Fostering inclusive innovation for sustainable development

Background Paper

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Pathways for Prosperity Commission
Technology & Inclusive Development

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Background Paper 9
September 2018

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This paper is part of a series of background papers on technological change and inclusive development, bringing together evidence, ideas and research to feed into the commission's thinking. The views and positions expressed in this paper are those of the author and do not represent the commission

Citation:
Kaplinsky, R. (2018). *Fostering inclusive innovation for sustainable development.* Pathways for Prosperity Commission Background Paper Series; no. 9. Oxford, United Kingdom

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Abstract

The gains from sustained economic growth have been unevenly spread, and many countries are confronted by substantial and growing levels of social and economic exclusion, accompanied by a degrading environment. The outcomes of existing growth pathways need to be holistically understood in terms of their economic, social and environmental character. Individual indicators such as employment and the share of manufacturing in gross domestic product (GDP) provide only a partial glimpse of the challenges to be overcome to promote more inclusive growth pathways.

More inclusive patterns of innovation offer the prospect of facilitating the move to more sustainable and equitable growth pathways. Inclusive innovation has three major characteristics. It can: involve the production of products appropriate to the needs and incomes of the marginalised; provide for a greater degree of involvement of marginalised people and communities in processes of production; and involve the participation of the marginalised in the process of innovation itself. Innovations can be new to the enterprise, the country, the sector or the world. From the perspective of the rate and trajectory of growth and development, the degree of absolute novelty is not the most important concern – the contribution of technological progress is that it provides an advance on what has occurred in the past, and that this advance is realistically within the competence-horizon of the innovating stakeholder.

We are currently witnessing the diffusion of a series of disruptive technologies. This report argues that these disruptive technologies are embedded in a wider historical evolution of socio-techno-economic paradigms. The existing dominant paradigm is a global extension of the principles of mass production, in which production and consumption are geographically separated, scale economies are pervasive, capital investments are scale- and skill-intensive, and negative environmental externalities are widespread. Systemic exclusion across a number of dimensions is intrinsic to this growth paradigm. The central argument of this report is that the dominant paradigm, characterised by systemic exclusion, is in crisis. However, we are witnessing the possible emergence of a new paradigm – one that offers the potential for more sustainable and inclusive growth pathways. This involves the widespread diffusion of smaller-scale, less capital-intensive and more environmentally benign technologies that facilitate distributed and inclusive patterns of production, and produce products more appropriate to the needs of the global poor, who represent an increasingly large consumer market. While new disruptive technologies such as ICT and Artificial Intelligence are key facilitators of this potential transition, reaping the benefits of their potential is subject to social and political agency.

Six case studies of the lived experience of inclusive innovation in low- and middle-income economies provide evidence of the opportunities opened by innovation to facilitate the transition to a more inclusive growth and development pathway. These are with respect to: hydroelectric and other sources of renewable power; promoting the dynamism of small and medium-sized enterprises (SMEs) and clusters of informalised enterprises; the diffusion of mobile money platforms and related ICT services; innovations in public healthcare; innovations by transnational corporations for Bottom of the Pyramid (BOP) markets; and the role played by social movements in urban habitats.

The case studies illustrate the potential for a more inclusive innovation and growth pathway and, in some cases, the diffusion of these innovations is being driven rapidly forward by market forces. However, potential does not always translate into reality; moreover, inclusive innovations, however profitable, do not always diffuse at optimal rates. Therefore, there is scope for a range for policy interventions. Some of these affect macro-economic policies; others (such as the promotion of South-South trade in appropriate technologies) will benefit from discrete policy interventions.

Two overarching conclusions arise from this analysis. The first is that the widespread diffusion of inclusive innovations reflects power relations and needs to be addressed as an issue of political economy rather than in terms of narrowly defined economic or innovation policies. The second is that inclusive growth requires a "Big Push" strategic vision of the sort proposed by Rosenstein-Rodan in 1943. He argued that only a large scale investment programme across a number of sectors would create the externalities to accelerate growth and absorb surplus labour from the agricultural sector in labour-surplus economies.

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1. Introduction

The systematic application of knowledge to production – in other words, technological progress – has been the dominant factor underlying the growth in global output and living standards since the onset of the industrial revolution. But the promotion of economic growth is not the only reason why technology is a central concern in the Development Policy agenda. For technology not only helps to determine the pace of economic growth, but it also reflects and shapes the nature and trajectory of growth. In the current era, growth is variable and uneven, punctuated by crises and often regressing into decline. Moreover, we live in a world of considerable and, in many cases, increasing marginalisation and inequality, accompanied by climate chaos and climate change. These developments have led to a growing concern about the extent that technological progress may be reconfigured to promote more equitable, inclusive and sustainable patterns of growth and development.

Rapid innovation is generally viewed as being socially constructive, albeit with contradictory outcomes. The Austrian economist Joseph Schumpeter famously characterised surges of rapid technological progress as ushering in a period of "creative destruction" – sweeping out the inefficient and old, and replacing it with new and superior methods of production. From this perspective, the gains of technological progress outweigh the losses. But what if the net balance is negative – if processes of "destructive creation" outweigh those of "creative destruction"?

We are currently living in an age of very rapid and disruptive technological progress, often referred to as the "Fourth Industrial Revolution". The gains from this innovative surge – both realised and potential benefits – are manifest. But so too are the costs. It is evident that, while many in the global economy are indeed net beneficiaries from this recent round of disruptive technological progress, others are net losers. Their losses are experienced on three fronts: *economically* (where their living standards fall); *socially* (they lose voice, they fall behind, and they feel disempowered and marginalised); and *environmentally* (they suffer from pollution and the insecurity arising as a consequence of environmental change and climate variability). The Sustainable Development Goals (SDGs) provide a framework for assessing these benefits and costs, and while "Innovation" is only explicitly recognised in SDG9 (Industry, Innovation and Infrastructure), the impact of technological progress affects each of the 17 SDGs in material ways.

It is for these reasons that "inclusive innovation" has come to the forefront of policy concern.[1] The goal of inclusive innovation is to contribute towards a more economically, socially and environmentally sustainable pathway in which the gains from growth are distributed more equitably than the currently dominant growth path.

[1] There are a variety of 'brand names' addressing these issues, such as Jugaad Innovation, Frugal Innovation and Bottom of the Pyramid Innovation. Each of these frameworks highlights specific elements of this general policy agenda. We use the term "Inclusive Innovation" to cover each of these specific elements of sustainable and inclusive innovation.

This requires three primary forms of inclusion in innovation pathways:

- The inclusion of the marginalised in production
- The supply of products that meet the needs of the many and the disadvantaged rather than the few
- The inclusion of the marginalised in the innovative process itself.

Without a transition to this sustainable inclusive innovation agenda, the development targets set out in the SDGs cannot be achieved in any meaningful way. An important consequence of this perspective on innovation and sustainable development pathways is that inclusivity cannot be achieved through increasing employment alone (a policy agenda favoured in much of the analysis of exclusion and of premature deindustrialisation). For one thing, households receive income from a variety of sources, so the focus must be on livelihoods rather than individual incomes and jobs in the formal sector. In addition, inclusivity will be determined as much by the qualitative nature of development as by the rate of growth in output, incomes and employment.

Translating this bold agenda into reality will require a change in behaviour by a range of innovation stakeholders who are either currently involved, or are potentially involved in applying knowledge to production. Broadly speaking, four sets of innovation stakeholders can be identified: the private sector; the public sector; civil society organisations (CSOs); and Public Private Partnerships (PPPs). Each of these sets of actors have diverse characteristics – for example, national and local governments in the public sector; and transnational corporations (TNCs) crossing national boundaries, large indigenous firms, small and medium-sized enterprises (SMEs) and informal sector producers in the private sector.

Similarly, there are different levels of innovation. Product and process innovations may be ideas that are new to the firm, region, economy, sector, or the world. From the perspective of the rate and trajectory of growth and development, the degree of absolute novelty is not the most important concern – the contribution of technological progress is that it provides an advance on what has occurred in the past, and that this advance is realistically within the competence-horizon of the innovating stakeholder.

In this report we will focus on the policy agendas that facilitate pathways of more inclusive innovation by different sets of stakeholders, operating with different levels of competence. The vehicle for identifying these policy agendas will be through a discussion of a number of inclusive innovations across a range of scales. Some of these innovations have already occurred, others are prospective. We have deliberately chosen case studies from a range of sectors to show how diffuse these challenges are and how appropriate policy responses are necessarily systemic in character. This report focuses on successes and potential, rather than analysing failures. There is much to learn from failures, but that would require a separate exercise.[2]

[2] For example, the failure of the Tata Nano – a small car retailing at less than $2,500 – in India nearly bankrupted its owner (Tata Motors). Ironically, Tata only stayed solvent because of the success of its upmarket affiliate (Jaguar Land Rover.)

In Section 2 the report begins by addressing different dimensions of innovation, arguing that, historically, innovation has occurred in waves. At this juncture we are living through the downswing of a previously dominant growth paradigm. Innovation waves are suffused with technological progress, and understood narrowly as comprising of physical artefacts. However, in reality, these new technologies are embedded in wider systems of organisation. Hence paradigm change needs to be seen in terms of its techno-economic dimensions, shifting the policy discourse away from the promotion of individual new technologies to clusters of related technologies in their attendant social and institutional context. The section concludes by examining the shapers of technological progress, since the specific applications of new families of technology can take a variety of forms, each with their implications for inclusive growth and development.

Section 3 reviews six cases of the lived experience of inclusive innovation, understood in terms of techno-economic paradigms. Each of these examples is analysed in terms of its contribution to the three characteristics of inclusive innovation – inclusion in the nature of product, in process, and in the innovation process itself. For readers who do not wish to read these detailed case-studies, they are summarised in Section 4. The report concludes in Section 5 with a discussion of the policy needed to strengthen inclusive innovation in the quest for more inclusive pathways of growth and development.

2. The shapers of innovation

In this section, we briefly review a series of factors that have an important bearing on the pattern and success of inclusive innovation, with a specific focus on the challenges arising in low- and middle-income economies. However, many of these contextual factors also influence the pattern of inclusive innovation in high-income economies (where economic and social exclusion is a growing problem).

2.1 Thinking big: Socio-techno-economic regimes

> "The current crisis, like that of the 1930s, is the hinge between an old world and a new. Such crises, as the Austrian economist Joseph Schumpeter pointed out, are periods of creation and destruction. In these circumstances, monetary and fiscal measures are unlikely to restore growth by themselves. What is needed is a programme of more profound structural change, of a radical transformation of infrastructures and institutions that will be the precondition for a new, qualitatively different period of growth. Anything less is an appeasement of the past." (Murray, 2009:5)

The predominant focus of most policy attention is on the near-term, and on the incremental. What measures can be taken that lend themselves to practical steps by individual innovation stakeholders and which will yield positive results in the short-term and foreseeable future? As will be shown in the case studies below, there is a range of discrete policy interventions that facilitate inclusive innovation. However, there is a level at which such limited policy interventions merely scratch the surface of exclusion and do not meet the challenge of altering growth paths in a fundamental way. More substantive structural change is a prerequisite if inclusion is to be meaningfully promoted.

A number of analytical frameworks address the problems of the contemporary global economy through the lens of disruptive innovation-led structural change. For example, the socio-techno-economic school of thought builds on long-wave theory and Schumpeter's analysis of "gales of creative destruction". Its initial focus on techno-economic paradigms (driven by major families of technological change such as ICT) (Freeman, Clarke and Soete, 1982) has been augmented by the inclusion of the societal organisation of production and consumption (Freeman and Perez, 1988; Perez, 2016). The literatures on "sociotechnical transitions" (Geels and Schot, 2008) and "deep transitions" (Schot and Steinmueller 2018), while distinctive in some respects, work within similar frameworks. Outside of this literature on long waves and growth surges, the emerging discussion of the "Fourth Industrial Revolution" forecasts an extended period of structural disruption and radical societal change driven by the development and diffusion of a number of synergistic and disruptive innovations, including ICT, robotics, Artificial Intelligence (AI), nanotechnology and biotechnology (Schwab, 2017). Each of these perspectives starts with the recognition that current trajectories of economic growth and development are experiencing a period of structural crisis. Some notable indicators of this structural crisis are illustrated in Box 1.

Box 1: Some indictors of structural crisis

Productivity growth has slowed in the industrially advanced countries (Gordon, 2000).

Despite rapid growth in China, India and other South-Eastern Asian economies, many low- and middle-income economies appear to be caught in "middle-income trap" stagnation, with little signs of "catch up" (Lee, 2014)

Unemployment in many low-income economies is high and there is a growing recognition that the advance of AI and robotisation will lead to significant labour displacement in industrialised economies, and limit the growth of employment in newly industrialising economies (OECD, 2018; Frey and Osborne, 2013).

There is a growth of informalisation and insecurity of work in many economies – high- and low-income alike. In Sub-Saharan Africa, South Asia and Latin America, more than two-thirds of non-agricultural livelihoods are earned in the informal sector (Kramer-Charmes, 2016) and much of agricultural production provides little above basic subsistence.

Accumulated growth has led to a global climate crisis, including an increase in climate volatility, one of the many factors leading to migration and conflict (see www.IPCC.com).

Failed states are widely evident and the legitimacy of relatively long-lived political regimes is subject to widespread challenge, triggered to a considerable extent by the consequences of cross-border migration (IPSC, 2018) which, in turn, is influenced directly and indirectly by climate change.

Three central features are common to these diverse analyses of structural transformation. *First,* post industrial revolution economic history has occurred in surges through stages of inception (when the paradigm emerges), rapid economic growth (when the paradigm becomes dominant) and then exhaustion (when the paradigm runs out of steam and experiences structural crisis).[3] Characteristically, these surges have a "life" of five to six decades. *Second,* each of these surges has been associated with (some would say driven by) core technologies, such as steam power, the electric motor and the internal combustion engine. In the most recent period, ICT has been the dominant facilitator of growth. And third, these techno-economic drivers of growth surges have been accompanied by wider forms of social and economic organisation, including in economic organisation, governance, residential and consumption patterns and value systems (Perez, 2010; Perez, 2016).

The current dominant paradigm has been characterised by the reach for scale through mass production and the spread and rapid deepening of globalisation. What are the implications of this for exclusion? For a variety for reasons, despite globalisation having a massive positive impact on income growth in China (and thus on equalising the global interpersonal distribution of income), it has simultaneously contributed to growing inequality within and between countries, between classes, between skills-sets and between regions (Kaplinsky, 2019 forthcoming). Even China, whose rapid growth has led to a narrowing of global interpersonal income inequality, has experienced

[3] The analyses of long waves by Schumpeter and the neo-Schumpeterians built on the observation of long-wave cycles (of approximately 50 years) by the Russian economist Kondratiev in the first decades of the 20th century.

deepening domestic inequality.[4] The reason for this systemic unequalisation is that those who command various rents (such as technologies and scarce resources) can take advantage of these rents in large global markets, whereas those without rents have to compete in larger, intensely competitive factor and product markets.

The search for scale-economies in production has led to a growing separation of production and consumption. Products – particularly intermediate products – and services are increasingly traded across boundaries (increasingly in Global Value Chains) and the fragmentation of value chains has led to declining terms of trade within many manufacturing and services sectors (Sarkar and Singer, 1991; Kaplinsky, 2005).

Suppliers produce for markets they have little connection with. In the case of many SMEs and producers in low- and middle-income economies, their divorce from final markets dulls their innovative horizons. The largest and, until recently, the most rapidly growing markets have been in high-income economies. The demands placed by consumers and governments in these economies have imposed standards in Global Value Chains which, in low- and middle-income producing countries, are excluding small-scale producers and relatively uneducated workers. This has contributed to the informalisation of work and supply chains in many low-income economies (Kaplinsky and Morris, 2018). One of the primary drivers of the current paradigm has been the spread of ITC. These technologies significantly cheapen the costs of information transfer, coordination and transport and reduce the penalties inherent in separating production and consumption. The same technologies applied to production are both labour-saving in aggregate yet require skilled labour. This marginalises many potential workers and relatively uneducated workers from production processes. Moreover, these labour-saving technologies are at the cusp of significant enhancement as AI and robotisation unfold, with potentially very significant impacts on employment (Frey and Osborne, 2013; OECD 2018).

Complementing these central characteristics of the now dominant economic paradigm are two other features that contribute to exclusion. The first is that energy and water infrastructures are large in scale and linked to centralised grids. This not only involves very large and lumpy capital expenditures but makes it hard to serve small and distant users at low cost. As a general rule, in low-income economies it also involves large externally-owned suppliers of technology and infrastructure. And, finally, for a range of reasons, the environmental consequences of economic growth have been adverse, not only threatening livelihoods but also increasing costs of production. To some extent, these environmental consequences are a function of centuries of accumulated emissions after the Industrial Revolution. However, some elements are a specific reflection of the carbon-intensive character of the existing growth paradigm and the growing spatial separation of production from consumption.

