Shetty, India's most celebrated heart surgeon, was determined to make the huge heart surgery industry more efficient by applying Henry Ford's management principles. Motivated by the idea that higher volumes lead to lower costs, he created Narayana Hrudayalaya- Low Cost Heart Surgery Centre in Bangalore, India. It combines economies of scale and specialization to radically reduce the cost of heart surgery gave rise to Narayana Hrudayalaya Hospital⁹⁰ in Bangalore. The hospital has 1,000 beds (against an average of 160 beds in American heart hospitals). Dr. Shetty and his team of 40 odd cardiologists perform about 600 operations a week. The sheer number of patients allows surgeons to acquire world class expertise in particular operations, and the generous backup facilities allow them to concentrate on their specialty rather than wasting their time on administration. The hospital charges vary but they can be as little as US\$1200 for open-heart surgery, compared with US\$20,000-100,000 in America, but its success rates are as good as in the best American hospitals.

The health care group has created a health insurance scheme, working with various local self-help groups that cover 2.5 million people for a premium of about 11 US cents a month each. About a third of the hospital's patients are now enrolled in the scheme. A sliding scale of fees is used for operations so that richer customers subsidize poorer ones. The entire enterprise is profitable given how many poor people it treats. Dr. Shetty's family owned hospital group reports a 7.7 percent profit after taxes, compared with an average of 6.9 percent in American private hospitals⁹¹. Dr. Shetty has established video and internet links with hospitals in India, Africa and Malaysia so that his surgeons can give expert advice to less experienced colleagues. He also sends clinics on wheel to nearby rural hospitals to test for heart disease.

116. **Decentralized 'Inclusive' Textile Manufacturing in India is another example of how private firms have achieved radical cost reductions by leveraging local resources.** In contravention to trends, textile manufacturers decentralized cotton to yarn production so that the field to fabric chain can be entirely village-based. This decentralized textile manufacturing innovation aims to stem migration from rural areas to urban cities, where huge textile mills are located, and create jobs in villages themselves.

⁹⁰ <http://www.narayanahospitals.com>

⁹¹ 'The India Idea' L.K. Sharma (Ed), Wisdomtree (2011), (www.wisdomtreeindia.com)

Box 17: Decentralized Textile Manufacturing: The Fractal Foundation

The Fractal Foundation in India⁹² has opened up the opportunity to reorganize the value-chain in the form of vertically-integrated clusters by enabling decentralized spinning through its line of “micro-spinning” machines, referred to as “the first ever desktop, in a world of mainframes” by an industry observer. These machines enable production at a scale that is 100 times smaller than the industry norm. Each ‘unit’ of decentralized textile production involves the entire chain from cotton lint to marketable cloth. Such a unit can provide livelihood to about 70 persons and generate an annual turnover of about US\$200,000.

The innovation offers a return of textile production to the community so that cotton yarn production, the dye house, the weaver and the garment-making unit are all localized. The new process is energy-saving, eco-sensitive, socially responsible – and produces good clothes. The revolutionary carding machine separates cotton fibers, cleans them and organizes them into a uniform endless sliver – at the rate of a million fibers every four-seconds. The draw-frame blends multiple carded slivers into one, with enhanced uniformity, and fiber parallelism. The drawn slivers are thinned-down to the thickness of a pencil-lead and wound precisely around bobbins, to render them amenable to subsequent spinning. The first pre-spinning machinery was installed on the field in 2002 in Chirala, Andhra Pradesh, India. The machines are operated by local rural youth, with high school education or with vocational qualifications.

The contrasts of decentralized textile manufacturing with conventional methods are stark. In the conventional Textile and Clothing industry, large scale is used for gaining a competitive advantage. As an example the vertical integration in a conventional industry involves 16,000 workers from cotton to cloth, producing around 3000 tons per year. The integration involves around 4000 farms, with 30 gimps, one large sized spinning mill, using 75 dyeing units with weaving done in 10,000 looms. In a vertically integrated decentralized cluster based on the new process, the cotton to cloth process is done by 240 workers, with an output of 40 tons per year. It involves 40 farms, one ginning unit, with 4 units of micro-spinning, 1 dyeing unit with the final waving being done in 130 looms. The new process combines the best of both processes and creates a reasonably priced fabric which is exported to Italy, France, Norway, the UK and the US, and is also affordable for the local villagers who create it.

Bypassing Constraints

117. **The “Chotu Kool”– an ultra low cost refrigerator developed by firms Godrej and Boyce in conjunction with BoP women–bypasses the need for constant grid-electricity through highly efficient battery-operation.** India hosts the world’s largest population deprived of electricity - some 92 percent of this population lives in rural India, with 380 million people or 71.7 million households. Chotu Kool meets the challenge of providing effective refrigeration to these households. The portable, top-opening unit weighs only 7.8 kg, uses high-end insulation to stay cool for hours without power, and consumes half the energy used by regular refrigerators – and costs only US\$69. To achieve its efficiency, the Chotu Kool does not use a compressor. Instead, it runs on a cooling chip and a fan similar to that is used in computers – and like computers, it can run on batteries. The impact is substantial: it reduces food costs, improves quality of life, and can potentially be used to store and transport vaccines and medicines to remote and underserved areas. The Chotu Kool is also exemplary for ensuring that the product had significant outreach. Since Chotu Kool was co-designed with village women it has had increased acceptability. In a true “More from Less for More” (MLM) spirit, the unit has only 20 parts as opposed to more than 200 parts in a normal refrigerator, making it easily serviceable. It also tapped into existing microfinance networks in India for distribution and financing, and marketing is performed entirely by villagers on commission.

118. **The Life Straw,⁹³ a water filter designed for per person use, provides potable water without electrical power, batteries or replacement parts, running water or a piped-in water supply.** The Life Straw is a plastic tube 31 centimeters long and 30 millimeters in diameter, and costs around US\$5.50 plus shipping. Water that is drawn up through the straw first passes through

⁹² www.fractal.in

⁹³ <http://www.vestergaard-frandsen.com/lifestraw/lifestraw-family/features>

hollow fibers that filter water particles down to 15 microns across, using only physical filtration methods and no chemicals. The entire process is powered by suction, similar to using a conventional drinking straw. Life Straw filters a maximum of 1000 liters of water, enough for one person for one year. It removes 99.9999 percent of waterborne bacteria, 99.99 percent of viruses, and 99.9 percent of parasites. It has an easy-to-clean pre-filter and purification cartridge and all the raw materials are US Food and Drug Administration compliant or equivalent. While Life Straw is mostly used by hikers in the developed world, and its widespread adoption remains limited due to its cost, Life Straw has been used with NGO support during humanitarian crises such as the 2010 Haiti earthquake, 2010 Pakistan floods, and 2011 Thailand floods.

119. **The massive scale adoption of mobile services due to extremely low costs has greatly facilitated commercial transactions by overcoming infrastructure constraints.** Innovations in general purpose technologies such as ICT have enormous multiplier effects as they have applications in numerous fields, and bring enormous efficiency to economic interactions while reducing information asymmetry. Communication, for example, helps fishermen not only get weather updates and fish concentration areas; it also helps them get accurate pricing information. Mobile communication has also spurred interesting models of delivery of health services and deepened social engagement.

Foundations and International Development Institutions

120. **Global Foundation such as Bill & Melinda Gates Foundation, Global Clinton Initiative, Welcome Trust, and others, are involved in funding inclusive innovation partnerships among different players.** Each of them support different domains and use different methodologies. These initiatives have drawn interest from the most advanced institutions, from Harvard to Yale to Oxford and Peking University. The ‘grand challenges initiative’⁹⁴ posed by Bill & Melinda Gates Foundation is one of the most innovative initiatives in recent times, which is giving a much needed boost to inclusive innovation. It is a five year US\$100 million initiative to encourage bold and unconventional research on novel global health solutions. It challenges the best minds around the world with a chance to win US\$100,000 grants to further their research. Presently it is in the eighth round.