Thus, in the context of the structural crisis of the existing growth paradigm, what alternatives exist for promoting inclusion and sustainable development? That is, sustainable in the sense of meeting the 'triple bottom line' developmental objectives, economically, socially and environmentally sustainable. This is of course difficult terrain, since technological progress does not unfold naturally

[4] In some Latin American economies, the unequalisation of earned incomes has been offset by redistributive policies (Cornea, 2011).

or neutrally. It is not only inherently unpredictable but, at the same time, malleable and open to policy interventions. It is also not necessarily the case that optimal or near-optimal outcomes will result. Nevertheless, we can proceed with a thought experiment that is suggestive of an emerging and more inclusive techno-economic paradigm.

In essence, the new paradigm will have to contain elements that are mirror-images of what currently exists. Notably, production and consumption will need to be more closely aligned, and occur on a smaller scale. This means that local markets will have a sharper influence on production organisation and on technological pathways. The environmental costs of production will need to be more centrally reflected in pricing and in investment decisions. All of this requires more flexible production systems and, crucially, more distributed forms of infrastructural provision. The development of ICT and scalable renewable energy are important facilitators of this transition. The new paradigm will also require different forms of governance, at the sub-national, national and transnational level, and a greater role for domestic and particularly localised economic agency. For example, the devolution of expenditure from the central to local government in Kenya has provided momentum to production outside of Nairobi and its surrounds; in many European economies the decentralisation of resource allocation and the growth of municipalism have both reflected and facilitated the expansion of community innovations and the creative industries.

Does this new production paradigm require a retreat from globalisation? The answer is that it does as production will be located closer to local markets, and also insofar as it reduces the role of external economic actors, particularly in infrastructural provision, since mega-infrastructure projects will be of diminished importance. However, the knowledge base in the new paradigm will remain global in nature since, while there may be a process of descaling in relation to the direct costs of production, the growing knowledge content of production systems will, if anything, be scale-enhancing in terms of technological development and the indirect costs of production (Kaplinsky, 1990). Many of the knowledge sets and capital goods will need to cross national borders, even in the case of high-income economies.

The case study on hydroelectricity in Section 3 illustrates these arguments, providing some details on the exclusionary consequences of the existing techno-economic paradigm and the possibilities for inclusion opened up by an alternative form of economic and social organisation facilitated by technological advances in renewable energy. The most important conclusion to be drawn, however, is that, if more inclusive growth pathways are to be developed, there will inevitably need to be changes on a macro scale, beyond the reach of incremental improvements in technologies and incremental changes in the incentives offered in policy reform –beyond the remit of innovation policies.

2.2 Path dependency and inducements to technological change

Technological imperatives often determine and pose limits to the character of innovation. For example: perpetual motion is impossible; there are physical limits to the extent to which silicon circuitry can be miniaturised; and the barriers to growing sugar in a desert are almost certainly insuperable. Moreover, there are frequently linked clusters of technological development – for example, in the synergies between digital information and communications technologies. In other cases, technologies emerge to solve bottlenecks. And, despite these examples of binding or near-binding technical determinants of technological change, as a general observation, technological development does not unfold in a Darwinian and technically determined direction. Technology is socially created and can evolve in multiple directions. This malleability clearly has very significant growth and developmental implications and it is therefore necessary to briefly consider the factors that shape the direction of technological progress.

The economics literature on the inducements to technological change tend to focus primarily on the price of factor inputs such as capital and labour (Hicks, 1932; Ruttan, 2001), or the anticipated price of inputs (Fellner, 1961). Price also influences technological development through the cost of material inputs. Where these inputs are scarce or are costly (for example, rising resource costs), technologies are developed that economise on their use.

Another factor influencing the trajectory of innovation is the character of final markets. High-income consumers demand high-quality products, and place a premium on differentiation and distinctiveness. They will also tend to be able and willing to pay more for products where the supply chains are focused on social and environmental objectives as well as the costs of production. Educated final consumers, or firms that have the knowledge to use complex machinery and intermediate products, spur and allow innovators to introduce technologically sophisticated outputs. The role of active, and often highly educated, users in innovation processes has grown in importance in recent decades (Von Hippel, 2005).

The regulatory environment determines the direction of technological progress. Governments (or groups of governments such as the European Union) impose binding boundaries ("hard regulation") on what is permissible in terms of production processes and product characteristics. CSOs promote "soft regulations", incorporating process and product standards. Whilst these soft regulation standards are optional for producing firms, many of the large lead firms governing Global Value Chains are vulnerable to reputational damage. In general the regulations and standards (hard and soft) which determine access to global markets, seek to shape technologies so that they protect the environment and the consumers (Kaplinsky and Morris, 2018).

Also shaping the trajectory of innovation is the quest for power and dominance. At the one end of the power spectrum lies the military imperative. Many of the key innovations that currently dominate the innovation highway were sponsored by the military, particularly the US Department of Defense (Mazzucato, 2011). But the role of the power imperative in shaping innovation is felt through the spectrum of innovation decision-making, including, for example, in the development of technologies designed to give managers greater control over the labour process (Braverman, 1974).

Finally, not all technology is developed within capitalist market relations. Many technologies involve public goods where innovation rents cannot be easily appropriated. For example, not all knowledge can be patented or 'owned'; this is particularly a problem with software that can often be easily stolen or replicated (Mason, 2016). Some inputs are non-exhaustible (for example, air) and cannot easily be appropriated. There may be substantial externalities arising from innovations where the users/producers do not pay for the negative consequences of use or reap the full benefits of the innovations. In other cases, innovations may also be characterised by network effects. That is, they are only effective if they are introduced simultaneously by a large number of users, as in the case of mobile telephony, and preventive medicines such as vaccinations. There are also social innovations that are difficult to fund in a market economy, such as many elements of the welfare economy and artistic endeavours. Beyond these examples, an increasing number of social enterprises seek to combine profit generation with social purpose (Murray, 2009). In all of these cases, the Schumpeterian profit-oriented, rent-seeking innovation motor delivers sub-optimal growth and development outcomes.

Two central points emerge from this literature on induced technological change that are relevant to the promotion of inclusive innovation:

- Notwithstanding the importance of some key technological imperatives, technology is malleable. The overall directions of technological development (for example, carbon-based or renewable energy), and the specific techniques that are commercialised and introduced, are shaped by the social, political, economic and environmental context they are developed in. In turn, these technological paths contribute to the shaping of the inducing factors.

- As a consequence of these complex interactions between technological, social, economic and environmental factors, when exclusion is significant (as it is in many parts of the world currently), meeting the challenge of promoting greater inclusion cannot be achieved by merely fine-tuning existing policy agendas. This is not to say that nothing can be achieved through incremental changes – as we will see in some of the case studies below – but these changes will need to have direction and contribute to the development of a new and more inclusive techno-economic paradigm.

What follows in the next section is a series of case studies that illustrate how this mix of macro, meso and micro policies might help to achieve these ends. Before we consider this material, it is perhaps important to confront the sobering reality of informalisation and exclusion in the world of production in low- and middle-income economies. Table 1 provides an estimate of the percentage of the non-agricultural working population in the informal sector in major regions. It is evident from this that in Africa, Latin America and much of Asia, more than half of this working population is informalised; this percentage is highest – more than 70% – in Africa and South and Southeast Asia, but comprises more than half of this labour force in Latin America. The ratio in the Transition Economies – more than one-fifth of the labour force – is similarly high. In each of these regions, the share of informalised work rose during the first decade of the century. The growth of 'zero hours' work in the high-income economies provides evidences that these trends are not restricted to low- and middle-income economies, but are intrinsic to the current techno-economic paradigm. What this reality of informalised incomes

tells us is that, if we are to make significant progress with inclusion, less attention needs to be placed on formal and technologically sophisticated activities, and more attention should be given to the informal sector and SMEs, not just in manufacturing but also in agriculture and services.

Table 1: The share of informal sector work in non-agricultural employment by region in low- and middle-income economies, 2000–2004 and 2005–2010 (%)

	2000–2004	2005–2010
North Africa	47.3	53.0
Sub-Sahara Africa	63.3	70.0
Latin America	55.9	57.7
South and South-East Asia	NA	69.7
Transition economies	20.7	22.6

Source: Drawn from Charmes, 2016.

3. Case studies on inclusive innovation[5]

In this section we review six sets of innovation that have either contributed materially to the development of inclusive innovation, or provided the opportunities for more inclusive patterns of innovation. The case studies deliberately encompass a range of unrelated sectors and consider different levels of innovative activity. The discussion is oriented to highlight the policy implications for major stakeholders driving innovation trajectories. These case studies focus on:

- Hydroelectric power and the decentralisation of infrastructural grids
- Innovation and inclusive innovation in SMEs and clusters
- Distributed infrastructure: Telecommunications, the diffusion of mobile telephony and inclusion
- Healthcare in Cuba
- TNCs innovating for the BOP
- Urban wetlands management in Colombia

3.1 Hydroelectric power and the decentralisation of infrastructural grids[6]

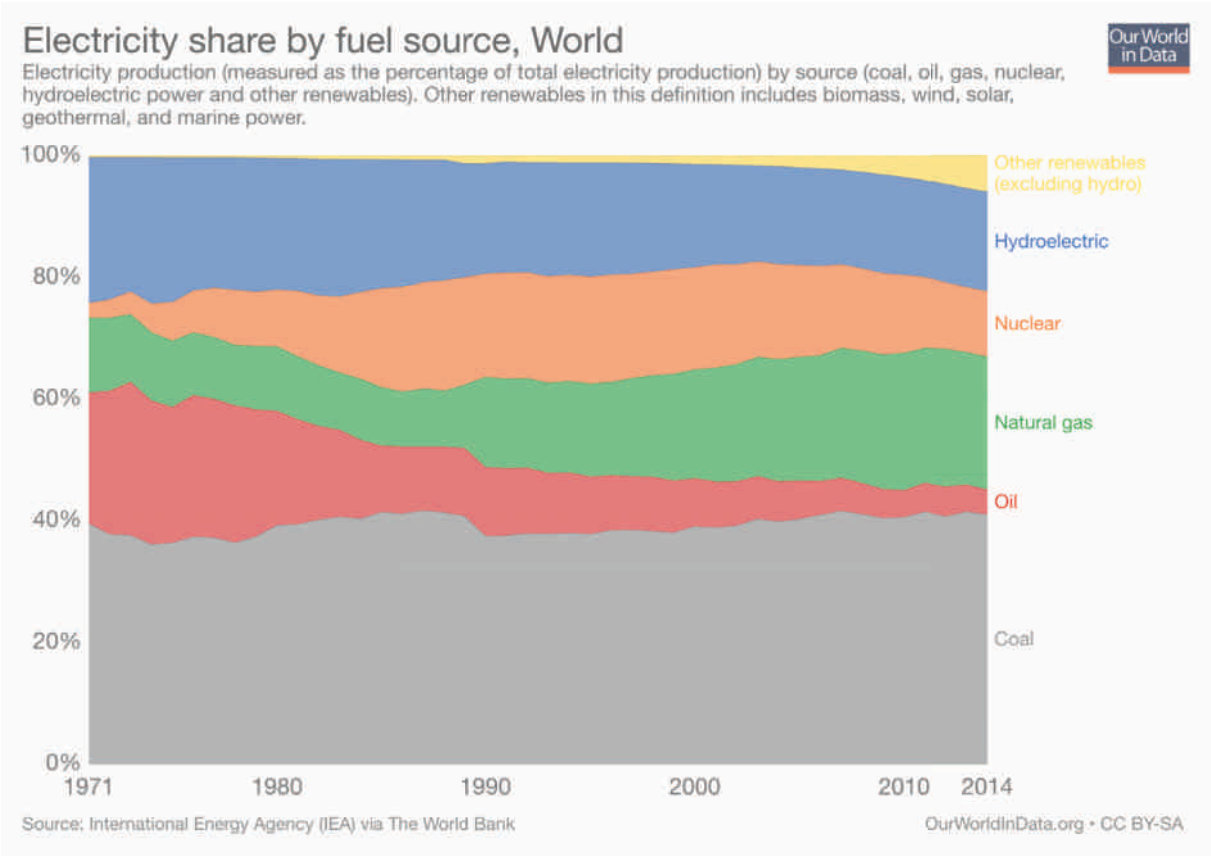
Analyses of the evolution of techno-economic paradigms point to the historical significance of the development of electric power during the second half of the 19th century (Freeman, 1974). Unlike previous sources of inanimate power (water and steam), electricity provided the capacity for distributed production, powering individual machines and homes as well as large integrated facilities. The organisation of society – both production and consumption – today is unthinkable without the pervasive availability of electricity.

Historically, fossil fuels were the primary source of power generation and, although they continue to play a dominant role in the generation of electricity, they are not the only source (Figure 1). Among the alternatives are nuclear power, hydroelectric power (HEP) and a cluster of smaller scale renewables such as wind and solar power. Although the share of HEP in global power generation declined after 1970, it remains a major contributor, accounting for more than 15% of global production in 2014.

[5] Readers may prefer to skip the detailed discussion of the case-studies in this Section of the Report. These are summarised in Section 4 below.

[6] I have been stimulated and greatly assisted in this case study by discussions with Belynda Petrie at Oneworld Group, Andrew Barnett at The Policy Practice, Benjamin Sovacool and Michael Lipton at the University of Sussex, Jamie Skinner at International Institute for Environment and Development, and Anton Eberhard and Mike Morris at the University of Cape Town.

Figure 1: The global share of different energy sources, 1971–2014



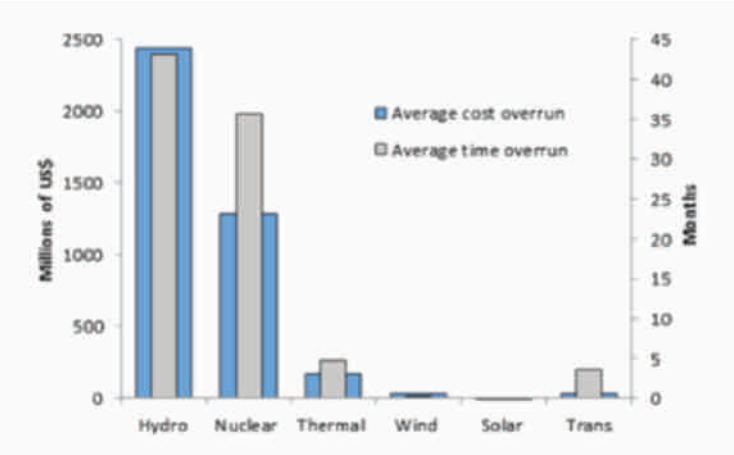
Source: Ritchie and Roser, 2018

HEP has played a dominant role in power generation in many low- and middle-income economies and has led to a series of "lock-ins" which have important (and in some cases binding) impacts on economic and social organisation, character of growth, distributional outcomes and the environment, and hence on inclusion. This is particularly true with respect to large scale HEP, involving the construction of very large dams to provide the water required to drive large-scale power systems and, in many cases, also to feed irrigation channels.[7] The investments required for these large HEP projects are very significant. For example, the projected cost of the Grand Ethiopian Renaissance Dam currently nearing completion is $4.8bn.[8] In investment-constrained low- and middle-income economies, the opportunity cost of these mega projects is manifest, notwithstanding the fact that much of the investment finance is externally sourced (although external loans will need to be repaid in future years). Cost and construction time over-runs are common in HEP projects, and disproportionately so when compared to other sources of power (Figure 2). The consequences of these cost over-runs are clearly higher for large-scale HEP (and nuclear power) than for other energy sources, particularly other forms of renewable energy.

[7] Similar arguments apply to other large-scale sources of power generation such as thermal plants. However, due to space constraints, this discussion is limited to large-scale HEP schemes.

[8] $1.8bn of which will be financed by a Chinese loan and the remainder by the Ethiopian state.

Figure 2: Frequency and cost escalation of electricity infrastructure projects (411 Observations)



Source: Sovacool et al. 2014

Although many (but not all) large HEP schemes provide long-life and low-cost sources of electricity and water for irrigation, large dams are not without their problems. Most of these harmful impacts are not priced into cost and revenue structures, undermining the claims that HEP is a source of low-cost power. Box 2 lists some of the adverse environmental consequences of large dams.[9]

Box 2: The negative impact of dams

- Around 400,000 km2 of land worldwide has been submerged due to the construction of dams and more than 40 million people have been displaced physically by dams worldwide.
- In flat basins, large dams can cause flooding of large tracts of land, destroying local animals and habitats.
- Displacement of populations forces changes in lifestyle and customs, often causing emotional scarring.
- Large amounts of plant life are submerged and decay anaerobically (in the absence of oxygen) generating greenhouse gases like methane.
- The migratory pattern of river animals, such as salmon and trout, are affected.
- Dams can restrict sediments that are responsible for the fertile lands downstream. Farmers use chemical fertilisers and pesticides to compensate for the loss in productivity.
- Salt water intrusion into the deltas means that the saline water cannot be used for irrigation.
- Large dams are frequently breeding grounds for mosquitoes and cause the spread of malaria and other diseases such as bilharzia.
- Farmers downstream who used to wait for the flooding of the fields to plant their seeds are affected. Although dams can mitigate the harmful consequences of periodic flooding, when they exceed peak capacity or fail, there can be devastating consequences for downstream residents.
- Dams serve as a heat sink, and the water is hotter than the normal river water. When released into the river downstream, this warm water can affect animal life.
- Peak power operations can change the water level 30 to 40 feet in one day and can kill the animals staying at the shorelines.