121. **The Global Responsibility License (GRL) strikes the right balance between the commercial exploitation of intellectual property (IP) and unlocking knowledge to help the world’s poorest people.** GRL is a project of the Young Global Leaders Group of the World Economic Forum working in concert with commercial companies, research organizations and IP development organizations such as Public Intellectual Property Rights for Agriculture (PIPRA). It addresses the challenge that only a few companies, universities, government agencies, and non-profits have the expertise and resources to broker successful deals that make a difference to the poor in developing countries. This is one the key causes of the failure to sufficiently leverage global capacity to design, develop, and deploy technologies that will improve the lives of the BoP. GRL is a practical solution that addresses this gap by promoting better use of technology to impact global poverty and making it easier for patent holders to temporarily release their patents for humanitarian purposes. GRL makes it easier for patent holders to make a significant contribution to aiding vulnerable populations in the poorest countries because it is a modular license, created specifically for the use of IP for development purposes. Corporations retain ownership of any research they have undertaken while giving NGOs the opportunity to improve the quality of life for the poorest. GRL

⁹⁴www.grandchallenges.org

thus unlocks IP to benefit the one billion poorest people in the world without requiring companies, universities and other IP holders to give up their rights to exploit their IP for other commercial uses.

122. **Launched as a part of the G20 leaders’ summit in Cannes on November 3-4, 2011, the “G20 Challenge on Inclusive Innovation”⁹⁵ seeks to recognize business with innovative, scalable and commercially viable ways of working with and for the BoP.** This is naturally a response to the fact that for the private sector, inclusive innovation products and services are emerging as perhaps the biggest business opportunity of the coming decade. The G20 Challenge defined inclusive business as a private sector approach to providing goods, services, and livelihoods on a commercially viable basis, either at scale or scalable, to people at the base of the pyramid by making them part of the value chain of companies’ core business as suppliers, distributors, retailers, or customers. The most innovative models use creativity and smart business thinking. The main features of innovation include building the capacity of the BoP, financing the BoP, adapting products for the BoP and distributing goods and services to the BoP. The 15 winners of the G20 Challenge combine these innovation features. The G20 Challenge winners are homegrown and financially sustainable companies in various sectors, including agriculture, affordable housing, health, education, water utilities, supply chain finance and retail.

Partnerships and Collaborative IP

123. **Successful inclusive innovations have relied on collaboration between various agents.** Many of the products discussed above were the result of partnerships across sectors. For example, the pine needle stove developed by MIT’s D-Lab was spurred by a challenge posed by an Indian NGO, Avani. With its superior knowledge of the BoP experience, Avani identified the BoP need, and helped coordinate development of the solution. South Africa’s tea-bag water purifier only achieved widespread use through commercialization as the Life Straw, and even that product had to be leveraged with NGO support to make it truly accessible to BoP consumers, which has focused distribution of the product on disaster-relief efforts. The Aakash tablet was collaboration between the Indian government, which established the mandate; Indian universities & RTIs, which helped develop the product; private firms, which innovated in response to the mandate and early research to reduce component costs and ultimately take over production. Similarly, Patrimonio Hoy has relied on support from the Inter-American Development Bank for credit guarantees. Other examples of inclusive innovations built through such partnerships are described in the Box 18.

⁹⁵<http://www.g20challenge.com>

Box 18: Inclusive Innovation Examples

MEDIKits. Medical Education Design Invention Kits (MEDIKits) are do-it-yourself medical device kits designed to unleash creativity in medical professionals in developing countries⁹⁶. Inspired by “evidence of innovative solutions in healthcare frontlines”—such as nurse-created accessories for neonatal intensive care units and homegrown suture and implant alternatives—this initiative of MIT’s Innovations in International Health (IIH, USA) program functions as a barrier-breaking “meta-innovation”: by offering the right tools to lead users, these kits facilitate necessity-driven, ground-level innovation, and bypass the inertia of healthcare infrastructure investments.

Spiral Pine Needle Stove. In response to a challenge posed by India’s Avani NGO, the Spring 2010 D-Lab Design class at MIT (USA) designed a stove capable of burning pine needles—a renewable energy source far less scarce than the wood fuel upon which many people in India rely⁹⁷. Featuring spiral chamber geometry and other innovations to accommodate the unique difficulties of pine needle combustion, the stove can boil 5 liters of water in 15-22 minutes using roughly a pound of pine needles, and has a current prototype cost of US\$20-\$25.

Bici-Lavadora. The Bici-Lavadora (a MIT D-Lab project), is a portable, pedal-powered washing machine⁹⁸. With an estimated prototype price of US\$127, this innovation stands to vastly increase the productivity of wash women, and bring some of the benefits of an appliance often taken for granted elsewhere in the world at low-cost and without reliance on electricity.

Safe Surgery Sterilizer. More effective than chemical sterilants and boiling water, this low-cost, solar-powered autoclave offers rural health facilities the ability to sterilize instruments onsite⁹⁹. Another initiative of the Innovations in International Health program at MIT (USA), the innovation stands to lower surgical infections in areas without electricity or where electricity outages are frequent.

Phototherapy for Jaundiced Newborns. In collaboration with Stanford University (USA) and the National College Inventors and Innovators (USA), D-Rev Design Revolution (USA) developed a brilliance phototherapy treatment for newborn babies with severe jaundice. At a cost 25 times lower than comparable Western devices, the innovation stands to empower clinics to treat the over 20 million children in the developing world who suffer from jaundice each year¹⁰⁰.

Freeplay Lifeline Radio (South Africa). The Lifeline Radio¹⁰¹ was designed and robustly constructed to operate in the harshest conditions and climates. It is rugged, colorful and easy to use and runs on either self-charge or solar power. It receives excellent AM/FM/SW reception. It plays non-stop for 24 hours and has been extensively researched and field-tested to determine its functionality, styling and ease of use for people who need sustainable access to listening. The Lifeline radio enables sustainable access to information and educational content. It has been used to provide information that is vital to improved health, safety, education, agricultural productivity, disaster mitigation and governance. The Lifeline radio is the first radio that has been designed specifically for use by women and children.

Low Cost Clean Light for the Poor (Canada). In 1998, Dave Irvine-Halliday, a professor of electrical engineering at the University of Calgary in Alberta, Canada began developing his own white LEDs or WLEDs, based on a design pioneered by Nichia Corp. in Japan. Field tests in Nepal in 1999 were done and three Nepalese villages were illuminated with WLEDs. Three years later, he founded¹⁰² the Light up the World (LUTW) Foundation to bring LED technology to the poor on a global scale. The non-profit group has helped to distribute low-power, white LEDs at low cost to more than 26,000 homes in 51 nations worldwide, illuminating the worlds of more than 300,000 people. There are numerous advantages to LEDs: they can be run on very small batteries; users don't have to be connected to a central electrical grid; they can deliver up to 100 times more light to illuminate an area than kerosene lanterns; and they can shine continuously for up to 50,000 hours compared with only 1,000 hours for traditional incandescent light bulbs. LEDs also use close to 80 percent less energy than incandescent light bulbs. The goal of supplying LED-driven light is help the poor increase their work productivity; give them more time to study at night; and reduce the widespread health problems and fire hazards caused by the use of kerosene lamps. In 2003, LUTW expanded their operations to India, Pakistan, the Philippines, Mexico and Ecuador. In 2004, a project in Ghana marked their first foray into Africa. LUTW’s response to the 2004 Tsunami in Sri Lanka was its largest operation, providing light to more than 2,000 temporary shelters. In 2008, its focus was on Papua, New Guinea, Ecuador, Peru, and Tibet. In 2009, it partnered with Cause Canada to bring solar powered reading lights to Honduras and its 2010 projects include Haiti, Guatemala and Costa Rica. LUTW supplies non-profit and humanitarian organizations with the lighting system components at subsidized prices. Typical home-based system costs as little as US\$75

⁹⁶ <http://iih.mit.edu/innovation.htm>

⁹⁷ <http://www.youtube.com/watch?v=ntmX8aFuKOA>

⁹⁸ <http://web.mit.edu/teresab/www/Bicilavadora/index.html>

⁹⁹ <http://www.who.int/patientsafety/safesurgery/en/>

¹⁰⁰ http://www.zzdison.com/products_list/

¹⁰¹ <http://www.freeplayfoundation.org/>

¹⁰² www.lutw.org

excluding shipping. Often, these can be financed by recipients with loans from micro-credit organizations. In contrast, many people in the countries served by LUTW spend up to US\$200 a year on fuel to keep their homes lit at night with polluting (and unsafe) kerosene-based lamps. The solar-powered system pays for itself in as little as two years when compared to using kerosene, though the battery needs to be replaced in two to three years.

The Milk to Market initiative. It is important to create a network of all the stakeholders so that the inclusive innovation based solutions can be deployed in the field. The Milk to Market initiative, which pertains to a low cost milk pasteurization innovation, is a good case in point¹⁰³. To solve the problem of spoilage and contamination plaguing milk storage, D-Rev Design Revolution (USA), in partnership with the International Livestock Research Institute (Kenya), Niparaja (Mexico), the Bill & Melinda Gates Foundation (USA), University of Arizona (USA), Meridian Design Group (USA) and Heifer International (USA), is developing three promising, low-cost innovations designed to help small-scale African dairy farmers bring more of their milk to market. These include two novel methods of pasteurization—low temperature pasteurization using little more than a simple kitchen thermometer and farmer’s stove, and cold pasteurization using UV-C ionizing radiation—as well as a low-cost method of making chlorine bleach to more effectively clean milk storage and transport containers.

124. **Collaborative Intellectual Property (IP) has also created networks of talent resolved to address BoP problems.** Novel concepts such as ‘open source’ leverage resources from all around the world and all sectors to make solutions amenable to customization for BoP needs. Frontline SMS open source text messaging software created by Ken Banks in the UK – transforms basic tools that most NGOs already have (computers and mobile phones) into a communications hub useful for fieldwork and surveys. It allows text messages to be sent to large groups, whose members can respond individually. Frontline SMS has spawned a number of other initiatives for use in specific fields such as health, finance, education, law and media. Perhaps its biggest impact has been in the medical field by an organization called Medic Mobile, which used Frontline SMS to empower a hospital in Malawi to care for a dispersed community of 250,000 people with only 2 doctors on staff. By equipping a network of 500 volunteer community health workers with cell phones and the Frontline SMS program, the hospital has greatly improved patient communication and care, while saving transportation time and costs by allowing patients to send health updates via text instead of forcing them to travel long distances to physically deliver information. Today, Frontline SMS is used in 70 different countries by more than 10,000 social-change organizations. It has enabled many communications-based projects such as disaster relief coordination in Haiti, a rural health-care network in India and a network for field communication used by a humanitarian organization in Afghanistan. The software remains free, and because the source code is open, developers are free to create their own features. Its current version supports on-screen language support for English, Arabic, Azerbaijani, Bengali, German, Spanish, Finnish, French, Hindi, Indonesian, Khmer, Portuguese, Russian, Swahili and Chinese.

125. **Inspired by successful innovation through an open source model in software development, open source principles are now being used in other fields such as drug discovery.** In the software industry, well-known examples such as the Linux operating system and Apache web server have demonstrated that open source methods can create market leaders. This success led many to speculate if open source can be applied to other industries with similar success. The pharmaceuticals industry is often seen as the prime candidate for possible transfer and adaptation of open source principles of collaboration and open IP. The World Health Organization’s Consultative Expert Working Group for Research and Development Financing and Coordination is currently evaluating open source drug discovery platforms – and several open source drug discovery projects already underway. The Synaptic Leap -a network of online research communities that connect and

¹⁰³ <http://d-rev.org/projects/milktomarket.html>

enable open source biomedical research- hosts a project to develop a new synthesis of the schistosomiasis drug, praziquantel. The CSIR India also has a formal Open Source Drug Discovery (OSDD)¹⁰⁴ initiative (Box 19), and an initiative called BiOS¹⁰⁵ (“Biological Innovation for Open Society”), which fosters decentralized, cooperative innovation in the application of biological technologies, through the merging of intellectual property informatics and analysis; innovation system structural reform; cooperative open access technology development activities. “Crowd-sourcing” innovation also has promise: Innocentive, Nine Sigma, and Foldit, are examples of organizations broadcasting an open call to solve problems, which are heeded by an undefined large group of people carrying on tasks usually performed by employees.

Box 19: CSIR India- Open Source Drug Discovery Program

The goal of the CSIR India’s Open Source Drug Discovery initiative is to enable open, collaborative scientific research that will make possible the discovery and development of drugs at a far cheaper cost than traditional pharmaceutical innovation. Its models are inspired by the success of the open collaborative processes that resulted in the speedy sequencing of the human genome and the Linux computer operating system – models deviating heavily from the closed-door environment, where confidentiality and intellectual property protection are paramount given the huge rewards that a successful drug launch can provide, which characterize traditional pharmaceutical research.

OSDD has created a scientific community of more than 4,500 participants from 135 countries. OSDD’s initial thrust is on producing more effective drugs to combat infectious diseases common in the developing world, specifically tuberculosis, which kills 1.7 million people annually, according to the World Health Organization (WHO). In some areas of the world, one in four people cannot be treated with existing TB drug regime, according to WHO.

OSDD has achieved a remarkable initial success: in 2010, it brought together hundreds of scientists by designing a “connect to decode” conference to provide the first ever detailed mapping of mycobacterium tuberculosis (MTB). While the MTB gene was sequenced more than a decade ago, until this conference, only about a quarter of the nearly 4000 genes had been annotated. In the true spirit of OSDD, it has made the TB gene map available in the public domain for drug makers. The current OSDD model is going to be used primarily to develop extremely affordable drugs required by resource poor people all around the world. However, OSDD has demonstrated the power of galvanizing the collective imagination and creativity of “anyone, anytime, anywhere.”

126. **Patent pools offer another collaborative mechanism for creating inclusive products.** Patents are known to be a major impediment in lowering costs. However, when the market has very limited purchasing power, as is in the case of developing countries, patents are not necessarily effective in stimulating R&D and bringing new products to the market. A patent pool allows a number of patents held by different entities to be made available to others for production or further development. The patent holders receive royalties by the users. Patent pools are part of World Health Organization’s recently adopted Global Strategy on Public Health, Innovation and Intellectual Property to help increase access to medicines. Several such initiatives are underway. For instance, Knowledge Ecology International¹⁰⁶ is trying to create a patent pool for medicines in low and middle income countries. In February 2009, Glaxo Smith Kline announced a patent pool initiative, with the intention of many drug patents for tropical diseases into a free pool.