[9] This list of negative consequences of large dams is drawn from a number of sources including Scudder (2005), www.internationalrivers.org/environmental-impacts-of-dams and Oneworldgroup.co.za. It is a 'gross' list, that is, it does not take account of the benefits of dams. It is also not the case that all dams suffer from any or all of these adverse consequences. Nevertheless, despite these caveats, many of these negative impacts are widely observed in the construction and operation of large dams.

Large scale HEP is a classic example of the mass production paradigm which has characterised growth paths over the past century.

- It involves the generation of very large sources of power, feeding into centralised grids, with significant transmission costs as power is transmitted from sources of production to consumption.[10] The magnitude of these power supplies is such that, in almost all cases, the production of energy is separated from its consumption, often by vast distances.

- Construction costs are very large and skills levels in construction and in the ongoing provision of electricity are high. In many developing economies, this necessarily involves external firms, external financing, and imported equipment and labour.

- The concentration of generating power in HEP is designed to provide large sources of energy to concentrated locales of living and production – large-scale and centralised power provision for large-scale and centralised power consumption.

- Large-scale investments underwrite the economic and political power of centralised governments, state-owned enterprises, large firms and institutions whose interests are served by the mass-production paradigm.

- Environmental externalities are often not priced, or inadequately priced into these large-scale investments, a characteristic of centralised infrastructural systems in general.

Each of these techno-economic paradigm characteristics are associated with exclusion. Concentrated sources of political and economic power drive investments in concentrated and capital-intensive forms of energy provision. Large-scale firms, generally foreign-based and foreign-owned in the case of low- and middle-income economies, actively promote dams and HEP. Their governments support these marketing drives, providing aid to developing economies, either directly in bilateral programmes or through multilateral agencies such as the World Bank and the newly formed Asian Infrastructure Investment Bank (one of whose first major investments was a $300m loan for an HEP in Pakistan in 2016). On the demand-side, governments and politicians seek high-profile investments. In many cases, individual politicians and civil servants benefit from the generous projects, opening up opportunities for corruption. Large-scale producers in agriculture and industry motivate for concentrated sources of power and water provision. Centralised grids are a key factor underwriting the growth of sprawling cities. The extent of land required for the dams is large and the local population has to be relocated; in many low- and middle-income countries, these relocated populations are poor and politically powerless, and their needs are poorly met.

[10] Typically, power loss in distribution channels in these centralised systems is between 7% and 14% of power production.

So exclusion is both a cause and a consequence of the choice of large-scale HEP and centralised grid provision of energy – large-scale, capital-intensive and environmentally damaging technology co-evolves with large-scale and concentrated sources of social and political power and capital. These developments were reflected in the construction of the Kariba and Cahora Bassa Dams on the Zambezi River.[11]

The Kariba dam, constructed on the Zambezi River, dividing two former British colonies (then Southern and Northern Rhodesia, now Zimbabwe and Zambia) was conceived during the 1950s and 1960s to meet the needs of urban and industrial sectors in both countries, and the mining sector in Zambia. The first stage was constructed during the 1950s (with a capacity of 705 MW) and the second stage was completed in the 1970s, providing an additional 610 MW capacity. Although not all of this generating capacity was utilised, Kariba not only provided abundant energy, but also reduced its price significantly – by 30% between 1961 and 1977 in a context where the general price index rose by more than 75% during the same period.

Set against this successful provision of low-cost energy (predominantly meeting the needs of high-income and large-scale users) were a series of costs borne by the local population and the environment. For example, the expanded water base extended the spread of predator tiger fish and crocodiles which had previously been confined to the Zambezi's primary channel. The potential for an expanded commercial fishing industry had been recognised early in the dam's development, but despite the intention to develop small-scale and artisanal fishing, in both economies the governments favoured large-scale expatriate firms. The development of the tourism industry in both countries reflected a similar trajectory of verbal commitments to inclusion but with the allocation of resources and opportunities to large-scale and foreign firms. On the Zimbabwe side, the river frontage was extended to 5km, making way for national parks and hunting concessions, and 23,000 people were settled inland in areas some distance from their previous livelihoods. In Zambia, the prime land was allocated to an expatriate who used paramilitary forces to drive out the indigenous population; he subsequently stocked the land with elephants that frequently foraged on local crops. An additional unanticipated consequence of the construction of the Kariba Dam and downstream Cahora Bassa dam was that the enhanced water control after the dam was constructed led local inhabitants to move closer to the river. Ironically this made them more vulnerable to flooding due to water releases at times of high rainfall. In 2000, this flooding affected 635,000 people in Mozambique and 180,000 were forced into emergency shelters.[12] Finally, a striking feature of this investment in large-scale HEP is that it failed to provide energy for the mass of the population, and in 2016 only 28% of the Zambian population had access to electricity.[13]

In technical terms, many of these adverse impacts arising from the Kariba dam could have been mitigated. But large dams are coterminous with the concentration of power to serve the interests of the politically and economically powerful, as seen in the case of fishing and tourism sectors. In

[11] This case study draws on the detailed and long-term observations reported by Scudder 2005.

[12] On 21 July 2018, the wall of the almost completed Xe-Pian Xe-Namnoy hydropower dam in Laos collapsed. The dam had taken five years to build and the release of 5bn cubic litres of water resulted in a heavy loss of life and significant damage to agriculture. The dam was part of a mega-scheme to build 11 HEP dams. See www.theguardian.com/world/2018/jul/24/laos-dam-collapse-hundreds-missing. Accessed 25 July 2018.

[13] World Bank Open Data, https://data.worldbank.org/indicator/eg.elc.accs.zs. Accessed 14 September 2018.

principle, the resettled populations could have been relocated in ways that were developmentally beneficial. However, in reality their interests were over-ridden. Here the World Bank was complicit – the report it used to justify its loans for the Kariba Dam referred to the need to resettle 29,000 people, whereas in reality the number was 57,000.

Large dams do not just provide power: they are also often are linked to large-scale irrigation systems. Since irrigation is an important driver of agricultural production and rural incomes, irrigation has an important positive growth impact. However, in many cases this positive growth impact is associated with deleterious developmental consequences. In 1996 the World Bank reviewed its experience with the funding of 50 large dams with an installed generation capacity of 39,000 MW. These were carbon-saving, since they replaced 51 million tonnes of fuel, and provided an additional total 1.8 million hectares of irrigation. However, the reliance on large dams to provide irrigation had important negative developmental consequences.

> "The 50 dam projects [reviewed by [the World Bank] … displaced about 830,000 people, and only half showed a satisfactory resettlement outcome. Hirakud dam, India, built over 1948-57, displaced 100,000 persons and submerged 167,376 acres of land … Sardar Sarovar, India is expected to displace about 100,000 people (30,000 from Gujarat and Maharashtra and 70,000 from Madhya Pradesh) … In some cases landholders have not been compensated, for example farmers were stripped of their land during the Semry I project in Cameroon" (Lipton et al, 2003)[14]

In terms of paradigm expansion, we should not be surprised at these linked developments. Over the past century, large HEP and large-scale irrigation schemes have been cost-efficient and growth-promoting. During this period, alternative technological choices (particularly in energy generation rather than irrigation) were economically sub-optimal. Moreover, although micro-HEP has played an important role in many economies (particularly in China) large-scale HEP and dam-based irrigation have made a major contribution in many low- and middle-income economies, such as the Kariba Dam. The dominance of these "efficient" mega schemes and the associated technological choices have led to the clustering of technological outcomes (large-scale production; production being separated from consumption and residence), social and political coalitions (the dominance of the large and the urban) and environmental impacts (externalities being excluded from the pricing system).

But what if there had been viable forms of energy provision which had made it economically cost-efficient to provide access to energy at smaller levels of scale, providing the scope for distributed production, and which were less environmentally harmful? This system of infrastructural provision would have involved lower barriers to entry in power supplies and irrigation and had lower capital costs, an important factor in capital-constrained low- and middle-income economies. It would have reduced the drive towards urbanisation, since production in rural areas across sectors could have been supported by available, proximate low-cost energy. Smaller-scale agriculture, which is generally more labour-intensive and more land-productive, would have been supported by

[14] The sources for each of these individual studies are listed in Lipton et al, 2003.

distributed water provision. Off-farm rural enterprises and production would have been aided by the availability of distributed and low-cost energy. There would be no need to relocate thousands of people and the harmful environmental impacts and environmental risks of dams would be avoided.

And perhaps most importantly, instead of meeting the needs of an elite and supporting the development of a political and social complex systematically focusing on the needs of the privileged and powerful, societies would be driven forward on a trajectory of smaller-scale economic and political organisation. In sum, were a distributed low-cost and environmentally friendly system of energy and water provision to have been available, not only would economic growth have been sustainable, but the developmental impacts would have been far more inclusive.[15]

However, with respect to the past, all of this is conjectural, since HEP and large dam irrigation schemes were, in many contexts, clearly the only available low-cost technology. But that is the past – we now live in the present and we plan for the future. So what alternatives now exist that might lead to more beneficial growth and developmental outcomes? The obvious answer is that recent developments in renewable energy technologies already provide the potential for distributed and low-cost energy production and consumption. With likely developments in storage technologies, they will be increasingly efficient in coming years. These offer a number of benefits with inclusionary impacts:[16]

- Advances in the cost efficiencies of renewables are obvious and increasingly well documented.[17] The growing cost-effectiveness of renewables is reflected in the reality that renewables increasingly dominate capacity augmentation at a global level (Figure 3).

- Large-scale HEP involves lumpy investments. Typically, like nuclear plants, they involve generating capacities of more than 1,000 MWs and 'small-scale' coal plants start from 200MW. By contrast, solar and wind power is modular, with individual units offering cost-competitive energy in scalable units of around 5MW. The scalability of small-scale renewables has a number of inclusionary benefits. In an increasing number of contexts, they provide low-cost power. Their scalability means that they do not suffer cost penalties when initial consumption is low; they involve low capital costs, reducing entry barriers for small-scale providers; they do not require long transmission lines with attendant power losses; they provide standalone energy sources, which do not disadvantage distant communities; they are less environmentally damaging.

[15] Although small-scale HEP could meet these needs, they only serve those close to the source of water, whereas large-scale HEP feeds into centralised grids serving distant markets.

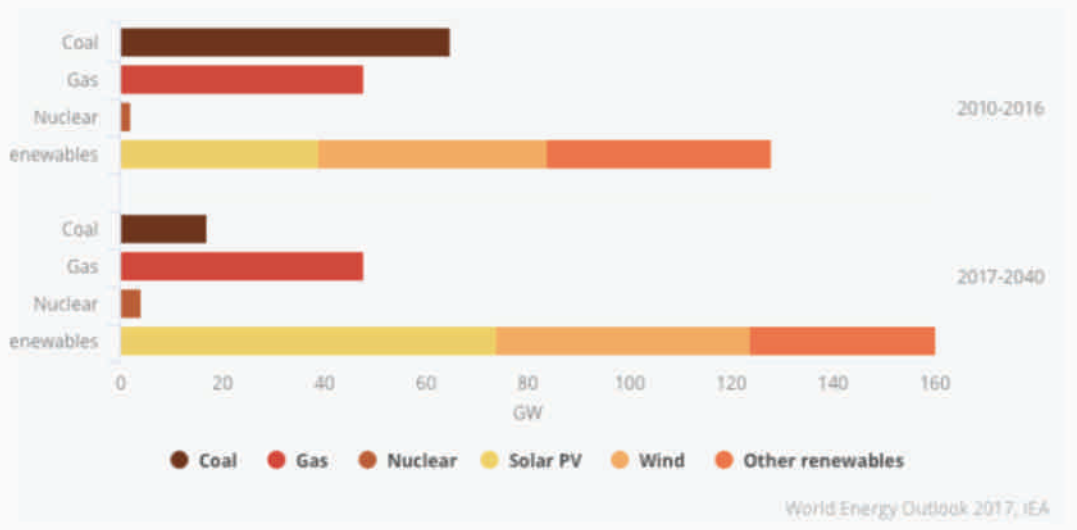
[16] A similar story concerning the viability of small-scale alternatives can be told for irrigation systems, including Zimbabwe where the Kariba Dam is situated. See www.fao.org/docrep/w7314e/w7314e0b.htm, accessed 24 June 2018.

[17] See for example: International Renewable Energy Agency: www.irena.org/costs; Bloomberg NEF – Tumbling costs for wind, solar, batteries are squeezing fossil fuels (28 March, 2018): https://about.bnef.com/blog/tumbling-costs-wind-solar-batteries-squeezing-fossil-fuels/; Bloomberg NEF – New Energy Outlook 2018: https://about.bnef.com/new-energy-outlook/; Renewable Energy Policy Network for the 21st Century (REN21), REN21 Renewables Global Futures Report: www.ren21.net/future-of-renewables/global-futures-report

- Renewables offer greater opportunities for developing local linkages – it is estimated that, even in high-income economies, around 85% of the capital costs in fossil fuel plants leak outside the local economy, whereas the proportion of local value added in renewable plant construction is far higher (Sovacool et al. 2014).

- The major constraint to many of the renewable technologies is their intermittent nature, but there are ongoing heavy investments into various forms of energy storage which will almost certainly reduce its significance. The more rapid the growth of these new storage technologies, the sooner reliance on non-renewables and large-scale HEP in the energy mix can be reduced.

Figure 3: Global average annual net capacity additions by type



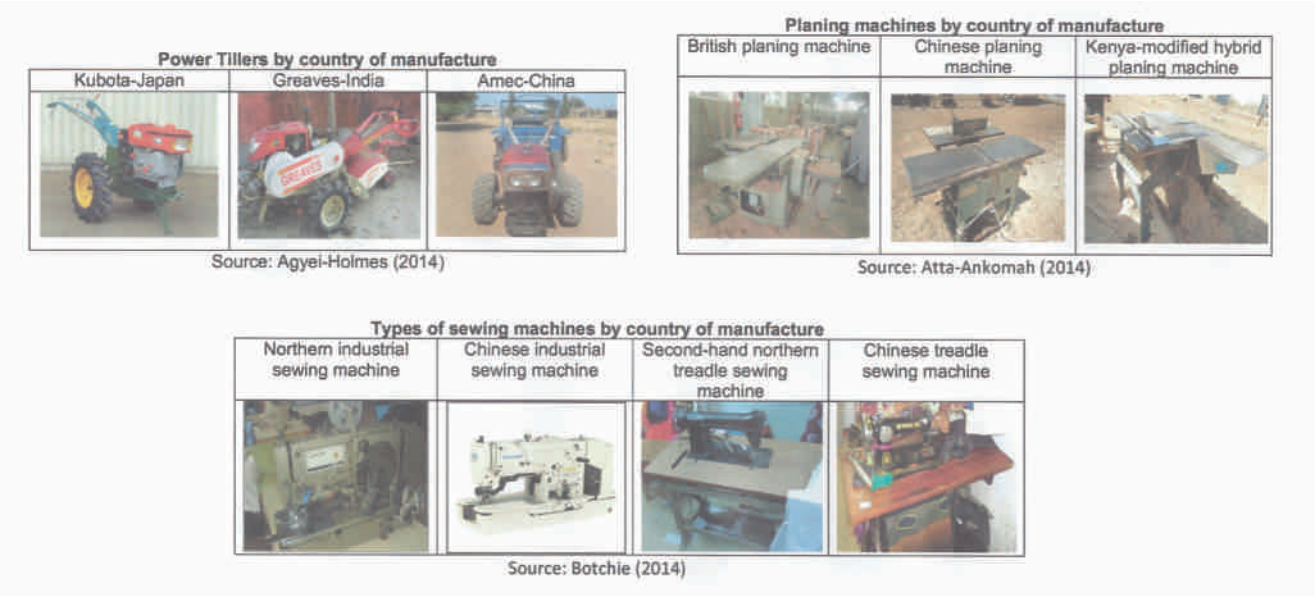
3.2 Innovation and inclusion in SMEs and clusters

As observed in Section 1, innovation occurs at a number of levels – new to the world, the sector, the country, the region and the enterprise. From the growth and development perspective, and particularly from the perspective of informal sector and SMEs in low- and middle-income countries, the key arena for innovation is the adoption of processes and the production of products that are new to the firm, rather than to the world. Since, as we saw in Table 1, in most of the developing world incomes in both the agricultural and non-farm sectors are predominantly earned in informal and small-scale activities, a more inclusive development path necessarily needs to focus on this arena of predominantly incremental innovation. Innovation at this micro-level of activity involves both improvements in process technologies and in the organisation of production within and between enterprises. The scope for these innovations can be illustrated through two case studies from East Africa.

3.2.1 The choice of appropriate technology (AT) and South-South trade[18]

AT has an uneven reputation in developing countries. For many, it is synonymous with poor-quality products and economically inefficient process technologies. This reflects the fact that, historically, the dominant source of innovation has been in the high-income economies, and reflecting the inducements to innovation in these economies. The resultant innovation trajectory has involved large-scale and capital intensive production, drawing on relatively skilled labour and requiring access to reliable and pervasive infrastructure. In a context when, as the widely-cited Sussex Manifesto in 1970 observed, only 2% of global research and development (R&D) occurred in the developing world, the sub-optimality of AT was not surprising (Singer et al, 1970). But, since the heyday of the AT movement in the 1970s and 1980s, there have been very significant changes in the global dispersion of innovative capabilities. Currently, more than 30% of global R&D now occurs in what were formerly low-income economies. Reflecting the inducing conditions shaping innovation in these economies, AT is no longer necessarily 'economically inefficient' (that is, using both more labour and capital per unit of output). Moreover, the concept of 'quality' (which for many years was seen to be a critical failure for labour-intensive and small-scale techniques) is also being increasingly challenged. The 'gold-plating standards' which determine the operating characteristics in value chains required to meet the expectations of high-income consumers may not be appropriate for lower-income consumers, who will settle for much lower standards if the product is available at lower prices.

Despite the global dispersion of innovative capabilities, not all low- and middle-income economies are sources of innovation. Larger economies such as China, India, Brazil and South Africa have relatively more advanced capacities to innovate. And these economies have increasingly come to offer a range of capital goods that are more appropriate for the operating conditions in other low- and middle-income economies than technology sourced from high-income economies in Europe, North America and Japan. These outcomes can be observed with respect to the use of Chinese sewing machines in Uganda (by comparison with German machinery), Chinese furniture machinery in Kenya (by comparison with British equipment) and Chinese and Indian rice tillers in Tanzania (by comparison with Japanese equipment). See Figure 4.



[18] This case study is drawn from Hanlin and Kaplinsky, 2011.

In all three case cases, Northern machines are more costly than the Southern equipment. For example, the acquisition costs of a power tiller and a sewing machine from the South are respectively about half and two-thirds of the costs of those from the North. The difference in acquisition cost is more noticeable in the case of woodworking machines where the Northern machine is over ten times the cost of the Southern-origin machines. However, the low-cost machines from the South tend to have a shorter lifespan, with more frequent breakdowns compared to those from the North. But the frequency of breakdown does not necessarily imply higher repair costs for the Southern machines, as the Southern equipment is generally less complex and spares are cheaper and generally easier to find on the local market. For example, the lifetime repair and maintenance costs of the Japanese tillers are more than four times those of the Chinese tillers (contributing to the much longer lifespans of the Northern equipment); the repair and maintenance costs for Chinese and German sewing machines are similar. In the case of planers, the substitution of Northern motors for the Chinese motors installed as original equipment adds to the capital cost of the Chinese planers but extends their lives considerably. Thus the 'quality' of equipment is a complex issue – the inherent robustness and longevity of the equipment needs to be considered in tandem with repairs, maintenance and modifications. In all three cases, the greater likelihood of southern-sourced machinery breaking down, coupled with their relative simplicity meant that an unintended externality of their operation was the growth of machine-servicing capabilities in the rural and peri-urban areas which spilled over into servicing equipment for other sectors.

The machines from the South in the three sectors are all more labour intensive than those from the North, but this is associated with lower rates of (designed) output than Northern-origin machines. Considered in the round – that is, taking both the productivity of capital and the productivity of labour into account – virtually all of the Southern-origin machines are economically efficient at actual capacity utilisation. To the extent that there are general trends, it is the Northern-origin equipment that is more likely to be economically inefficient (at actual rates of capacity utilisation). This contrasts with the 1970s when empirical studies showed a pervasive tendency for appropriate technologies to be economically inefficient, and this was the basis for the dismissal of appropriate technology in that era and for low rates of diffusion.

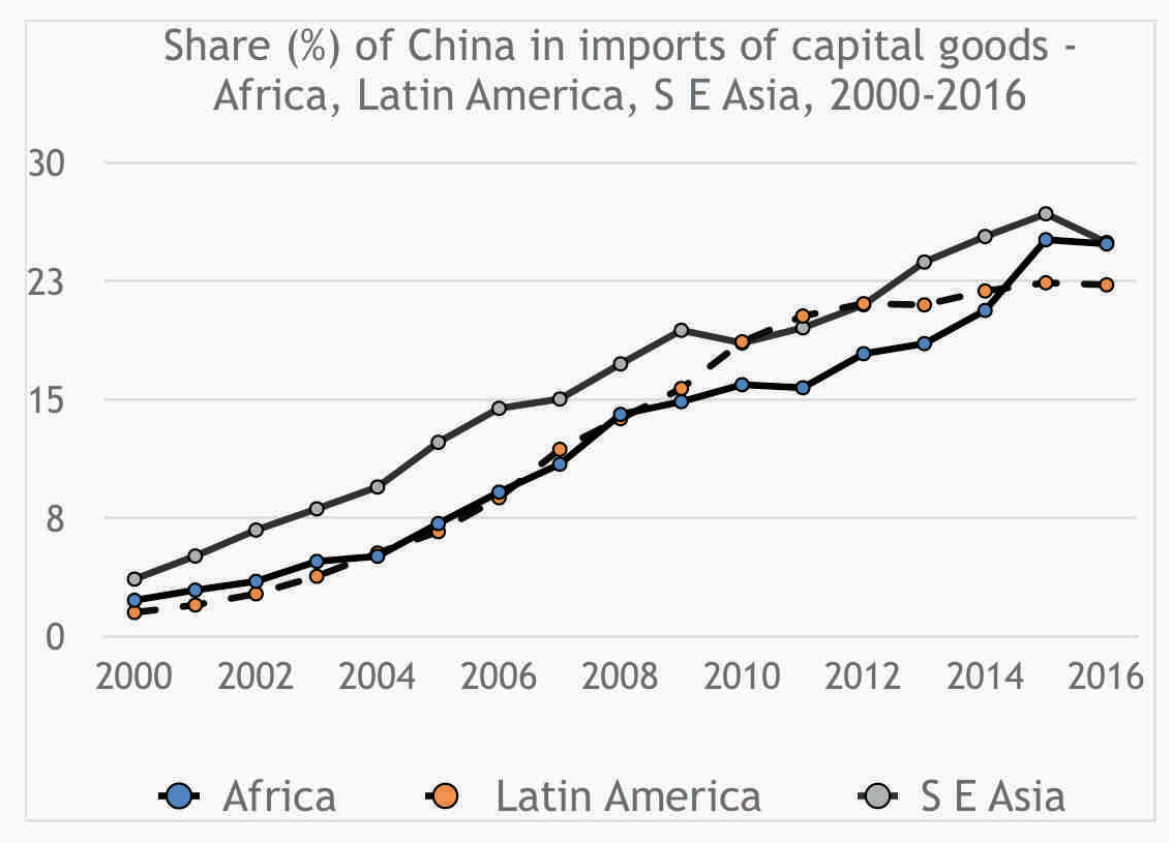
In Kenya, the lower precision of Southern-origin machinery generally means that the producers feed into low- and middle-income markets rather than into higher-income markets. A similar story emerges in the case of Uganda's apparel sector. The users of the two sources of the machines largely target different income segments of the consumer market. Generally, users of Northern-origin machines serve high- and middle-income consumers, while those who use Southern-origin machines focus on the lower end of the market. This is particularly true for the users of woodworking machines, and to a lesser degree, the users of sewing machines. For power tillers, however, the market is segmented based on differences in the suitability of Northern-origin and Southern-origin machines for different aspects of land preparation. Northern-origin tillers are also more suitable for performing off-farm tasks such as transport.

In summary, although there are complex differences at the detailed level of analysis, a number of common themes emerge. First, there is no evidence of the systematic economic inefficiency of Southern-origin machinery. Nor in the case of Southern-origin machinery, are the imports of Southern-origin capital goods into the three African associated with aid flows. Second, this means that the adoption of the machinery will be a function of factor- and product-prices, actual rates

of capacity utilisation and the character of the final market. Third, as expected, Southern-origin machinery is more labour-intensive and has lower acquisition costs. It also generally has shorter lifespans, but this can be compensated for by more skilled operation and regular servicing and repair. Fourth, considering broad indicators of social appropriateness, the Southern-origin machinery appears to have a more inclusive footprint. It operates at lower levels of scale and lends itself to decentralised production, and its lower acquisition costs favour women and other poor producers. However, finally, the environmental impact of Southern-origin machinery – at least in the rice sector – is relatively adverse.

It might be thought that these are special cases, particular to the individual sectors and the three East African economies. However, there has been an astonishing growth in South-South market-driven trade in capital goods. This has largely occurred 'beneath the radar', escaping the attention of academic observers and many policymakers. Although China is not the only source of southern capital goods, it is the dominant supplier. The extent of this trade is evident from Figure 5 – in the case of a mere 15 years, China's share of aggregate capital goods imports into Africa grew from 2% to 25%; those into South East Asia from 4% to 25%; and into Latin America from 2% to 23%. This is a development of historical importance and, as will be argued in later sections of this report, potentially has major significance for inclusive development.

Figure 5: China's share in capital goods imports in Africa, SE Asia and Latin America, 2000–2014 (%)



Source: UN Comtrade Database, http://comtrade.un.org. Accessed 14 September 2018.

3.2.2 Fostering innovation in informal sector manufacturing[19]

The assessment of living standards characteristically focuses on inter-country comparisons of per capita incomes and livelihoods – for example, through indicators such as GDP/capita and life expectancy. But in reality, the greatest contrasts are often to be felt within economies rather than between countries. For example, in the US there are stark differences between downtown Michigan and Palo Alto; in the UK there is a sharp divide between Sunderland and Oxford; and in Italy between Sicily and Bologna. Recognition of these spatial differences has led observers to identify the importance of clusters (sometimes referred to as Industrial Districts) as drivers of economic dynamism. The successful regions are generally characterised by a clustering of like enterprises – for example, electronics, software and AI in Silicon Valley, motor racing in Northampton (UK), metalworking and machine tools in Baden-Württemberg (Germany), and woollen textile firms in Prato, ham producers in Parma, ceramics in Sassuolo and ladies' footwear in Brenta in Italy.

Often, and most notably in Italy, these industrial clusters have been dominated by small firms. During the 1970s and 1980s Italy was the world's largest net exporter of furniture, apparel and footwear. Yet, in each of these sectors, the average firm size was less than seven employees (Best, 1990). So, what explains the dynamism of clusters and the predominance of small firms within many of them? Industrial districts are not a new phenomenon and were analysed by both Alfred Marshall and Karl Marx in the UK. Marshall's explanation of clustering – which he referred to as 'industrial districts' – was ascribed to "external economies" arising from co-location. Examples of external economies are a pool of skilled labour, the agglomeration of suppliers, the pull of buyers to locales where they had a choice of suppliers and the development of specialised support institutions and service providers (referred to in recent analysis as the "regional system of innovation").

More recently, a distinction has been drawn between the simple and unintended external economies resulting from co-location observed by Marx and Marshall, and collective efficiency when firms in the cluster engage in purposeful, planned joint action (Schmitz, 1995). This collective action can take a number of forms, including joint market intelligence and marketing, product development, skills upgrading and lobbying for support from government. When policy design and delivery is effective, cluster dynamics are greatly aided by appropriate backing from local and national governments (Best, 1990). The most dynamic clusters, particularly in contexts of a challenging external environment, tend to be characterised by joint actions of various forms.

Industrial clusters are not confined to high-income economies. They are widely observed in the developing world, in Latin America, in South Asia, in China, and in Africa. From the perspective of inclusive development, clustering *per se* does not in itself promote inclusion; it all depends on the nature of these industrial districts. With this in mind, we can return to our earlier observation of the dominant role played by the informal sector in most low- and middle-income economies. Visitors to the peri-urban districts and small towns in these economies cannot fail to notice the widespread prevalence of clustered informal sector enterprises, predominantly grouped in labour-intensive low technology activities, such as furniture-making, apparel and sewing, metalworking, and automobile

[19] This case study is drawn from Kaplinsky and Morris 2014.

servicing and repair. These clusters exist in a range of trajectories, from survivalist to dynamic groups of firms. As a general observation, the dynamic clusters are associated with enterprises which upgrade their activities through the adoption of better processes, the development of improved products and the adoption of improved business practices, including in marketing and skill development – that is, by innovation. The development challenge – with potentially significant returns – is to assist these clustered informal sector enterprises to upgrade by becoming more innovative, and the policy-relevant knowledge gap is thus to assess the determinants of upgrading in these clustered informal sector districts.

Here we can draw on the experience with innovation of 25 African clusters (Kaplinsky and Morris, 2014).[20] These span nine economies – Egypt, Ethiopia, Ghana, Kenya, Nigeria, Mauritius, South Africa, Tanzania and Uganda. They include clusters in the south, east, west and north of the continent, and in both the manufacturing and agricultural sectors. These cluster experiences with innovation are considered in relation to the major determinants of cluster dynamics in other regions of the global economy.

The first consideration is the market for the cluster's output since the nature of the final market is a primary determinant in the organisation of competitive supply. The second issue considered is the dynamism of the cluster with respect to its growth and upgrading trajectories. Not all clusters are dynamic, and the evidence suggests that static clusters are either survivalist in nature or 'die'. The third is the nature of the external economies which explains why most clusters exist. These are the spill-overs between co-located enterprises which are unplanned, in particular with regard to labour and skills, the proximity of suppliers and customers and the extent of specialisation between firms. Beyond unintended external economies lies the possibility of joint action between enterprises, distinguishing in our analysis logistics, marketing and training. Finally, the institutionalisation of assistance to each of reflects the nature and effectiveness of policy support. This support may be provided by government, by formal associations developed by the private sector and by parties external to the economy, such as lead firms or aid agencies. We assess the significance of innovation in these cluster dynamics by classifying them in term of their growth performance (sales/employment) and our reading of the case studies with regard to their capacity to innovate and to upgrade their processes, products and business organisation.

The nature of unintended externalities

All of the 25 clusters benefit from at least one of four categories of external economies: labour skills spill-overs; proximity of suppliers; proximity of customers; and the development of inter-firm specialisation and the division of labour. Table 2 considers the prevalence of individual external economies in these 25 clusters. It shows that 12 of the clusters benefit from all four types of spill-over, eight benefit from three types, and five benefit from two types of externalities. In none of the clusters did firms benefit from only one type of external economy.

[20] All of these observations are judgements made on the basis of publically available material on the nature and the performance of these 25 clusters (See Kaplinsky and Morris 2014 for the detailed sources). It is not possible to subject these clusters to any form of numerical analysis since each has been documented in a different form.

Table 2: Prevalence of external economies

Evidence of external economies	Number of clusters
Availability of labour supply	18
Availability of suppliers	23
Customer attraction	22
Inter-firm specialisation	19
2 external economies [type 1]	5
3 external economies [type 2]	8
All 4 external economies	12

The role of markets in cluster dynamism

There is a clear pattern in the relationship between the location of the final market and the dynamism of the clusters (Table 3). Each of the three clusters selling primarily into global markets, the six clusters selling into national markets and the ten clusters selling into domestic and regional markets, show signs of both sustained growth and innovation. By contrast, the seven clusters selling into the immediate vicinity show the least signs of growth and innovation – they are predominantly survivalist clusters. It is not possible to determine the direction of causality in these numbers, that is whether only dynamic clusters are able to sell outside local markets, or whether the act of selling outside local markets leads to enhanced growth and upgrading.

Table 3: The final market and cluster dynamics

	Evidence of dynamism			Number of clusters
Market orientation	Growth	Upgrading	Growth & upgrading	
Local only	1	2	0	7
Domestic (local and national)	2	2	2	6
Domestic and international	5	5	5	5
International only	3	3	3	3

Joint action and upgrading

International experience shows that clusters achieve collective efficiency when members build on these accidental external economies and take deliberate joint action to strengthen cluster performance. Table 4 considers three types of joint action – skills development (learning), marketing and logistics – and the extent to which this is associated with cluster dynamism. Approximately 75% of the 16 clusters cooperating in skills development have experienced sustained growth or upgrading, or both. A smaller number of clusters cooperated in either marketing (ten of 25 clusters) or logistics (11 of 25 clusters). Logistics cooperation is particularly closely associated with growth and upgrading, whereas joint marketing does not appear to be as important. The more clusters engaged in different types of joint action simultaneously, the more likely this was associated with cluster dynamism. Once again, causality cannot be imputed from these aggregate data alone.

Table 4: Cluster dynamism and joint action

	Evidence of dynamism			Number of clusters
Evidence of collective activity	**Growth**	**Upgrading**	**Growth & upgrading**	
Learning	12	11	10	16
Marketing	8	6	6	10
Logistics	10	10	10	11
1 Collective activity	0	3	2	5
2 Collective activities	7	5	5	9
All 3 collective activities	5	5	5	5

External support and upgrading

Finally, there are a variety of forms of institutionalisation of joint action activities. One source of support is through government – either national or local government or both. Another form of institution is that created by the members of the cluster itself, or by sectoral associations. These institutions are both private sector driven. The third form of support is provided by parties external to the economy, such as through aid or non-governmental organisations (NGOs). Table 5 shows the distribution of these institutional support programmes in the 25 clusters. The largest number of clusters received multiple types of support – from government, through the firm's own contributions and from external sources. Four of the clusters' support institutions were entirely the result of private sector cluster and sectoral initiatives, and an additional three involved collaborations between governments and the private sector.