Lessons and Challenges from Global Inclusive Innovation Efforts

127. **The inclusive innovation process must harness all innovative processes: high-tech, low-tech, business models, process efficiency, and delivery models; and technologies can have uses**

¹⁰⁴ <http://www.osdd.net/>

¹⁰⁵ <http://www.bios.net/daisy/bios/home.html>

¹⁰⁶ <http://www.keionline.org/>

not just for the BoP in developing nations but also for regular populations in the developed and developing nations. This means traditional frontier innovation agents, and ecosystem linkages in the frontier innovation ecosystem, must be re-evaluated, re-tooled, or even created from scratch. Indeed, the challenge is tougher: an inclusive innovation ecosystem must be global in scope but also reach targeted localities as well, cutting across differences in geographic location, access to financing, education, socioeconomic status, culture, and way of life. By supporting the initiatives of elite institutes and formalizing the international exchange, the fragmented efforts can be consolidated to yield superior results. With appropriate facilitation, the direction of trade and technology can run in any direction: north to south, south to north, or south to south.

128. **Sustainable adoption and outreach remains a considerable challenge for inclusive innovation efforts: just as inclusive ideas are under-developed, they are also under-commercialized.** Innovations such as Life Straw and Free Play lifeline radio can have uses for several needs and are not restricted to sections of population or specific geography. Such existing technologies that have shown enormous promise but are still not widely adopted by the BoP due to cost reasons can be suitable candidates for inclusive innovation. Also, as discussed earlier, there are numerous inventions either at prototype stage or with limited commercial success at the BoP level. Scouting for such innovations and exploring ways by which such innovations can be made cost efficient would be a more efficient route to achieving desired objectives as opposed to initiating new product research on the concerned topic. The problem is not simply that the technology is not as promising as it seemed during the research stage: some, like the Life Straw, have been commercialized, but only as luxuries for high-income consumers. This suggests that firms are struggling to overcome the numerous barriers to entering BoP markets.

129. **Indeed, solutions created with a holistic view of the ecosystem in which the innovation resides – and confront the BoP as both consumer of innovation and a participant in it – are more likely to be widely adopted.** Typical financing, marketing, delivery, and design perspectives may fail, and firms which developed the capacity to overcome those challenges of BoP markets have succeeded. Deep and nuanced understanding of the needs of the BoP defines and clarifies the goals of the product, and avoids problems by the Nano Car, and the “One Laptop for All initiative” – both of which significantly missed goals in serving their target markets because consumers simply did not take to them. Moreover, firms must intermeditate between themselves and their market – and that means forming relationships with consumers and deploying them as a resource. CEMEX localized financing, marketing, and distribution of cement and other materials to support the BoP. In the case of the Chotu Kool, the entire sales and delivery channels are drawn from the community leading to not just greater adoption due to factors such as trust, but also producing income generating opportunities within those communities. Challenges, however, remain. For inclusive innovation businesses, such as start-ups, such investment in gathering critical information and exploring new markets could be cost prohibitive – and even sophisticated firms struggle to do it. Alleviating the cost burden and help in information gathering and dissemination can be beneficial.

130. **Like frontier innovation, successful inclusive innovations have relied on a handful of champions of the ‘More from Less for More’ (MLM) approach to doing business.** Visionary leaders in industry, such as GE’s Jeffrey Immelt, and Tata Group’s Ratan Tata, individual researchers such as Professor George Whitesides, leaders of public institutions, and pioneering public officials have brought inclusive innovation from concept to reality (Box 20). This is not surprising, given the risk, disruption, awareness, inherent in the MLM approach. Even well-formed innovation ecosystems, like Silicon Valley, place immense emphasis on high-value individuals, and maximize

their contagion effect through angel, incubation, venture, and cross-sector networks. The same can be done with inclusive innovators.

Box 20: Leadership Matters

Successful leaders in inclusive innovations share several traits. First, they have a deep commitment to inclusive growth. Companies often identify markets by asking: “Given our cost structure, which segments can we serve?” Successful inclusive innovation leaders always asked: “Given that we need to cater to the unserved, what should our cost structure be?” Second, these leaders complemented their business vision with a human dimension. Thus the leaders like G. Venkataswamy of Aravind Eye Care were passionate about eliminating ‘needless blindness.’ Third, they established ambitious goals and clear time frames for achieving them: Ratan Tata set a target of a US\$2,000 car, and Dhirubhai Ambani setting a target of a phone call at the cost of a post card, to name a few examples. Fourth, successful inclusive innovation leaders have forced project teams to work within self-imposed boundaries that stem from a deep understanding of consumers. This has resulted in a novel, outside-in view of innovation – and even changed the language inside their organizations, which now call “consumers” as people, “suppliers” as partners, and “employees” as innovators. All of these traits have resulted in an affirmative answer to the fundamental question any firm can ask about its business: “If we change the way we operate to reduce costs and focus less on operating margins, can we earn an even higher return on capital? If we reduce prices enough and make our products available to the poor, will there not be explosive growth as they quickly find uses for and buy our offerings?”

131. **Great success stories can spur other innovations both domestically and abroad raising critical issues related to intellectual property protection.** The quintessential problem of balancing protections and fostering competition must be struck, but the cost to innovation—particularly inclusive innovation—must be made explicit. Moreover, collaborative IP, motivated by a combination of social responsibility and profit, must be fully examined as an alternative for at least certain products in certain markets.

132. **Several key lessons can be drawn from global inclusive innovation efforts such as:**

- Inclusive innovation is a very useful policy instrument to improve social inclusion and harmony, but it is not a ‘silver bullet’. It is one important tool in the basket of many tools available to policy makers, but it is by no means the solution to all social problems. Therefore, Governments need to consider deployment of all possible tools including inclusive innovation in designing strategies to deal with the social inclusion and harmony.
- Given that the concept of inclusive innovation is relatively new, currently, there are no real best practices, or a country that has demonstrated the significant impact of a set of coherent and inter-linked policies to foster inclusive innovation. India is well head in this regard, but even India’s efforts are work-in-progress. Therefore, we lack clear evidence on how to make inclusive innovation happen from a systemic or policy stand point.
- The inclusive innovation process must harness all innovative processes: high-tech, low-tech, business models, process efficiency, and delivery models; and technologies can have uses not just for the BoP in developing nations but also for regular populations in the developed and developing nations.
- Sustainable adoption and outreach remains a considerable challenge for inclusive innovation efforts: just as inclusive ideas are underdeveloped, they are also under-commercialized. There are numerous inventions either at the prototype stage or with limited commercial success at the BoP level.
- Solutions created with a holistic view of the ecosystem in which the innovation resides – and involve the BoP as both consumer of innovation and a participant in it – are more likely to be widely adopted.
- Like frontier innovation, successful inclusive innovations have relied on a handful of champions of the ‘More from Less for More’ (MLM) approach to doing business.

Visionary industry leaders, such as GE's Jeffrey Immelt, and Tata Group's Ratan Tata, individual researchers such as MIT Professor George Whitesides, and leaders of public institutions have brought inclusive innovation from concept to reality.

CHAPTER 4: POLICY OPTIONS FOR PROMOTING INCLUSIVE INNOVATION IN CHINA

I. Key Goals of Public Policy Intervention

133. **As discussed earlier, the Chinese government has placed building a harmonious society and reducing disparities in income and access to services on top of its agenda.** In September 2010, President Hu Jintao proposed an inclusive growth strategy aimed at reducing poverty, narrowing rural and urban income gap and promoting equal access to basic social services for urban and rural poor and migrant workers. The 12th Five-Year Plan (2011-2015) enshrines the goal of “sharing benefits of development by all Chinese people”. In this context, inclusive innovation is of high relevance for the Chinese authorities but the concept is new to the Chinese government, from both conceptual and policy perspective. So far, China has emphasized frontier innovation, yet has recognized the importance of inclusive innovation in addressing increasing disparity between the rich and poor.

134. **Five elements of inclusive innovation- affordable access, high quality, low cost, sustainable business model, and extensive outreach- are fundamental.** As noted in previous Chapters, there are many examples of policy initiatives and promising products in the domain of inclusive innovation, unfortunately, such developments are highly inadequate, especially in relation to the huge unmet needs of the BoP. Further, many such products are either at prototype (e.g. Embrace infant incubator) stage or small scale production (e.g. Jaipur foot). Only a few have achieved large scale sustainable production. Examples of new product technologies, the end result of innovation needs to be seen in terms of large-scale adoption/diffusion and market impact. In that respect, commercialization and bringing inclusive inventions to market remains a major challenge. Obviously, in situations where the invention is part of a market expansion strategy of a private firm, there is a strong incentive to address the diffusion question- success stories such as telecom in India, GE’s portable ultrasound, Godrej Chotukool. These illustrate market dynamics – a private firm responding to a market opportunity. However, as mentioned earlier, there are domains of inclusive innovation where there might not be a strong private sector player for either creating new innovations (especially, low cost and high quality) or bringing the innovations to market. In these situations, the challenges of developing enough new products or commercialization and diffusion are non-trivial, and require appropriate policy support and interventions.

135. **Given that the concept of inclusive innovation is relatively new, currently, we do not really have best practices, or a country that has demonstrated the significant impact of a set of coherent and inter-linked policies to foster inclusive innovation.** While countries have been implementing initiatives (including inclusive innovation) to deal with the social inclusion, most countries do not have explicit inclusive innovation strategy. India is well head in this regard, including setting up a high level National Innovation Council, formulating an explicit inclusive innovation strategy, setting up a dedicated Fund, and promoting clusters, etc. But even in this case, India’s efforts are work-in-progress. Therefore, we lack clear evidence on how to make inclusive innovation happen from a systemic or policy stand point. The issues faced by grassroots innovators (innovators who lack formal training or education but who come up with ingenious solutions to their own problems) are different from those of the enterprise innovators.

136. **‘Inclusive Innovation’ should not be looked as a ‘silver bullet’, but as a useful policy instrument which can make a difference in social inclusion and cohesion.** Inclusive innovation is

one important tool in the basket of many options available to policy makers and should be deployed along with other instruments to maximize impact in dealing with the issue of social inclusion and harmony. Such tools include, but not limited to: a supportive business environment, physical and ICT infrastructure (especially rural), sound FDI regime, protection of intellectual property rights, governance systems, strong institutions, participatory approach, direct subsidies, sound education system, labor mobility, market based competitive economic environment, including vibrant private sector, etc. For example, reform of the household registration (*hukou*) system holds the potential to unleash enormous welfare improvement for hundreds of millions of the rural poor in China, which cannot be matched by any other means including inclusive innovation. The same goes true for rural infrastructure, such as a paved road connecting a poor village to the main road.

137. As discussed in Chapter 2, China has the basic building blocks that are prerequisites for becoming an inclusive innovation powerhouse:

- A well-developed national innovation system, with solid indigenous knowledge and technology capacity;
- A strong institutions and entrepreneurial culture;
- A thriving class of business persons and professionals;
- A growing private sector with strong manufacturing capacity and reverse innovation capabilities;
- Strong and widely-covered physical and ICT infrastructure; and
- An enormous BoP market with huge potential purchasing power.

138. However, China's current inclusive innovation ecosystem faces significant challenges. In China, many efforts are being made in the domain of inclusive innovation, but there is no explicit national strategy and implementation plan. While China has a large number of public support programs many of them suffer from important deficiencies such as: most government programs and policies are ad-hoc and inadequately structured, uncoordinated, and inefficiently operated; private sector efforts are limited in scope due to a lack of incentives, barriers to BoP markets, implicit bias against the private sector, regulatory burdens, and a lack of early-stage financing; universities and research institutions remain insufficiently focused on inclusive innovation and their output seldom leads to usable and widely adopted products; grassroots innovation is not well-supported and remains sporadic and limited in scope and impact; international collaboration on innovation is insufficiently oriented towards inclusive innovation; and the linkages between all of these actors are weak and in some cases non-existent. This situation raises many questions whether in China, the numerous Government inclusive innovation-related initiatives in their current state are operating efficiently, have a wide outreach, adequately leverage the capabilities and comparative advantages of all stakeholders, sustainably producing pro-BoP products, and deliver best possible outcomes and impact for the target population, at a least burden to public budgetary resources.

139. Sound public policy can help address many of these challenges and create a well-functioning innovation infrastructure that raises inclusive innovation outputs on a sustainable basis. Experience in China and globally demonstrates that output of inclusive innovations relies heavily on a vibrant inclusive innovation ecosystem. Policies that harmonize efforts, facilitate partnerships across sectors, institutions and borders, and coordinate financing, can result in a superior generation, exchange and transfer of pro-BoP knowledge, and take innovations from conception to

deployment and widespread adoption. The policy instruments should be based on the principles of achieving wider impact, greater outreach, and deeper involvement of all stakeholders. To leverage the managerial and organizational efficiency, manufacturing capabilities, market knowledge, technical and industrial expertise and risk taking capability of the private sector, public policy should have provisions to encourage businesses to adopt commercially sustainable business models for inclusive innovation. The policy framework should also incorporate independent and regular monitoring and evaluation mechanisms and aim to achieve maximum efficiency, sustainable production to deliver results minimize burden on government resources. What is required is innovation (itself) in both *doing as well as delivering* inclusive innovation to Chinese society.

II. Elements of Public Policy to Promote Inclusive Innovation

140. **Given the above, China could consider certain policy tools that it may find suitable for Chinese conditions.** The Government may design, adopt, experiment and adjust various options based on its own institutional systems, experience and outcomes. Potential options for the public policy interventions include the following.

- An integrated national inclusive innovation policy and required institutional systems.
- A facile regulatory system and supportive public procurement policy.
- A dedicated fund to support inclusive innovation including private risk capital for pro-BoP solutions.
- Incentives to leverage strengths and comparative advantages of all stakeholders, especially the private sector.
- Mandates for public research system to channel the very best technical and scientific expertise towards inclusive innovation.
- Dedicated support to grassroots innovators to deepen and expand their innovation capacity.
- Collaboration with national, regional and global STI organizations to leverage global talent, technology and resources.
- Grand Challenge and recognition for game changing inclusive innovations to target specific goals- encouraging risk taking, experimentation and recognizing failures.
- Independent and regular monitoring and assessment of policies and programs to maximize efficiency and impact, and benefit from lessons learned.

Integrated national inclusive innovation policy and institutional systems

141. **An integrated national inclusive innovation policy with required institutional systems is essential to spur inclusive innovation in China nation-wide.** There are many inclusive innovation initiatives and programs in China with laudable goals and technology prowess. However, the present policy and institutional structure faces the challenge of effective co-ordination mechanism. For the entire inclusive innovation ecosystem to fire on all cylinders, an integrated national policy and co-ordination among various government levels, agencies and programs is required. Such role could be assigned to a suitable high level body with the responsibility to create a robust framework for pursuing inclusive innovation in China, and facilitate collaboration between different stakeholders, ministries and programs. This body should have power and resources to design as well as execute

policy and monitor implementation. In addition to formulating a roadmap for inclusive innovation, this agency should come up with an action plan that encourages innovation in public service delivery and synchronizes all policies and programs of central, regional and local governments aimed at inclusive innovation. This agency could help creation of clear goals for each of the stakeholders. Specific targets can help mobilize efforts of the stakeholders towards precise objectives. Similar arrangements could be considered at the provincial, district, as well as sectoral levels. For policy interventions to influence every innovation stage – from conception to deployment of the innovation – this agency should have the ability to seek views and advice from all stakeholders in inclusive innovation, such as industry leaders, eminent researchers, economists, ministries, financiers, international experts, and representatives from the NGO and BoP communities.