Table 5: Institutional support for joint action

Evidence of institutional support	**Number of clusters**
Only government	1
Only Cluster/sectoral	4
Only external	2
Government & cluster/sectoral	3
Government & external	1
Cluster/sectoral & external	2
Government, cluster/sectoral, external	9

3.2.3 SMEs and clusters: From survival to dynamics

As a general phenomenon, there appears to be a close correlation in low- and middle-income economies between exclusion and growth trajectories associated with large-scale investments and large-scale enterprises. On the other hand, although smaller-scale and more labour-intensive enterprises are associated with greater levels of inclusion, their growth performance has often been poor. Achieving better developmental outcomes, therefore, requires an upgrading of the performance of the small-scale sector, including in small-scale enterprises working in rural areas and the agricultural sector.

The two sets of African experiences discussed above show how innovation can assist the small-scale sector to become more innovative and dynamic. In the first case, this dynamism is achieved through the use of appropriate technologies sourced from economies with similar innovation-inducing characteristics. In the second case, innovative dynamism is assisted through a combination of cluster externalities, collective action and policy support. The pervasiveness of small-scale informal sector enterprises in low- and middle-income economies – particularly in Africa and SE Asia – emphasises the significance of these drivers of inclusive innovation.

3.3 Distributed infrastructure: Telecommunications, the diffusion of mobile telephony and inclusion

From the outset of the semiconductor revolution in the 1970s, it was forecast that electronic digitisation would lead to the fusion of information processing and data transmission into the ICT sector. The pace and extent of development in this sector has been phenomenal, with transformative impacts on the economy and society – as we observed in Section 1, the emerging technological paradigm depends critically on the low-cost, pervasive applications and flexibility of ICT across the full range of human activities.

One of the most important arenas of innovation in ICT has been with the development of mobile telephony. This not only provides low-cost access to voice and data, but does so in a manner that transforms the communications infrastructure. Previously, fixed-line telephones, operating in a centralised grid, required the construction of costly transmission lines, and this inevitably excluded poor, isolated and distant consumers from access to communication channels. By contrast, mobile telephony provides access on a much more distributed scale, without the need for costly hard-wired interconnections. Mobile telephony has spread with extraordinary speed. As seen in Table 6, the number of mobile subscriptions globally almost quadrupled between 2005 and 2017 (from 2.2bn to 7.7bn). In the same period, the number of fixed-line subscriptions fell by one-third (to less than 1bn in 2017). In the case of less-developed economies, while fixed-line subscriptions were paltry and static over the 12-year period, mobile connections grew 18-fold to 692m subscribers.

Table 6: Fixed and mobile Telephone Subscriptions, 2005-2017

	(millions)												
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
Fixed-telephone subscriptions													
Developed	570	565	546	544	562	553	540	527	516	503	490	479	471
Developing	673	696	708	705	692	676	661	653	626	592	556	524	500
World	1,243	1,261	1,254	1,249	1,254	1,229	1,202	1,179	1,142	1,095	1,046	1,004	972
LDCs	6	7	7	7	8	8	8	9	9	9	8	9	9
Mobile-cellular telephone subscriptions													
Developed	992	1,127	1,243	1,325	1,383	1,404	1,406	1,443	1,479	1,527	1,563	1,603	1,607
Developing	1,213	1,618	2,125	2,705	3,257	3,887	4,483	4,817	5,183	5,468	5,621	5,909	6,133
World	2,205	2,745	3,368	4,030	4,640	5,290	5,890	6,261	6,661	6,996	7,184	7,511	7,740
LDCs	37	69	118	173	217	280	362	426	501	580	638	650	692

Source: International Telecommunication Union. Available at www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx. Accessed 4 July 2018.

There are a number of aspects of the diffusion of mobile telephony that affect patterns of inclusion. The case study to illustrate these characteristics of inclusive innovation is the development and diffusion of M-Pesa in Kenya over the past two decades.

3.3.1 The origins and development of M-Pesa[21]

Mobile phones were introduced in Kenya after the mid-1990s. The number of subscriptions grew rapidly, comprising over half of the adult population by 2003. The introduction of mobile telephony was accompanied by deregulation and a number of foreign firms, including Vodaphone from the UK (operating through a Kenyan subsidiary Safaricom) built presences in this rapidly expanding market. Responding to the desire to promote the Millennium Development Goals, the UK's aid agency made a grant to Safaricom to develop a system to promote access to financial intermediation for low-income citizens. M-Pesa was launched in 2007, under the banner Send Money Home, a means of transferring money from the largely urban-based formal sector to family members in rural areas. Subscriptions grew rapidly. Before the end of 2007 there were 1.3m Safaricom users. By 2013, the number of Safaricom M-Pesa customers had grown to 17m. But it was no longer the only company providing mobile banking services and, with the entrance of other providers, the number of users of mobile banking had grown to 26.2m, equivalent to more than 80% of Kenya's adult population. The total system involved 17,000 agents, significantly exceeding the combined numbers of all other forms of financial service providers (Postbanks, post offices, bank branches and ATMs). M-Pesa has now diffused to a number of other economies, including Egypt, Lesotho, Mozambique, South Africa, Tanzania in Africa and Afghanistan and India in Asia and to Romania and Albania in Eastern Europe.

A key feature in the successful development of M-Pesa was the involvement of users in the innovation process. Focus groups were used intensively during the development of the prototype between 2005 and 2006, and in the initial roll-out of the product. The significance of this user involvement

[21] Unless otherwise specified, information and data for this case study are largely drawn from Onsongo and Schot (2018).

was predominantly that it led to a better-designed product, rather than allowing users to share in the financial rewards of innovation, since the property rights were firmly lodged in the hands of Safaricom and related partners.

Critically, the development of M-Pesa was made possible through changes in the regulatory environment. The initial response of the formal banking system to the disruption posed by mobile finance was hostile. The four largest banks lobbied the Minister of Finance to stop its diffusion accusing M-Pesa inter-alia of being a Ponzi scheme. The Kenya Bankers Association called for an audit of mobile banking and for it to be incorporated within the existing banking legislation. Fortuitously for mobile banking, the political crisis after the post-election violence in 2007 led to the shut-down of the formal banking sector, illustrating the strength and durability of a well-run distributed system of financial intermediation. Thus, the Central Bank resisted the pressures exerted by the formal banks. A number of new regulatory measures were introduced, designed to protect the mobile banking sector from money-laundering and related potential problems.

M-Pesa had a complex inter-relationship with the broader financial system. On the one hand, it rapidly substituted the unregulated *chama* network of informal (and generally very costly) loans. The proportion of households depending on these unregulated transfers fell from 32.1% in 2006 to 7.2% in 2016. But on the other hand, the growth of financial transfers stimulated by M-Pesa led to an expansion of the formal banking system, and the proportion of households using the formal sector banks grew from 22.7% to 42.7% over the same period.

Does M-Pesa facilitate inclusion?

M-Pesa has contributed to social and economic inclusion in a number of ways:

- Within two years of M-Pesa's launch in 2009, 50% of M-Pesa users were previously unbanked households.
- The proportion of households completely excluded from financial intermediation fell from 41.3% in 2006 to 17.4% in 2016.
- The rate of uptake of mobile banking has been highest in low-income households.
- A high proportion of users are women, live in rural areas and are relatively less well-educated.
- Mobile banking is predominantly used for small payments, and although in 2014 it accounted for only 7% of total national payments value, this comprised two-thirds of total payment transactions (Lal, Cox and McAra, 2016)
- Access to M-Pesa credit and collectivised informal insurance schemes allowed poor households to withstand variable financial flows (Jack and Suri, 2014).

- An analysis of financial diaries showed the role played by M-Pesa in allowing investment in productive capacities (Zollman, 2014), and detailed qualitative studies of peri-urban slums and rural economies illustrated how M-Pesa had contributed positively to the expansion of local economic activity. Moreover, a reduction in holdings of physical cash reduced the incidence of mugging and robbery (Plyler, Haas and Nagarajan, 2010).

Nevertheless, despite M-Pesa's substantial inclusionary impacts, there remain a significant number of unreached poor households. This results from a combination of very low-cash incomes, the transaction costs of using M-Pesa, and the geographical unevenness of mobile phone connectivity. Only 15% of households defined by FinAccess as comprising excluded households in 2013 owned a mobile phone.

Leveraging innovation in related sectors

In Section 2 we referred to the seminal analysis of Freeman on technological paradigms. He argued that the core heartland technologies associated with each of the techno-economic waves since the onset of the industrial revolution were characterised by three features – they were demonstrably and significantly cost efficient, they were structurally distinctive by comparison with the technologies that they succeeded, and they had widespread applications across a range of economic sectors. The brief discussion above illustrates the cost advantages of mobile telephony and its rapid take-up. It also showed the manner in which mobile telephony disrupted the financial sector in Kenya. In both of these respects, there were important inclusionary benefits for low-income and rural citizens. But these beneficial impacts were not limited to the financial sector and were also evidenced in the rapid diffusion of renewable energy to poorer, rural and isolated houses through the M-Kopa scheme facilitated by the mobile payments infrastructure.

M-Kopa synergises the financial intermediation developed by M-Pesa with the growing cost-competitiveness of small-scale renewable energy technologies. It seeks to provide access to limited quantities of energy to poor households that either are off the energy grid or lack the financial resources to connect to and maintain the continuous payments that grid-based energy requires.[22] It is a direct spin-off of M-Pesa – one of its three founders was involved in setting up and running M-Pesa – and was established in Kenya in 2011.

In mid-2018 M-Kopa customers could acquire an 8W solar panel plus LED bulbs, a rechargeable LED torch and radio and a phone charger for $30, with a further payment of $0.50 per day – paid through M-Pesa – for a year, after which they own the panels. A 20W system, powerful enough to also drive a refrigerator and a solar TV (both of which M-Kopa also sells) requires a deposit of $80 plus a daily payment of $1.20 for a year. Take-up was rapid and, by 2018, there were more than 400,000 household customers in Kenya, Tanzania and Uganda, and a further 500,000 M-Kopa sets on order. 100,000 of the larger solar panels, which provide access to solar TV, have been assembled in Kenya and the firm is installing the capacity to also assemble the smaller panes domestically.

[22] This case-study is largely drawn from a Wikipedia entry - https://en.wikipedia.org/wiki/M-kopa - accessed 6th July 2018.

M-Kopa is unquestionably an inclusive technology. It has connected hundreds of thousands of homes previously without electricity to energy supplies. The homes that have been connected were either cut off from the old centralised grid energy infrastructure or could not afford the connection, and this is a particular advantage in rural areas. The value of lighting should not be underestimated – the Carnegie Commission on poverty in South Africa during the 1980s estimated that reading by candle was 188 times costlier than reading by electric light (Wilson and Mamphela, 1989). M-Kopa reaches the poor, and in 2015 estimated that more than 80% of its household customers had per capita incomes of less than $2 per day. It has also led to the growth of a supplier industry domestically and although its 'manufacturing' activities were essentially the assembly of imported components, employment was created domestically, including for engineers and technicians.

3.4 Inclusive innovation outside of the market: Healthcare in Cuba[23]

> "The realities are that 25 years of the approximate 30-year gain in life span in the 20th century are because of public health actions rather than clinical care; that risk factors for chronic diseases such as tobacco use, inappropriate diet, lack of exercise, and drug misuse are not easily addressed in clinical settings; that many societal influences not traditionally included in medicine's purview can profoundly affect population health." (Keck, and Reed, 2012:e13)"

Cuba's experience with healthcare offers a strikingly successful example of transition from extreme levels of social exclusion to exemplary patterns of social inclusion. It is a story that developed over six decades and involves comprehensive patterns of inclusion – in process, product development and the participation of formerly marginalised citizens in the innovative process. Central to this story is the absence of the Schumpeterian innovation motor discussed in Section 2, illustrating the limits of the market allocation of resources in delivering inclusive development. But it also provides evidence of the difficulties that non-market-based innovation pose for integrating economic growth and social development.

At the time of the Revolution in 1959, Cuba had the third-highest ratio of doctors to population in Latin America, only bettered by Argentina and Uruguay. However, this health endowment was associated with extreme patterns of exclusion. For example, in 1959 there was only a single rural hospital and the rate of infant mortality was more than 100 per 1,000 live births (Keck and Reed, 2012:e13). Two-thirds of its physicians lived in Havana (Cooper et al, 2006). Six decades later, the level and distribution of health outcomes has been transformed. These outcomes were achieved despite the mass exodus of half of its physicians (more than 3,000) at the time of the revolution, a decades-long period of sanctions prohibiting medicine exports from the US to Cuba, and the collapse of the Soviet Union in 1989. Until 1989, the Soviet Union had provided significant economic assistance to Cuba, and following the withdrawal of this support, adult calorie intake fell 450% and and instances of underweight newborns increased by 23% (Drain and Barry, 2010).

[23] I am grateful to Maureen Mackintosh from the Open University for assistance in this case study.

Table 7 illustrates the absolute level of health outcomes and Cuba's comparative performance. Its infant mortality rate of under 4.5 deaths/1,000 is similar to that of the high-income economies and superior to that of the US. It compares very favourably with the infant mortality rates of regional economies with similar levels of per capita income. Life expectancy is also similar to that of high-income economies. Additional impressive achievements include:[24]

- First country to eliminate polio (1962)
- First country to eliminate measles (1996)
- The lowest AIDS rate in the Americas
- 98% full immunisation for 13 illnesses by the age of 2 years
- Infectious and parasitic disease mortality per 100,000 fell from 45.4 in 1970 to 8.0 in 2010
- The most effective dengue control programme in the Americas
- The highest rates of treatment and control of hypertension in the world
- World-leading ratios of health workers per citizen – in 2005, Cuba had 627 physicians and 94 dentists per 100,000 population compared to 225 physicians and 54 dentists per 100,000 population in the US and around 123 physicians and 30 dentists per 100,000 in Central America.

Table 7: GDP/capita, infant mortality and life expectancy, Cuba and some comparator economies (2017)

	GDP/capita ($PPP) 2016	Infant mortality (per 1,000 births)	Life expectancy
Cuba	11,900	4.4	78.7
Dominican Republic	17,000*	17.5	78.3
Guatemala	8,100	21.3	72.6
Jamaica	9,100	12.8	73.7
EU	39,100	4.0	80.2
UK	43,200	4.3	80.8
US	58,600	5.8	80.0

* 2017

Source: Central Intelligence Agency. Available at www.cia.gov/library/publications/resources/the-world-factbook/index.html . Accessed 10 July 2018

Beyond these achievements in domestic health outcomes, Cuba provides free medical training for medical students from Africa and Latin America, with an enrolment of 19,300 students in 2013. It provides more medical personnel to developing countries than all G8 economies combined. More than 20,000 health tourists visited Cuba in 2013, earning revenues of $40m, and doctors working abroad provide significant (but unmeasured) foreign exchange to the economy.[25] Cuba also has growing exports of drugs to more than 50 countries based in large part on its expertise in biotechnology (see below).

[24] These data are drawn from Cooper et al 2006 and wikipedia.org/wiki/Healthcare_in_Cuba. Accessed 10 July 2018.

[25] wikipedia.org/wiki/Healthcare_in_Cuba accessed 10 July 2018

Inclusive innovation is central to these achievements in inclusive healthcare and has taken two primary and related forms – changes in the design and delivery of healthcare and the development of new drugs.

3.4.1 Innovation in the design and delivery of healthcare[26]

Following the Cuban Revolution, national programmes were introduced to reduce malaria and acute diarrheal and vaccine-preventable illnesses. These objectives were addressed by dispatching newly trained health professionals to rural areas. Central to their agenda was the integration of public health education and clinical medical expertise. But, despite rapid progress, waiting times were long, care was hospital-centred and there was a continuing emphasis on curative rather than primary care. Hence, in 1974 there was a major shake-up in healthcare, with the pioneering and subsequent diffusion of community-based polyclinics. This decision recognised that morbidity and health outcomes were determined by the social environment of local communities. These primary-care polyclinics focused on four areas of health priority: maternal and child care; infectious diseases; chronic non-communicable diseases; and care for the elderly. The 1983 Cuban Public Health Law declared free healthcare to all as a right, that it would be wholly delivered by the state, that healthcare would be integrated with economic and social development and that the public would be actively involved in its development, monitoring and delivery.

The Health Law saw the introduction of the Family Doctor and Nurse Plan in which each polyclinic served as a hub for approximately 15 neighbourhood teams. Public health interventions (for example, health education, changes in sanitary practices, environmental clean-up, community-based rehabilitation) were closely integrated with the clinical support provided by these teams. Each of these neighbourhood teams lived in their communities. By 2012 there were 488 polyclinic hubs, providing support to all citizens. Each polyclinic oversees care for between 60,000–80,000 people and provides specialist curative support for those whose needs cannot met by the Neighbourhood Teams. Above this layer of support, there are specialised hospitals in each Province.

The collection of data and, critically, the use of these data for informed care delivery is a central feature of this comprehensive care system, and also has important implications for the growing investment in drug development (see below). Detailed patient records are updated at six-month intervals, and this results in them being classified in terms of health risks – for example, smoking, weight, hypertension (every citizen is tested at least once per year) and diabetes. Each household is visited at least once a year, and individuals with chronic illnesses are seen every three months or less. All of this comprehensive data is fed into a national database.

Community involvement is central to this system. The Neighbourhood Teams are supported and monitored by neighbourhood Popular Councils. For example, following complaints by HIV/AIDS patients, their care was moved from sanatoriums to living in the community, but accompanied by extensive public health education – and, as observed above, Cuba has the lowest AIDS rate in the Americas.

[26] The discussion of public healthcare is drawn from Keck and Reed (2012), Campion and Morrissey (2013) and Cooper et al. (2006)

3.4.2 Innovation in drug development

Cuba has an extensive and long-term programme of investment in biotechnology and, in recent years, this has led to a growing stream of new product development. For example, three innovative new drugs have received global attention:[27]

- CimaVax lung cancer vaccine was developed by Cuba's Center of Molecular Immunology. The vaccine reduces the likelihood of recurring non-small cell lung cancer and in 2017 was cleared for testing by the US Food and Drug Administration and was used in Peru, Paraguay, Colombia and Bosnia.

- Heberprot-P was developed in 2006 by the Center for Genetic Engineering and Biotechnology. It treats diabetic foot ulcers and prevents the need for amputation. By 2017, Heberprot-P had been used to treat more than 165,000 patients in 26 different countries.

- Nimotuzumab was developed by the Center of Molecular Immunology. It is an anti-cancer drug used to treat head, neck and brain tumours. In 2014, Nimotuzumab was recognised under 'orphan drug status' in the US for the treatment of Glioma tumours.

A particularly important characteristic of the Cuban health system is the enormous database that exists as a result of the detailed patient and household monitoring undertaken by the Neighbourhood Teams – every individual's health status and treatment schedules (such as vaccinations) are recorded in detail throughout their lives and held in a central database. In an era of big data, this is an invaluable data set that can potentially be used to determine the range of factors associated with morbidity and the results of treatment. Should foreign direct investment into Cuba be liberalised, and should external countries such as the US allow their firms to operate freely in Cuba, this database lends itself ideally to the sophisticated development of new drugs and new forms of treatment.

3.4.3 The costs of the Cuban healthcare system

Data is seldom (if ever) neutral; it always represents the conscious or unconscious bias of the observer. In the case of Cuba, data on the economy and health service is caught up in the ideological hostilities with the US (and therefore subject to conscious manipulation). Also, some of the units of measure are often not globally comparable. This latter issue is a particular problem with respect to the monetary evaluation of inputs and outputs, since transactions in the domestic economy involve at least two (and sometimes more) rates of exchange with foreign currencies. Nevertheless, despite the disputation about numbers, there is general agreement around approximations. The data on health outcomes reported in Table 7 are widely accepted to be a reasonably accurate reflection of the state of comparative health across the nominated countries. There is also general agreement that

[27] Guajardo, T. Lynx Global Intelligence. See:http://lynxglobalintelligence.com/2017/05/16/accessing-cuban-medical-technology. Accessed 11 July 2018.

these outcomes are achieved at a relatively low comparative cost. The World Health Organization estimated that, in 2012, per capita health expenditure in Cuba accounted for 8.6% of GDP costing $558/capita, and this compared with equivalent ratios for the US of 17% and $8,845 respectively.[28] However, were the low salaries paid in Cuba's health sector (doctors receive a cash income of $20 per month) applied to health professionals in other countries, this comparative cost-efficiency would be less evident.

3.4.4 In what ways is Cuban healthcare inclusive?

Despite the outflow of skills soon after the revolution, the long-lived US blockade and the removal of support from the Soviet Union, Cuban healthcare was transformed into a distinctively inclusive system. It developed products for the poor – for example, public health interventions and vaccinations and drugs to treat diabetes and skin cancers. It developed very labour-intensive processes of health delivery in which interpersonal contact substituted for costly (imported) drugs and medical equipment, and the community was involved in the monitoring, implementation and design of healthcare delivery.

There is one further inclusive aspect that has much wider significance than the character of the innovation path in the health and pharmaceutical sectors. At an address given to an assembly of global researchers working on innovation (Globelics Conference, 24 September, 2015), the Research Director of the Center of Molecular Immunology began his address by contrasting Cuba's health outcomes with those of the US, and then explained the primary driver of Cuba's drug development research programme in the following terms:

> "You must understand – in the development of drugs in Cuba, we never start with the question of money. All of our drug development priorities are driven by the incidence of morbidity".

This approach flies in the face of Schumpeterian innovation trajectories in market economies. However, it poses challenges to the cost-efficient use of scarce resources invested in innovation processes. The returns to R&D, even in terms of health outcomes let alone profits, may be very weakly related to the incidence of morbidity and vast resources may consequently be expended in meeting insurmountable health challenges, precluding progress in other areas of health delivery. The evidence from the Cuban health sector suggests that this approach towards innovation in healthcare has not had these adverse impacts. But when extended to the economy as a whole, the rejection of the Schumpeterian innovation motor has arguably been an important factor underlying Cuba's very low rate of innovation and economic growth.

[28] O'Hanlon, C., and Harvey, M. Key Health Care Indicators in Cuba and the United States. Available at www.rand.org/blog/2017/10/doing-more-with-less-lessons-from-cubas-health-care.html. Accessed 12 July 2018.

3.5 Transnational Corporations (TNCs) at the bottom of the pyramid (BOP)[29]

As we observed in Section 2, one of the major inducements to the direction of technological change is the character of the final market. Until the 1990s, the primary locus of global demand lay in the high-income markets. Given high per capita incomes in the advanced economies, the value chains that have been developed to serve consumers in these markets are characterised by a 'triple bottom line' performance requirements, including the character of final products (for example, recyclability, absence of lead paints in toys, organic produce), the labour processes in production (for example, child labour, health and safety requirements) and their environmental impact (for example, emissions and chemical residues). These 'gold-plating standards' in value chains have resulted in high unit prices, affordable to high per capita incomes (that is, high by comparison with the low- and middle-income economies). Increasingly, urban elites in China, India and other low- and middle-income economies replicate these consumption standards.

However, the very rapid growth of incomes in China and other low-income economies from the late 1980s, coupled with the slowdown in growth rates in the high-income economies after the turn of the millennium, provided a new and dynamic source of global demand, and one with a distinctive character. The new consumers had low per capita incomes, and purchased in small transactions. They also did not share the concerns of high-income consumers about the provenance of the value chains that served their needs – or if they did, they did not have the incomes to pay for these 'gold plating' standards.

In the early 1990s, the potential demand from low-income consumers grabbed the attention of the large TNCs that dominated final markets. This awareness was aided by the seminal text of writings of Prahalad (Prahalad and Hammond, 2002; Prahalad and Hart, 2002) who drew attention to the market potential of this new class of consumers, pointing out that there was something in the region of 4 billion people living at per capita incomes below $2,500 p.a. He argued that there was a "fortune at the BOP". But crucially, and perhaps not surprisingly given that he worked in Northern business schools, Prahalad believed that this provided a market opportunity for TNCs rather than for the small-scale and locally owned firms long identified in the appropriate technology and informal sector literature as being key providers for low-income consumers. He argued that "[b]y stimulating commerce and development at the bottom of the economic pyramid, [northern-based] multinational corporations could radically improve the lives of billions of people… Achieving this goal does not require multinationals to spearhead global social development initiatives for charitable purposes. They need only act in their own self-interest, for there are enormous business benefits to be gained by entering developing markets" (Prahalad and Hammond, 2002: 4). The potential for reaping the fortune at the BOP was particularly attractive for the manufacturers of Fast Moving Consumer Goods (FMCGs) such as Unilever and Procter and Gamble and for firms such as Nestlé selling food products

[29] I am grateful to Dev Nathan of the institute for Human Development in New Delhi and Jaideep Prabhu for assistance with this case study.

to low-income consumers. But the potential for restructuring products to meet the needs of low-income markets was not limited to FMCG TNCs – cost-stripping Frugal Innovation became a major objective for producers of capital goods, medical equipment and other durable goods.[30]

By innovating new products and changing production processes, these disparate TNC innovators offered the potential to foster more inclusive patterns of growth. Three short case studies illustrate the potential, the achievements and the challenges of this inclusive innovation trajectory. We begin with an account of General Electric's (GE's) successful attempt to strip out the costs of medical equipment in India. This is followed by review of the operations of Unilever, a TNC acknowledged to be at the forefront of BOP inclusive innovations. This leads on to a discussion of the attempt by S.C. Johnson to grapple with problems that face Unilever and other TNCs in reaping the fortune at the BOP.

3.5.1 Frugal innovation in India's medical equipment sector

India's population and its rapid growth provide a platform for long-term demand expansion. However, despite a rapidly growing urban middle class, per capita incomes are generally low and the infrastructure required to service rural demand is weak, unreliable and fragmented. Hence TNCs selling into this market have made considerable efforts to strip out the costs of their final products and to make them more appropriate for the Indian operating environment. GE's experience in the Indian medical equipment sector illustrates the potential for combining market growth with profitability. Between 2005 and 2009 its Indian product development centre grew from 600 to 1,100 staff, making it the second-largest engineering centre in GE's Healthcare division. Sales at GE Healthcare in India grew at 30% p.a., at a time when sales growth in developed markets was slowing.

In 2008 GE India introduced the MAC 400 portable electrocardiogram (ECG) machine, wholly conceived, designed and produced in India.[31] Following a range of changes to product design and manufacturing process (for example, eliminating ticket printers and a costly motor), the MAC 400 sold at one-third of the price of the imported product. To cope with the power-interruptions prevalent in India, the MAC 400 was battery-powered and, in the face of a shortage of skills in rural areas, was much easier to use than the imported variants. Wherever possible, commercially available generic components were used instead of customised components, improving the repairability of these machines in rural areas. Sales grew rapidly, and in 2009 a new model was introduced (the MAC i), selling at half the price of the MAC 400. Sales extended to other low-income economies and, by 2009, 7,500 MAC 400s had been sold globally, including 2,000 in India. These low-cost ECG machines have made an important contribution to healthcare inclusion in India: 60% of global heart disease occurs in India, and 80% of India's healthcare providers work in cities.

[30] Strategies designed to simply products and to strip out costs through changes in product design are often discussed under the headings of 'Jugaad' – meaning intelligent, low-cost solutions (Radjou, Prabhu and Ahuja 2012) and 'frugal innovation' (Leliveld and Knorringa 2017).

[31] Wharton University of Pennsylvania. Reverse Innovation: GE Makes India a Lab for Global Markets. Available at http://knowledge.wharton.upenn.edu/article/reverse-innovation-ge-makes-india-a-lab-for-global-markets/, Accessed 16 July 2018

A second frugal innovation product developed in India by GE was the low-cost baby incubator, the Lullaby Warmer.[32] Applying the same design and manufacturing principles used in the development of the MAC 400, the incubator cost 20% of the price of its forerunner. The design sought to fashion the incubator for rural markets, with an emphasis on durability, robustness for power outages, ease of use and ease-of-service. For example, the motor control was replaced with a crank and handle, and plastic and steel substituted for other more expensive materials. A voltage stabiliser was included to cope with power surges and electricity consumption was halved. Graphic instructions were prominent, making it easier to use in low-literacy environments. Despite these frugal innovations, the Lullaby Warmer met International Electrotechnical Commission standards. In 2010, it was sold in more than 80 countries, including in Western Europe and emerging markets in China, Russia, and Africa.

3.5.2 Unilever at the BOP

Unilever is one of three giant TNCs straddling the FMCG and over-the-counter healthcare sectors. It has led the way in trying to penetrate BOP markets and is frequently cited as an exemplar for other TNCs operating in low-income markets. Three examples of Unilever's BOP product development and marketing strategies illustrate the potential in these markets and the difficulties in serving them.

The first example lies in the introduction of small sachets rather than the traditional bulkier packaging historically used in the FMCG sector in India.[33] The major product and marketing innovation was made by a local firm, Nirma, in the early 1990s. Recognising the limited purchasing power of poorer Indian consumers, Nirma reformulated its product and its manufacturing processes to cut costs, and marketed its product in very cheap small sachets rather than bulkier packaging. After initially dismissing this strategy, Unilever responded with a similar programme to sell products such as a branded detergent called 'Wheel'. The product was reformulated to reduce the ratio of oil to water in the product, since poorer consumers generally wash their clothes in rivers and other public water systems. Wheel was a rapid market success and, for some years, subsequently was India's leading detergent product.

A second example lies in Unilever's development of low-cost shampoos.[34] This built on Unilever's close understanding of Indian consumer preferences. Indian women value long hair, and spend a disproportionate amount of money and time on hair care. Unilever estimated that, while Indian women comprised 16% of the global female population, they accounted for 28% of the world's hair. But low incomes meant that poor, and especially rural, Indian women used the same product for their body and hair washing. Unilever responded with two linked strategies. The first was to develop a soap specifically formulated to wash both hair and the body. This product – Breeze 2-in-1 – was

[32] Davidson, Leah, "Do Frugal Innovations Lead to Frugal Outcomes? A Case Study of Healthcare in India" (2015). Wharton Research Scholars. 127. Available at http://repository.upenn.edu/wharton_research_scholars/127, Accessed 14 July 2018.

[33] Prahalad and Hart, The Fortune at the Bottom of the Pyramid, Strategy+business. See: www.strategy-business.com/article/11518. Accessed 16 July 2018.

[34] Balu, R., Strategic Innovation: Hindustan Lever Ltd. See: www.fastcompany.com/43028/strategic-innovation-hindustan-lever-ltd. Accessed 14 July 2018.

targeted at markets in rural areas and small towns. The second strategy was to invest heavily in the marketing and brand development of more upmarket Lux shampoos sold in sachets. By 2000, Breeze 2-in-1 dominated its market segment and Lux accounted for 70% of all rural shampoo sales in India.

Notwithstanding these agile responses to market conditions in BOP markets, Unilever found itself operating in very difficult market conditions. Although in 2000 its Wheel detergent had become the market leader, by 2017 this dominant market position had been eroded by a low-cost Indian competitor, Ghari Detergent.[35] Moreover, like other TNCs operating in a variety of BOP markets, Unilever's distribution channels in urban markets proved to be both costly and difficult to replicate in rural markets. It responded to these challenges with an innovation in its distribution network, drawing on the entrepreneurial energy of India's women and the key role they played in household purchases. This complemented its inclusive product development (products for the poor) with the inclusion of the poor in process.

Unilever has traditionally invested heavily in understanding the characteristics of poor rural markets – every management trainee spends a minimum of six to eight weeks living in a rural village. Based in this detailed knowledge of living conditions in rural areas, 150 women from villages in Andhra Pradesh, who were members of self-help groups, were brought together in 2000 (Rangan and Rajan, 2007;).[36] They were offered the opportunity to act as marketing agents in their villages for Unilever products, but this had to be complemented with training in hygienic practices and public health. This programme – referred to as Shakti-Ammas (Shakti means 'power' and Ammas means 'mother') – proved to be a marketing success. By 2012 the average Shakti entrepreneur earned $60 per month, and the programme was extended to include the husbands of these female marketing agents (Shaktimaan). This marketing network involved more than 70,000 Shakti entrepreneurs by 2015, reaching three million rural consumers a month and operating in 165,000 Indian villages (Mahajan, 2016).[37] Shakti sales people were provided with smartphone apps to assist them in inventory control. The programme was then extended to Pakistan, the Philippines and Thailand.

Nevertheless, despite this agile response to product development aimed at meeting the needs of poor consumers, and by including poor women in the marketing of these products to BOP consumers, like other TNCs in the FMCG sector, Unilever has found it difficult to achieve profitability in this agenda.[38] It remains a work-in-progress offering potential for the future, rather than commercial success in the present.

[35] Malviya, S. No Wheels enough to catch up with Ghari; detergent maker maintains market share. The Economic Times. See: https://economictimes.indiatimes.com/industry/cons-products/fmcg/no-wheels-enough-to-catch-up-with-ghari-detergent-maker-maintains-market-share/articleshow/62060828.cms. Accessed 13 July 2018.

[36] Narsaly, R., T. Coffey and A Sen (2012), Hindustan Lever: Scaling a cost-efficient distribution and sales network in remote areas, Accenture Case Study. See: www.accenture.com/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_23/Accenture-Unilever-Case-Study.pdf. Accessed 14 July 2018.

[37] Mahajan, V. (2016), "How Unilever Reaches Rural Consumers in Emerging Markets", Harvard Business Review, December 14, 2016, https://hbr.org/2016/12/how-unilever-reaches-rural-consumers-in-emerging-markets, accessed 14 July 2018

[38] Karamchandani, A., M. Kubzanskyj and N. Lalwani (2011), "The Globe: Is the Bottom of the Pyramid Really for you?" Harvard Business Review, March. See: https://hbr.org/2011/03/the-globe-is-the-bottom-of-the-pyramid-really-for-you. Accessed 16 July 2018.

3.5.3 S.C. Johnson in Africa

S.C. Johnson is an American TNC manufacturing household cleaning and pest control products. Reflecting the experience of many TNCs operating in this market segment, in particular the costs of serving low unit price markets, Johnson introduced an innovative marketing scheme in Ghana in collaboration with the Gates Foundation and Cornell University.[39] The objective of the WOW® programme was to help reduce the spread of malaria through mosquito control, operating in villages with household daily expenditures of between $1.50 and $5.

The marketing innovation stands on three pillars. The first is a home care "gift basket". It contains a bundle of four Johnson products supplied in bulk, with reusable containers for customers. Second, club membership is offered. This involves coaching on malaria prevention and home hygiene, with social events involving neighbouring villages and a "homemaker-of-the-year" prize. Loyalty points are earned at three-month intervals, with rewards provided in the form of products rather than cash. And, third, membership is offered only to groups of households, consolidating the idea that malaria prevention is a social and shared experience.