142. **An Inclusive Innovation Academy—a think tank to undertake policy, analytical, advisory and advocacy role by connecting various stakeholders (e.g., public officials, R&D institutions, enterprises, NGOs, global organizations, foundations) could play an important role to advance the inclusive innovation agenda in China.** Given the prolific inclusive innovation initiatives in China by businesses, NGOs and different government agencies, a think tank could help provide institutionalized mechanism to learn from experiences and experiments in China and world-wide. This could help address the problem of information symmetry among various stakeholders. It could also help deepen the culture of inclusive innovation and orient China’s rich human capital towards the same. The think tank will research lessons learned about the efficacy of various policies and programs that different countries have undertaken. Also, case studies of successful inclusive innovation initiatives by both businesses and governments world-wide will help refine the toolkit of policies and strategies and the understanding of what works best and under what circumstances. The Academy would also disseminate the literature produced by its efforts thus engendering an interest in inclusive innovation among practitioners, policymakers, amateurs and the general public. To galvanize information related to innovations and innovators in a single repository as well as act as a platform for idea exchange, a portal for inclusive innovation could be considered.

Facile regulatory system and supportive public procurement policy

143. **Easing of regulatory requirements for inclusive businesses/initiatives will be essential to expedite starting and growing inclusive businesses.** While China has made significant reforms and as indicated by its improved position on global ranking on the ease of doing business, inclusive innovation businesses face many regulatory constraints. In order to address these constraints, agencies could establish guidelines to expedite clearance and processing of legal requirements. Streamlined and expedited bankruptcy rules for this class of businesses could enable efficient and speedy allocation of resources to their optimal use. Creation of specific regulatory framework also sends a strong signal about the strong commitment of the government towards inclusive innovation. Further, a simpler IPR system oriented specifically towards BoP innovations may be useful. Such a regime will strike the right balance between encouraging innovation by protecting the intellectual property of the inventor and advancing the knowledge frontier. Inclusive innovators face special problems in protecting their inventions due to several factors including high cost, lack of knowledge of the formal IP protection process. Therefore, reducing the cost of IPR application and maintenance is particularly important, for many small and grassroots innovators are often unable to pay recurring fees for maintaining the patent. Efforts at educating the innovators about IP and supporting the innovators in filing, prosecuting, and maintaining their IP should also be considered. The IPR framework could have provisions for creative mechanisms such as Global Responsibility License (GRL) which protect IP while benefitting the BoP.

Dedicated fund to support inclusive innovation

144. **A dedicated Inclusive Innovation Fund will help provide required resources to support research, technology development, sustainable production and distribution of inclusive solutions.** This Fund, set up in a public-private partnership mode, can help address the lack of national level dedicated resources problem. Using grants, soft and hard loans, patient capital and venture capital, such a fund could support all stages of inclusive innovation required to meet Grand Challenges and devise BoP solutions, and alleviate funding challenges at all stages of inclusive innovation – especially when a lack of funding delays bringing a known product to market. The fund could also accelerate the process of moving from conception to deployment. To de-risk investee enterprises, help them develop the ability to deliver social impact and financial returns, the Fund should create a network of incubators and mentors to support and guide innovators and entrepreneurs. Emergence of successful inclusive innovation initiatives and businesses can serve as ‘models’ which can spark the imagination of the people and generate deeper interest in inclusive innovation as an attractive business opportunity.

145. **The Government will need to coordinate and provide financing, particularly early-stage financing and financing to scale-up proven products.** The segment of the innovative process where significant risk threatens to sink viable projects is longer in inclusive innovation because of the challenges of distribution, newness of markets, and adoption of products by BoP members. Thus, public support for financing may need to be present at later stages than in typical high-tech innovation. Indeed, several examples exist of promising, inclusive products that cost little to make and serve vital functions, but have yet to be marketed to the resource-poor. Instead, they remain in a proof of concept stage, or get deployed for use as lifestyle items by more affluent consumers. In this context, Government may consider to reorient some existing government funding schemes to support inclusive innovation, by redefining their scope, targets and activities. Further, as provider of essential goods and services – both through social welfare programs and in their traditional role as suppliers of public goods – government could consider limited direct support for innovations in areas like water provision, sanitation, electricity production and transmission, transportation, etc. Using instruments such as grand challenges, sponsored research, and procurement guarantees, governments can lend demand-side support to innovators, decreasing the risk and uncertainty of projects.

146. **Further, communities of practice (e.g. angel networks and venture capital organizations) focused on inclusive innovation should help making risk capital more accessible for inclusive innovation initiatives.** While China has made major strides in expanding the private equity and venture capital markets in general, viable private capital for inclusive innovation is in its nascent stage. Establishing and supporting unique funding mechanisms, including public-private partnerships and business angel networks, with special focus on equity financing can stimulate and supplement the flow of private equity capital. Establishing such communities of practice can help in capturing the lessons from various initiatives thus providing a rich source of knowledge that can help refine future funding efforts and help one community in a specific region or sector learn from another community. The government guideline fund that has specific tasks of promoting the creation and early-stage funding for SMEs in specific technologies could provide support to enterprises developing innovative solutions for the BoP. Programs directed at providing livelihood opportunities for BoP could result in the direct production of viable inclusive innovations, while also building capacity in these institutions for inclusive innovation, and promoting linkages with industry and BoP members that facilitate transfers of promising inclusive technologies.

Leveraging strengths of all stakeholders, especially the private sector

147. **The Government will need to incentivize different stakeholders to develop and deploy affordable inclusive solutions to benefit the BoP population.** Incentive regime should focus on leveraging the strengths and comparative advantages of all stakeholders, in particular the private sector. For example, innovation clusters can lead to solidifying BoP innovation as an attractive business opportunity and can drive inclusive innovation and social development. China has a thriving professional class and solid industrial and business capabilities. However a flourishing inclusive innovation ecosystem requires greater cross-pollination of ideas between different agents. The collaborative spirit in such hubs where research, business, risk capital and creativity come together to turn ideas into products, processes and services is often cited as one of the key reasons for the success of Silicon Valley. Creating hot spots or clusters of innovation leads to increased participation and collaboration between relevant parties and can increase outreach and scalability of inclusive innovation initiatives. Apart from conducting cutting-edge, multidisciplinary research such a hub creates crossroads between researchers, businesses entrepreneurs, financiers, and mentors. It also creates a critical mass of firms to experiment with concepts such as patent pools. There is increased interest among the private sector across the world in the BoP market. In order to improve the participation of the private sector the clusters could generate successful ‘role models’ businesses fueling the drive toward inclusive innovation. Such clusters could be a crucible for experimentation by firms and collaboration efforts. Industrial economists have attributed dedicated economic zones devoted to specific sectors such as ICT as one of the important reasons for success of the sector.