Drawing on the same marketing principles, in 2010 a programme aiming at sanitising public bathrooms to reduce the spread of diarrhoea caused by unsanitised bathrooms was introduced in a Nairobi slum. Slum-dwellers were charged to use the public toilets (at a cost of around $0.20 per household per week) and the toilet operators were required to use Johnson cleaning products to maintain hygienic standards.

Johnson's BOP programme took ten years to develop and their rollout has been slow – more than four years in Ghana, for example. However, being a private company, it has more scope to persevere in slow-yielding markets such as those at the BOP. It is also aided by support from the Gates Foundation and Cornell University. The stark reality from the experience of both Unilever and Johnson is that the initial promise that TNCs could access the fortune at the BOP has not been easy to achieve.

3.6 Social movements and inclusive innovation in urban wetlands in Bogota[40]

Urban habitats play an important role in public health, environmental sustainability and the quality of life. Characteristically, the quality of urban habitats is both a symptom and a cause of social and economic exclusion. Since these habitats are replete with (mostly negative) externalities they are generally overseen by public authorities, in most cases by decentralised governments.

[39] Simanis, E. (2012), "Reality Check at the Bottom of the Pyramid", Harvard Business Review, June, https://hbr.org/2012/06/reality-check-at-the-bottom-of-the-pyramid, accessed 14 July 2018.

[40] This case study was prepared by Javier Garcia Estevez of the Interdisciplinary Centre for Development Studies, University of Los Andes, and Claudia Obando, Matias Ramirez and Oscar Romero of the Science Policy Research Unit at the University of Sussex. The authors wish to thank the Colombian Science, Technology and Innovation Administrative Department (Colciencias) for their generous support in the writing of this case study.

In many environments, and particularly in low- and middle-income economies, the commitment to habitat care is either non-existent or does not translate into effective policy implementation. Although innovations in the private sector induced by the 'Schumpeterian motor' generate technologies useful in addressing these environmental challenges, the needs of urban wetland care are only partially met by tangible technologies. Wetlands are a clear example of a socio-technical system and therefore their care requires a mix of changed practices and institutional design as well as discrete physical technologies. Moreover, since each locational habitat is environmentally specific, their care necessarily involves the application of science and technology to innovation.

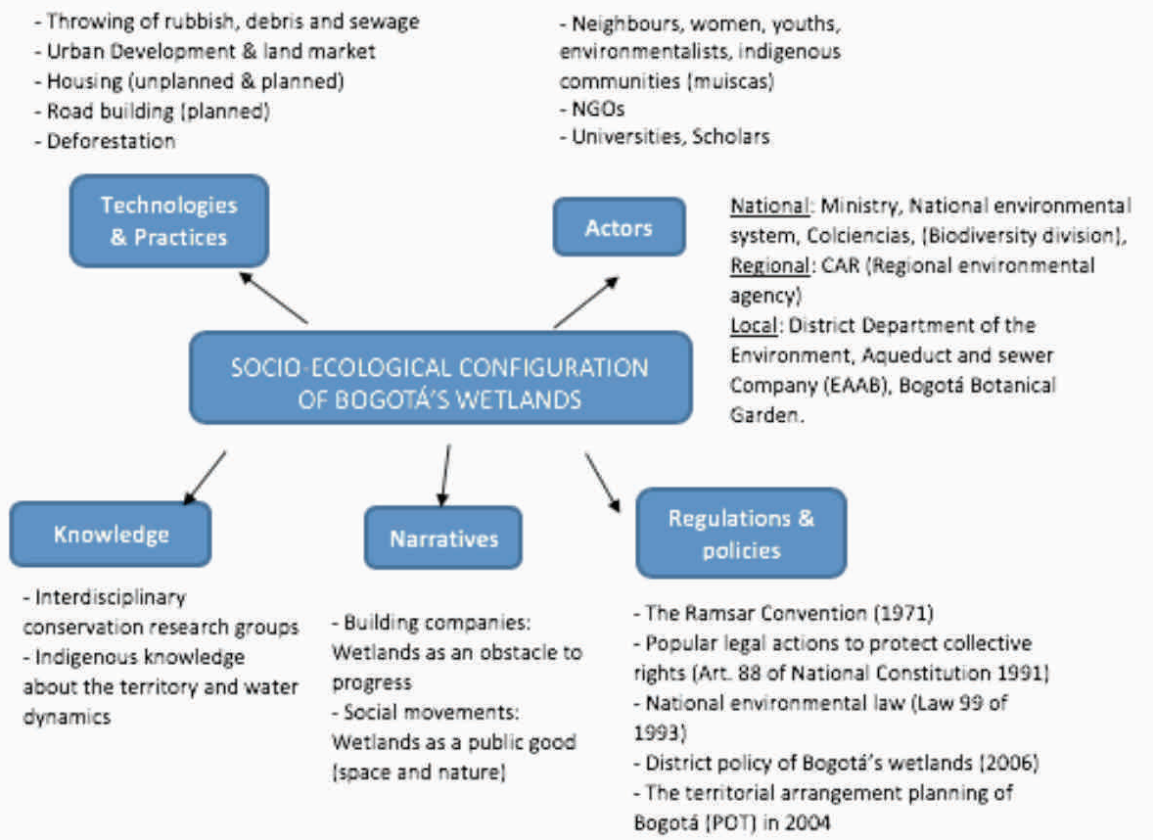
In many parts of Latin America there is a strong tradition of the participation of scientists in social movements, such as citizen science movements. These can play an important role in supporting the defence of the commons (Frickel et al. 2010; Hess, 2015). An example of a successful social movement that was able to draw on capabilities in the National Innovation System to produce inclusive innovations was the defence of the wetlands social movement in the city of Bogota. These wetlands had long been a source concern, degrading the quality of urban life and public health hazards.[41]

Figure 6 shows that attitudes to the wetlands had competing framings, reflecting the interests of different stakeholders.[42] For example, construction companies and many politicians viewed wetlands as marshes hampering the progress and expansion of the city. In contrast, a cluster of civil society actors including people living adjacent to the wetlands, environmental activists, academics and students of local universities saw the wetlands as an environmental asset, intrinsic to the natural commons. They also recognised from the outset that management of the wetlands required a combination of social, economic and technical innovations. The systemic character of the wetlands is evident from Figure 6, reflecting a combination of technological practices, actors, narratives, regulations and knowledge-gaps.

[41] A local newspaper reported: "The marshes of the Savannah and, especially, those of the jurisdiction of the District of Bogotá, have traditionally been recognized as wasted lands or mosquito breeding places where the waters stagnate to produce bad odours. No one gives them their biological importance" (El Tiempo, 1991).

[42] The social movements in Figures 7 and 8 are constructed from a database of news articles related to wetlands in Bogotá and their actions in Colombia over the last 40 years compiled by the Centro de Investigación y Educación Popular (CINEP). Semantic network analysis was used to identify the main topics addressed by the social movement (key words in title of articles) and topics of research projects. These are separated by different colours in the network diagrams.

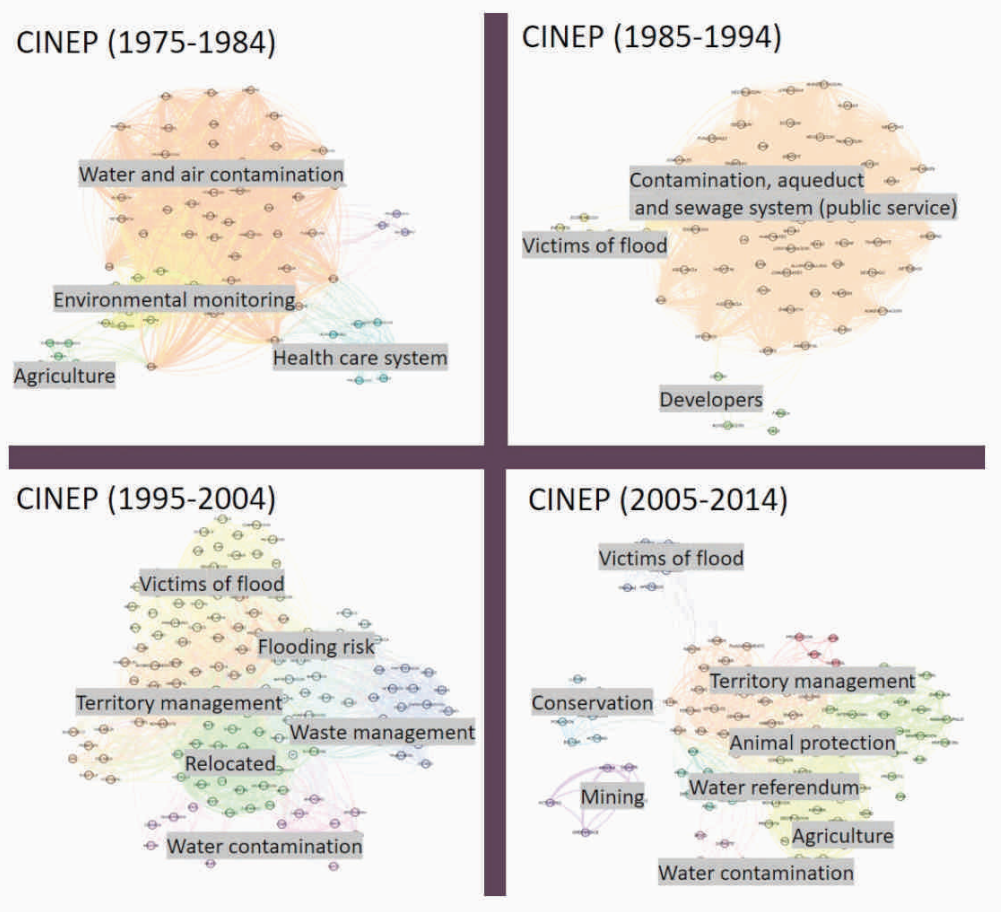
Figure 6: Socio-technical configuration of Bogota wetlands



3.6.1 Identifying the innovation challenge

In the absence of effective public action to address the innovation challenges of wetland management, over the space of more than two decades, social movements played an important role in identifying the changing challenges arising in the wetlands habitat. Between 1975 and 1994 social movements focused on the contamination of water and air primarily as a consequence of industrial and agricultural production. The agenda reflected urban-rural tensions as economic growth led to conflict over the use of the land on the edge of the urban areas. After 1985, displaced people poured into Bogota fleeing from the violence taking place in the regions, and established makeshift homes in the wetlands. The development problems this raised were exacerbated by major flooding events. These various outcomes had clear negative developmental outcomes, with disproportionate impacts on poor and displaced people. The changing focus of the social movements is illustrated in Figure 7.

Figure 7: The Changing Agenda of Social Movements

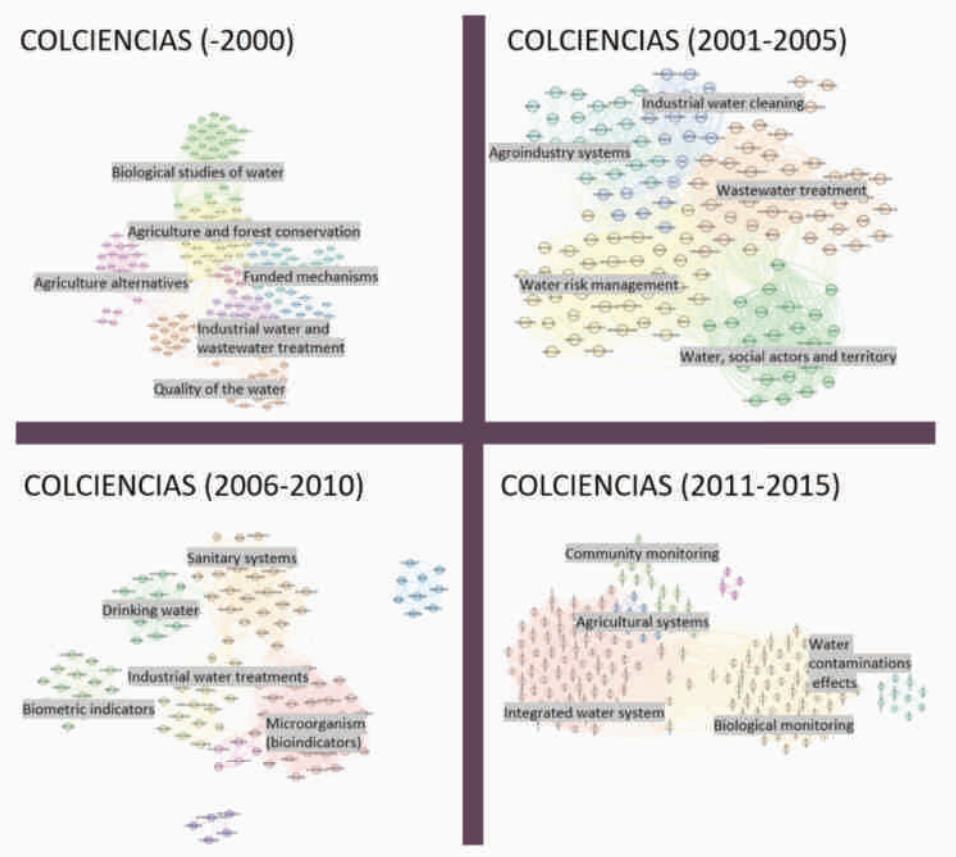


Source: Derived from Colciencias database.

3.6.2 The inclusive innovation response

By the 1990s there was an increase in the number of social movements operating in the Bogotá wetlands and in greater community awareness and specialisation over a more diverse range of topics (territory management, contamination, flooding). Alliances between residents, including lawyers, ecological activists and NGOs created heterogeneous knowledge-generating and lobbying networks. A critical element in this social awareness was the active participation of academics and students from the nearby Javeriana University as activists, teachers (who provided classroom and lessons to the community to reinforce the socio-ecological vision of the wetland) and as researchers funded by projects within the Science and Technology system. These provided legitimacy and technical support for a series of lawsuits, environmental diagnoses and environmental management plans. The defence of the wetlands and the socio-ecological system therefore evolved from a narrow ecological narrative towards a recognition of the needs for a systemic innovation response, reflecting the socio-techno-economic character of the innovation challenge. The critical role played by these social movements can be seen in relation to the specific innovation challenges addressed by projects funded by Colciencias, Colombia's national science and technology agency (Figure 8 and Table 8).

Figure 8: Projects funded by Colciencias



Source: Derived from Colciencias database.

Table 8: Innovation objectives and inclusive innovations addressed by Colciencias as a response to pressure from social movements

Innovation challenges	**Inclusive innovation outcomes**
Introducing sensors and collecting information concerning the states of ecological systems.	Water monitoring including filters, Ph indicators, climatological stations, geological stations, social observatory, geographic information system and sampling of fauna and flora.
The impact of economic growth and restructuring on multiple social-ecological systems.	Water management and clean water improves and reduces the cost of public health. For example, acute respiratory diseases in children have been reduced.
Cleaner technology to improve the efficiency with which material resources are harvested and transformed into valued outputs.	New technologies introduced to reduce water contamination in the wetlands and Bogota River, for instance, in the el Burro wetland, biofilters, water treatment equipment and infrastructure construction to improve oxygen rate.
Repairing harmful environmental impacts.	Restoration of flora, fauna and water quality by Bogotá Botanical Garden and the District Department of Environment. Technologies developed specifically for the wetlands conditions in Bogotá – for instance, Bogotá Savannah has a specific biodiversity and hydraulic conditions in its rivers and wetlands.
Governance strategies to promote greater social-ecological systems resilience.	Projects regulating use, cleaning and contamination of water. For example, Bogotá Wetland Policy requires COLCIENCIAS to include programmes for environmental education and social strategies.

Source: District policy of Bogotá's wetlands (2006), Environmental Management Plans in Bogotá (Empresa de Acueducto y Alcantarillado de Bogotá (E.S.P) y Fundación Humedal la Conejera, 2012; Instituto de Estudios Ambientales (IDEA), 2007

3.6.3 The role of social movements in inclusive innovation

The social movements had a decisive impact in reframing both the concept of the wetlands as a socio-ecological system and R&D investment priorities of the funding agencies. As the socio-technological agenda of the wetland was consolidated, the leaders of the social movement took up positions as head of the aqueduct company, the main agency responsible for managing the wetlands. This led to fundamental changes in the company routines as new sets of practices and protocols were written up and implemented by the water engineers. Similarly, the new wetland policy produced changes in the technologies used for management of water ecosystems in Bogotá. These, and other developments, had a significant impact on inclusive innovation in the Bogota wetlands area.

Hence, social movements that ally scientific and local needs embedded in local territories can enrich inclusive strategies in five ways:

1. They comprise a powerful lobbying force for innovation.
2. Where technical skills are involved, scientists can provide credibility to activist demands for inclusive innovations.
3. Their intimate knowledge of local conditions provides critical data determining the development of innovations appropriate for specific operating conditions.
4. They are sensitive to the needs of local populations and the character of local environments and hence, where relevant, they can overcome sceptical public perceptions of participation on social outcomes.
5. Social movements signal to science and technology agencies emerging problems and offer advice on where to invest in R&D and innovations.