Orienting public universities and research institutes towards inclusive innovation

148. **A right blend of incentive structures for researchers and institutions would encourage them to marshal their intellectual capital and creativity of students towards inclusive innovation and lead to greater production and commercialization of inventions.** To create an entire culture of research on inclusive innovation, piecemeal efforts by motivated researchers and departments would not suffice. While many research organizations have taken pioneering efforts toward conducting research on inclusive innovation, by and large the research community in China focuses mostly on formal conventional research paradigms. To orient RTIs and the research community towards inclusive innovation however, newer mechanisms of prizes, rewards and incentives are needed to meet the nascent and unique area of inclusive innovation. Policy options could include mandates to major Chinese RTIs, matching grants, competitive funding mechanisms, and incubation facilities focused on inclusive innovation. Similarly, targeted early stage financing mechanisms for RTI start-ups and allowing researchers share equity in spin-offs could foster greater commercialization and technology transfer. RTIs evaluation and promotion criteria for researchers also need to adjust to encourage focus on inclusive innovation.

Inclusive solutions require a full understanding of the end-user’s technical, economic and social needs, which may be quite site-specific. For non-community members, understanding needs, especially in socio-cultural terms, requires immersion in the community coupled with well-developed informal information gathering and analytical skills, which even accomplished scientists do not normally possess. The Chinese Government can thus intervene to help Research Councils strengthen their research prioritization and technology intermediary function: it can, for example, support studies for needs assessments of the BoP, which RTIs can use as input for research planning process.

Box 21: Instruments to Foster University and RTI Participation in Inclusive Innovation

- The Chinese Government could formalize the incentive structure for RTIs aimed at delivering inclusive solutions. The funding of the Science Councils could be linked to the delivery of outputs and outcomes for the benefit of the BoP.
- The Governing and Executive bodies of the RTIs should have representatives of socio-economic ministries and other stakeholders including NGOs representing the end-users in order to give inputs on inclusive innovation programs that will meet the needs of the resource poor people.
- A methodology could be developed, which can be applied at the project proposal stage to help researchers specify how they anticipate their work to impact positively on inclusion. While, it is difficult to predict the impact of research on inclusion, it should be possible to identify and screen out proposals clearly unrelated to inclusion.
- The performance measurement system could take into account indicators that best capture the benefits to society. Science Councils are expected to produce a mix of outputs. These can be labeled as private goods, public goods, social goods and strategic goods.
- Value system could be changed in RTIs so that there is a greater recognition to people who produce breakthrough results in inclusive innovation. Promotion and monetary reward systems should recognize scientists and engineers who run the last mile to take the BoP products of their research to masses through productive/service sectors.
- Capability building is also required to encourage science-pull from the BoP. One of the important functions the RTIs may be asked to perform is to build the technological capabilities of the BoP. Together with poor people new technological options may be subjected to field-testing to see whether they are affordable, accessible and appropriate.
- The Government can also help each Science Council to identify and monitor on an annual basis key performance indicators relevant to the Council consistent with China's goal of achieving a harmonious society.

149. **Inclusive Innovation Centers could be important tools to carry out BoP-related research and new technology development, as well as upgrading and adaption of existing innovations from both domestic and global domains.** Such centers would be dedicated to inclusive innovation, helping to sharpen focus on the specific topic of inclusive innovation. The creative energies of such a center would be devoted to inclusive innovation thus helping produce not just inclusive innovation solutions, but also document and disseminate insights from research efforts into inclusive innovation. In the interest of time and cost, certain facilities in the existing institutions could be designated as Inclusive Innovation Centers as opposed to creating new entities. To attract and retain outstanding scholars focused on research on inclusive innovation, research chairs could be established. To steer the best and brightest students and researchers towards inclusive innovation and create new generation of thought leaders on the topic, incentives such as prizes, scholarships could be considered.

R&D is not always the most important step in the innovation cycle. Much inclusive innovation is the result of recombining existing technologies and business process innovation. The biggest failure for innovation in general and inclusive innovation in particular, generally comes in the steps between the initial prototype of the innovation and its further development, scale-up, commercialization and widespread adoption – even if the prototype is promising. Coordination across sectors and access to financing can help overcome those hurdles: for example, the right firm – perhaps with experience in the line of business or with a solid BoP distribution network in a completely different line of business may be uniquely situated to commercialize a promising product created by an NGO or RTI; or a local Chinese actor—a government entity, private firm, or RTI—might find use for a prototype developed by a researcher overseas, that would otherwise remain under-deployed.

Support for Grassroots Innovation

150. **The Government could enhance policies, incentives and institutions to promote grassroots innovations and to identify promising grassroots innovations and scale them up.** While China has some policies, programs and institutions aimed at grassroots innovators, greater focus and coordination of policies can systematically increase the chances that such innovations are discovered and successfully deployed—directly addressing the problem of sporadic diffusion and limited scale that characterizes the current state of grassroots innovation in China. Funding, technical

assistance, and tweaking existing programs like MOA and MOST to assist grassroots innovators to seize the opportunities such programs create for them rather than to simply allow them compete at a handicap with formal innovation sector players, can foster grassroots innovators. Creating repositories of traditional knowledge—appropriately protected by IP—will encourage grassroots entrepreneurship and facilitate the process of using that knowledge for innovation by other agents.

151. Many existing innovation facilities provided by the government, including the testing equipment and other research facilities, in several universities and research institutes, could be made more accessible for grassroots innovators. Many organizations in China are engaged in promoting and diffusing grassroots innovation development. However, although there have been a lot of activities on grassroots innovation, many valuable innovations possessed by the resource-poor tend to be isolated from each other. Greater access to engineering, design, testing and scientific and tools would increase the chance of success of grassroots initiatives. Targeted funding coupled with technical assistance could help more grassroots innovation to scale up. Initiatives to enhance collaboration between grassroots innovators and other members of the innovation ecosystem should be explored: “start-up weekends,”¹⁰⁷ a short, but intense, collaborative and hands-on experience where aspiring entrepreneurs can determine if their ideas are viable, offers one method of doing that. Further, Government might consider establishing a central agency responsible for outreach to grassroots innovators soliciting, documenting, and sorting through submitted innovations; arranging experts assistance to take promising ideas to a proof of concept phase; facilitating patent and licensing arrangements and coordinating technology transfers to interested parties.

Collaboration with national, regional and global STI organizations

152. Policies should help increasing collaboration and synergies between disciplines and institutions in China as inclusive innovation projects cut across disciplines. While China has a thriving innovation base, interactions between and within institutions on the topic of inclusive innovation remain limited. Moreover, breakthrough solutions often come from thinking about a BoP solution outside the existing conventional solution paradigm. Hence the importance of interdisciplinary research. Special incentives, mandates, and funding options should be considered to increase the number of joint inclusive innovation projects between departments within an institution and among RTIs. To channel national and international talent towards a common goal of meeting inclusive innovation challenges, RTIs should be provided incentives to experiment with novel concepts such as crowd sourcing, which can greatly decrease the costs of standard innovative processes.

Many of the innovations produced just stay at the prototype stage. Therefore it is necessary for policy makers to look at how to improve the broader innovation ecosystem and to encourage greater collaboration among agents with complementary comparative advantage.

153. China could also benefit from deeper collaboration with international RTIs and networking between research councils of different countries to share best practices and collaborate on solving common problems of the BoP. While China has large and sophisticated scientific human capital, it can leverage global talent and technologies to capitalize on a greater pool of ideas. New networks could be formed to bring together scientists and engineers from around the world. For instance, the Global Research Alliance (GRA) brings together nine R&D institutional networks and 60,000 scientists from nine countries, rich and poor, to work on problems of poverty,

¹⁰⁷ <http://startupweekend.org/>

of water, energy, health, and others This network brings diversity and scientific credibility together to tackle the most pressing problems¹⁰⁸. Many elite universities in the developed world are conducting research on inclusive innovation. Greater collaboration should be fostered to harness the rich knowledge of, and create synergies with, Chinese institutes of excellence. Exchange programs, field visits, and joint research with organizations involved in inclusive innovation can deepen and expand the knowledge base of Chinese institutions on inclusive innovation. Additionally prototypes created in international universities that have yet to fully commercialize should be examined by local ones which are better able to explore deployment. Since BoP solutions can emerge from frontier technologies and not just conventional technologies, such collaboration can open up greater set of possibilities to the Chinese researchers.

Grand Challenges, Competitions and Prizes

154. **China could initiate Grand Challenges nationally to address its unique BoP related challenges.** Programs such as the ‘Grand Challenges Initiative’ posed by the Bill & Melinda Gates Foundation, and competitive funding mechanisms specifically focused on the problems of the BoP can coordinate resources to address the great intellectual challenges of BoP innovation. Such challenges can energize the community and harness their talent towards achieving a specific goal related to BoP innovation, and bring focus to particularly salient BoP needs. While international challenges are typically tied to the MDGs, the Chinese grand challenges could be aimed at challenges that are unique to China or could complement the MDGs. China can also use grand challenges to promote innovation that lowers costs and increases quality of publicly-provided goods and services, as India did with the Aakash tablet.

155. **To reward outstanding projects in particular themes judged most important to the BoP, competitions and prizes could be considered.** Prizes are increasingly being appreciated as a unique and powerful tool to produce change¹⁰⁹ as they can bring many potential partners (e.g. private investors, innovators, R&D institutions, etc.) together, including many sophisticated ones that place considerable value on the reputational benefit of a well-recognized and acclaimed pro-BoP victory. Prizes not only provide recognition but also increase competition, which often leads to better innovations. Most importantly prizes serve to channel efforts of the participants to a specific goal. To engender a culture of risk taking, prizes should celebrate successes as well as smart, novel, and high-effort initiatives that have failed.

India’s iconic Tata Group has instituted a surprising competition: A prize for the best failed idea! To spark innovation and keep the company from avoiding risks, the prize is intended to communicate how important trying and failing can be. “Failure is a Gold Mine!” proclaimed the former chairman who conceived this novel idea.¹¹⁰

¹⁰⁸ www.globalresearchalliance.org/

¹⁰⁹ http://www.mckinseyquarterly.com/Nonprofit/Philanthropy/Using_prizes_to_spur_innovation_2396?gp=1

¹¹⁰ <http://blogs.hbr.org/hbr/mcgrath/2011/04/failure-is-a-gold-mine-for-ind.html>

Box 22: Inclusive Innovation: Public Policy/Practice Differentiator

The governments all around the world have tried to help create 'National Innovation Ecosystem'. However, creation of a 'National *Inclusive* Innovation Ecosystem' calls for some important (and even bold!) departures from such current practices.

Incentivizing scientists and institutions. Promoting science led innovation implies incentivizing the scientists to have a commercial outlook by going beyond just creating 'new knowledge' to creating 'monetisable knowledge'. Incentivisation of this is done by rewarding scientists on the basis of standard systems. For example, the number of patents filed (and those commercialized) and then offering them a share. For inclusive innovation, scientists will have to be given special charters to work on cutting edge science that leads to inclusion, a mandate of creating 'affordable access'. New matrices for judging institutional performance are needed for this purpose.

Early stage public support. Inclusive innovation invariably leads to new products and creates new markets. For the normal products delivered through the standard innovation mode, not much government support or intervention is needed. However, for promoting the early seeding and growth of inclusive innovation products, it will be necessary to have a strong public procurement/subsidy support in the early phases. Without such support, the kill rate of inclusive innovation products/services will be otherwise high. In the normal innovation systems, venture capital funds have been created, which support firms at the growth and expansion stage. However, 'inclusive innovation' requires significant patient capital, and a far stronger contribution by the Government can only make that possible.

Supporting grassroots innovation. Substantial contribution to inclusive innovation will come through grassroots innovation (which is innovation 'by' the people). In the case of the Government policies and support for normal innovation the path of discovery to development to delivery in the market place is well defined. In the case of grassroots innovation, new structures are needed. For instance, just as 'microfinance' model helped financial inclusion, 'micro-venture capital' will help bridging the gap between the grassroots inventor and the market. The government will have to support such ventures, since the private sector will have a limited interest in creating such funds.

Sustained Government interest with subtle balance of responsibilities with the private sector. For example, the history of programs such as SPARK in China, which was designed to take the fruits of science and technology to the rural poor illustrate the point for such a need. The SPARK program received high level of Government support in the 80's and 90's. However, in the last decade or so, most of the capital has come from banks and private enterprises. In the final delivery of the products and services to the end consumers, Government should entrust this role to the private sector by ensuring that business based on 'inclusive innovation' or 'inclusive business' remains sustainable.

Supportive regulatory systems. 'Technological innovation' plays the key role in the normal mode of innovation. In 'inclusive innovation', non-technological innovations, such as business model, system delivery innovations, etc., play a key role. These innovations need to be backed up by strong policy level innovations. For promoting truly inclusive innovations, the governments will have to be more 'relaxed' and less 'restrictive'.

Source: Ramesh A. Mashelkar and Vinod K. Goel, "Inclusive Innovation: More for Less for Many" (Manuscript, forthcoming).

III. Improving Design, Monitoring and Evaluation

156. **All public policies and support programs should incorporate mechanism to enable effective participation of relevant stakeholders during their design stage.** Some programs and initiatives in China have already produced immediate results in outreach and scale, and are contributing prominently to the inclusive innovation agenda.¹¹¹ However, a deeper understanding of the needs of the BoP and greater upward communication will increase the viability and impact of inclusive innovation programs and initiatives. The BoP can provide valuable inputs in the innovation process and solutions that are created with deep understanding of the entire BoP ecosystem are more likely to be successful.

¹¹¹ For instance, it is estimated that under the Spark Program, over 40 million rural households receive training and under the S&T Commissioner Project, there were about 170,000 S&T Commissioners nationwide, benefiting over 50 million rural households.

157. **To improve the impact of government expenditure, criteria and standards (such as impact on intended beneficiaries, the quality and affordability of goods and services provided, scope of outreach) should be taken into account by the Chinese policy makers in program design and assessing program efficacy.** Creating specific metrics on impact focuses efforts on those with the greatest societal returns and those which promote established national goals and challenges. For instance, off-grid solutions that are also carbon negative or carbon neutral not only help improve economic productivity of the BoP by bringing them electricity source, they also help alleviate climate change.

158. **Systematic and independent monitoring and evaluation of outcome and impact should be adopted for all policies and programs.** Emphasis should be placed on results and outcomes than on inputs- such as how much has been invested and how many subsidies been disbursed. Metrics for evaluation and monitoring should clearly outline targets and outcomes, outputs and impacts, indicators, and the cost of conducting the monitoring and evaluation. The multiplier effects of inclusive innovations should be considered while specifying metrics. Metrics should take a holistic view of the impact of policy on all inclusive innovation characteristics such as outreach, cost, sustainability etc.

159. **Incorporating the concept of social audit would provide impetus for inclusive innovation.** Currently the accounting auditors of the respective government ministries and agencies perform financial oversight function but there is a need to conduct an economic and social audit of the Councils. The Governments should explore, evolve and espouse the quality, relevance and importance aspects of such indicators. It may be worthwhile to publicize select performance indicators for different councils so that public is informed about their functioning and a comparison can be done. Creating such indicators and publicizing them could help create an impetus for achieving certain targets.