4. A prelude to policy

Before we turn to the policy implications for promoting more inclusive pathways of innovation and development, it is helpful to briefly summarise the major insights drawn from the six innovation case studies and their relationship to the three characteristics of inclusive innovation: inclusiveness of product; inclusion in production processes; and inclusion in innovation processes.

Hydroelectric power and the decentralisation of infrastructural grids (Section 3.1)

The main lesson to be learned from the experience of large-scale HEP schemes concerns the character of socio-technical regimes and the need to think about inclusive innovation at a large scale of decision-making.

Large-scale HEP is a classic example of the mass production paradigm in which exclusion has become widespread. It involves very large outlays of lumpy investment (minimum scales of supply are high) and provides electricity through a centralised grid that underwrites a socio-technical system in which production and consumption are separated by large distances. Skills levels in design and in capital-intensive construction limit local linkages and there are manifold opportunities for kleptocratic governance. Typically, despite the intentions of many aid donors, environmental externalities are not priced into the construction and operating costs of HEP, particularly in very large projects. Large-scale HEP reflects the co-evolution of concentrated economic and political power and results in exclusionary pathways. It is both a cause and a consequence of exclusion – large-scale, capital-intensive and environmentally damaging centralised grid technology co-evolves with large-scale and concentrated sources of social and political power and capital.

At the time of the construction of most large-scale HEP schemes, there were few viable small-scale alternative technologies that might have supported an alternative techno-economic paradigm. Small-scale and distributed electricity supply would have involved lower barriers to entry in power supplies and irrigation and involved reduced capital costs, an important factor in capital-constrained low- and middle-income economies. It would have reduced the drive towards urbanisation, since production in rural areas across sectors could have been supported by available, proximate low-cost energy. Smaller-scale agriculture, which is generally more labour-intensive and more land-productive, would have been supported by distributed water provision. Off-farm rural enterprises and production would have been aided by the availability of distributed and low-cost energy. There would be no need to relocate tens of thousands of people and the harmful environmental impacts of dams would be avoided. And, perhaps most importantly, instead of meeting the needs of an elite and supporting the development of a political and social complex systematically focusing on the needs of the privileged and powerful, societies would be driven forward on a pathway of smaller-scale economic and political organisation.

But we now live in a different world, one where technological advances in small-scale renewables such as solar and wind power are increasingly cost competitive and are scalable, providing manifold opportunities for decentralised provision, meeting the needs of poor consumers and reaching disadvantaged regions of the economy that have been cut off from access to electricity due to the

cost of transmitting energy from large-scale centralised grid provision. This provides the potential for supporting a new, decentralised and more inclusive pattern of growth and development. The conditions under which this potential is grasped, and by whom, is a challenge to the political economy, rather than to the innovation system narrowly defined.

Inclusive innovation in SMEs and clusters (Section 3.2)

An important source of employment and incomes for marginalised populations is to be found in the informal sector and those firms straddling the boundaries between informalised production and the formal sector. As observed in Table 1 in Section 1, in Africa and Asia the informal sector accounts for more than two-thirds of employment outside of agriculture, and for more than 50% in Latin America. The development challenge is to provide these enterprises with dynamism, since many producers in these sectors are 'survivalist' small and micro enterprises. Innovations in both process technologies and in organisation have a critical role to play here.

In the case of southern-origin capital goods, we can witness an important shift in the global dispersion of innovative capabilities. Capital goods produced in countries with low wage costs and patchy and unreliable infrastructure are generally appropriate for economies with similar endowments. These technologies tend to be labour-intensive, operate at low scales, are geared to handle poor and unreliable infrastructure and are robust and relatively easily to repair. As a consequence, they can be an important contributor to inclusive growth in SMEs. However, they also come with disadvantages, and are often environmentally damaging and involve unsafe working conditions.

Often these imported small-scale technologies are used in clusters of informal sector enterprises co-located in urban areas and in rural towns. These informal sector enterprises are characteristically composed of survivalist entrepreneurs. But if their energy can be tapped, they can become an important source of dynamism, employment and income. However, these SMEs face two major hurdles. First, their problems are not so much that they are small but that they are isolated. Hence, if they can engage in the various forms of collective action described in this case study, they are able to leverage the unintended externalities arising from co-location and to systematically improve their offerings. The second obstacle they face is the smallness of their markets and the impoverishment of their proximate customers. This problem can be met in part by income growth among the poor (just as exclusion breeds exclusion, so inclusion breeds inclusion), either because of generalised economic growth or through deliberate redistributive policies exercised by government. An additional factor aiding their dynamism is assistance in penetrating new markets in other locations, and the case study material evidences the strong link between distant markets and innovative dynamism.

Both sets of innovation foster inclusion in process and product. To the extent that SMEs engage in joint action, and Kenyan informal sector capital goods firms develop hybrid machinery by drawing on Chinese and northern machinery and components, these technologies also involve marginalised populations in innovation processes.

Distributed Infrastructure: Telecommunications, the diffusion of mobile telephony and inclusion (Section 3.3)

The use of mobile telephony to extend banking to the poor – M-Pesa – is an exemplary story of how advances in ICT can serve to enhance economic and social inclusion in low-income economies. The technology was developed in Africa by a TNC, funded in part by UK development aid. Initially envisioned as a means to transfer income from the formal sector to relatives in rural areas, M-Pesa and its competitors forged a new system of financial intermediation which not just enabled income transfers, but has become a unit of exchange (substituting for cash) and an important capital-good for small-scale and rural enterprises (keeping them in touch with suppliers and customers). Although inclusion in this new system of finance is still partial (some regions without mobile connections and some of the poorest are not able to benefit), there is substantive evidence that it has made an important contribution to economic and social inclusion, particularly enabling rural areas to participate in the cash economy. Developed in Kenya, M-Pesa has now diffused to other African economies and to Eastern Europe and the Balkans.

M-Pesa is a development that follows from the development of a new heartland technology, ICT (Freeman, 1993). As such, it has widespread application across sectors and this evidenced in the synergy between mobile telephony and renewable solar energy. Coupled together, these two sets of ICT-related innovations have had a major inclusionary impact, offering both new products to the poor and providing new process technologies for the poor (low-cost energy is an important capital good for rural and petty enterprises). The poor were marginally involved in the development of M-Pesa, but this participation was temporary and limited.

Healthcare in Cuba (Section 3.4)

At the time of the Revolution in 1959, Cuba had a well-developed but deeply exclusive healthcare system. Despite the outflow of skills soon after the revolution, the long-lived US blockade and the removal of support from the Soviet Union, Cuban healthcare was transformed into a distinctively inclusive system. Life expectancy is close to that of high-income countries, infant mortality is lower than that of the US and a range of tropical- and poverty-related diseases that afflict the marginalised in many low- and middle-income countries have been overcome or significantly reduced. In addition, Cuba provides free healthcare training to more than 19,000 students from low-income economies and has a large cadre of health professionals working in low-income environments in many developing economies. These achievements have been cost-efficient, as the share of health expenditure in Cuba is lower than that in most other economies.

The primary innovatory impulse in reaching these achievements was in the design and delivery of public healthcare. This provides comprehensive monitoring of public health and the provision of support at the household and community level. However, innovation was not limited to the redesign of the public health system, but also to the development of advanced new pharmaceutical products based on biotechnology and responding to the incidence of morbidity in Cuba, rather than to the pursuit of profit. Cuba's unusually rich database on health and morbidity provides a stepping stone for future pharmaceutical development linking big data analysis to advances in bio-technology.

Innovation in Cuba's health system has been unambiguously inclusive, in product development, in the process of health delivery and in the design of health service innovations. Another striking feature that has broader relevance (and which will be discussed below), is that new drug development explicitly abjures the Schumpeterian motor as the driver of innovation priorities. But this non-pecuniary approach to innovation has had important adverse impacts on innovation in other sectors.

TNCs at the BOP (Section 3.5)

The confluence of market saturation and declining growth rates in high-income economies and rapidly growing incomes in some large low- and middle-income economies from the early 1990s led to the recognition by many of the world's largest TNCs that there was scope for profitable innovations targeted to meet the needs of the poor. This recognition, fuelled by leading thinkers in Northern Business Schools, focused attention on the prospect of serving growing demand from low-income consumers, including those in rural areas – reaping "the fortune at the BOP". The adoption of BOP strategies was particularly prominent in the fast-moving consumer goods sectors. Unilever has been a leading TNC BOP innovator, drawing on the dynamism of its Indian subsidiary (Hindustan Lever). Initially, Unilever copied some BOP innovations pioneered by domestic firms, but like many other TNCs targeting low-income rural markets, the company found it difficult to earn profits from low unit price sales in distant markets. It responded with a combination of new product development and in innovations in marketing that drew on the entrepreneurial energy of women in these low-income markets. This innovation in an inclusive process was extended by Unilever to other low-income economies and, in a related but different form, was copied by other TNCs in Africa. Although the design and marketing of inclusive product innovations has drawn on a knowledge of values and consumption patterns in marginalised communities, and although the marginalised have been involved in the marketing of some of these inclusive products, there is little evidence that marginalised populations have been actively involved in the design of inclusive innovations by TNCs.

Not all BOP innovation has been in the FMCGs sector, however. Some TNCs such as GE have stripped down and redesigned their product development in processes of frugal engineering to meet the demanding operating conditions and low purchasing power in low- and middle-income markets.

Notwithstanding these successful ventures, the heady optimism of many TNCs that they could produce profitability for very low-income markets, particularly those in rural areas, has experienced a severe reality check in recent years, and this strategic agenda has been put on hold by many TNCs.

Social movements and innovation in urban wetlands in Bogota (Section 3.6)

Natural habitats are replete with externalities and hence innovation to meet environmental challenges experiences many of the central problems of public goods. The benefits of innovation are difficult to appropriate and the incentives to innovate by private sector stakeholders are thus weak. When the negative externalities in public goods are predominantly felt by marginalised populations, there is not just an underinvestment in innovation in these areas, but a bias in this underinvestment which leads to social and economic exclusion.

The wetlands around Bogota, Colombia, reflect these problems. Initially the environmental challenge arose in response to emissions from agriculture and industry and were associated with a variety of public health hazards such as mosquitos breeding in stagnant water deposits. Subsequently, the wetlands were settled by migrants escaping from the civil war and frequent flooding. This exacerbated the negative distributional character of the wetland deposits. The challenges of these developments were raised by a variety of social movement groups, who exerted considerable pressure to highlight the impact of poor wetland management. Not only did this raise the political profile of these problems but the involvement of a variety of professional groups and a local university led directly to a series of inclusive innovations funded by Colciencias.

As a consequence, we can observe the positive contribution of social movements in the innovation of inclusive products and processes. Although the direct role of marginalised communities in the innovation process was muted, this inclusive innovation experience shows the importance of the involvement of user-communities in generating public awareness of the need for different paths of innovation. It also highlights how social movements can lead to the tailoring of innovation to meet the particular environmental characteristics of different locations.

5. Fostering inclusion through innovation: the big – and the small – picture

It is evident from the case studies that there are demonstrable opportunities for inclusive innovations that promote more inclusive patterns of growth and development. All the case studies show inclusivity in final product; most show inclusivity in processes of production; some show inclusivity in innovation processes themselves; and most show a beneficial environmental impact that has inclusionary consequences. Directly and indirectly, in most cases the availability of a cluster of revolutionary new technologies, plays an important role in fostering these inclusive trends. This is particularly true of ICT, a heartland technology in the Schumpeterian sense that has pervasive applications across sectors.

The disruptive power of these technologies has led to their diffusion through market forces. Mobile telephony substitutes for fixed lines in developing economies and is eroding the fixed-line telephonic grid in the industrialised economies; renewable energy is increasingly cost-competitive (and is also attractive since the variable costs of production are minimal) and is the preferred generating option in an increasing number of environments. In agriculture, a sector not considered in the case studies, commercially-driven genetic modification, provides the opportunity for higher yields, more robust crops and different crops, and these have the potential to foster inclusionary pathways. More importantly for the future, perhaps, an increasing number of companies (particularly in economies such as Germany, China and Denmark) see the potential for the profitable production of these technologies and are investing considerable resources in their development.

However, market forces alone can only scrape the surface of inclusive innovation. For one thing, all of the disruptive core technologies would not have emerged without state support in basic and applied research (Mazzucato, 2011), and in the regulations that have promoted their diffusion (for example, state support in China and tapering subsidies for solar power in Europe and North America). But the role which public policy can play in fostering and speeding up the development and diffusion of inclusive innovations cannot be limited to support for technological development and the introduction of new regulations. So, what further public interventions might constructively contribute to enhanced inclusionary pathways?

5.1 The inclusionary potential is not always realised: Political economy to the fore

We have argued that the cluster of new technologies emerging provide the potential for a new socio-technical paradigm of production to emerge. This is one in which production and consumption will be brought closer together, the scale of production will be reduced, and labour-intensive and environmentally benign production processes will flourish. This new paradigm has the potential to provide a much more inclusive pathway of development than the trends that have emerged in the global economy over the past two decades.

However, this potential does not automatically feed through into new forms of social and economic organisation – technological progress can often reinforce existing power hierarchies. For example, rather than promoting decentralised energy generation, in many countries scalable solar power is being used to feed into centralised grids. This is the predominant trend in South Africa, for instance (Morris and Martin, 2015, Filipova, 2017). This echoes prior experience with HEP where, in many economies, the potential for micro-HEP was ignored, despite the fact that it provided low-cost electricity close to the point of use.[43] The forces underlying scale and concentration include the fact that centralised grids offer diverse rent-seeking opportunities to individuals including in procurement decisions, staffing and revenue collection. Beyond the pursuit of individual rent-seeking actions, large-scale schemes also reflect and reinforce the coalesced power of institutions and the state, including the ease through which centralised grids can provide fiscal revenues (Barnett, McCollouch and Woods, 2018). In South Africa, for example, the diffusion of smaller-scale renewable energy has been limited by a coalition of the state, coal producers, the state-owned energy provider and the trade unions, all of which have long-term commitments to large-scale coal-based energy generation (Morris and Martin, 2015). Large projects also provide politicians with highly visible banners to support their legitimacy.

Although these examples are focused on the energy sector, they have wider relevance where alternatives exist between large-scale and viable small-scale technologies. The new technologies provide the *potential* for dispersion and a reduction in scale across a range of sectors. But whether this potential will be realised depends on the constellation of power in which innovations are diffused. Similar trends can be observed in social media. On the one hand, it opens up the possibility for increased inclusion in political processes (as observed in the Arab Spring in North Africa). On the other hand, using large data techniques, it can be manipulated by elite oligarchies to promote fake news with significant, unequalising political impacts. In another example, ICT-facilitated market innovations such as Uber and Airbnb, initially provide for greater social inclusion with enhanced incomes for new producers and new choices for consumers with relatively limited incomes. But when diffusion is widened, it often leads to falling incomes for participating producers (home-owners and drivers), but not for the owners of the platforms that govern these innovations.

The general observation from these various examples is that the development and diffusion of inclusive innovations is, in the first instance, determined by processes of political economy. New disruptive technologies in ICT offer the unique *opportunity* to promote greater social and economic inclusion. But if these opportunities are not grasped, the outcome of their diffusion may result in uninterrupted, and often heightened trajectories of exclusion.

[43] However, these micro-hydro schemes could not support energy provision in areas distant from the riverine source of power.

5.2 The limits of incremental change: The need for a big push strategy

Techno-economic paradigms pass through phases – the 'installation stage' where the heartland technologies emerge, the 'deployment stage' where they diffuse widely and the 'atrophy stage' where their gains diminish at the margin and the new heartland technology is prefigured.[44] When these techno-economic paradigms are ascendant, incremental changes drive the system forward. But when they reach beyond their high points – as is currently the case – incremental changes no longer meet the challenge of sustaining growth and development.

Thus, the positive potential of the new paradigm is unlikely to emerge as a consequence of marginal and incremental changes, however profitable these limited innovations may be for individual actors. What is a required is a 'Big Push', of the sort promoted by Rosenstein-Rodan during the 1940s (Rosenstein-Rodan, 1944). He argued that transformation can only be assured if clusters of related investments diffuse at the same time. Assuming that they recognise the significance of paradigm change, governments are therefore required to develop a strategic vision and to use this vision to deploy a range of related inclusive innovations, not just of physical technologies but also in institutional design and patterns of governance. A commitment to inclusive development pathways, incorporating programmes of inclusive innovation, is precisely the sort of Big Push Vision that is required to shift from an old, exhausting paradigm to a new and more dynamic one.

5.3 Income distribution, final markets and demand

It is clear from the case studies, and from the wider literature on economic growth and inducements to innovation, that the quantum and nature of demand play critically important roles in trajectories of innovation and economic growth and development. Focusing first on the character of demand, the use of many small-scale and labour-intensive inclusive technologies (such as southern-origin capital goods in three sectors in East Africa – see Section 3.2) produces products that would not meet the exacting standards of high-income consumers, even in their domestic markets. The expansion of final markets with demand profiles that induce the innovation of efficient 'appropriate technologies' will thus be a spur to inclusive innovation and investment. These market characteristics will be evident in areas local to production by marginalised producers, in the domestic economy, and generally in neighbouring regional economies and in distant low- and middle-income economies.

Beyond the character of demand is its volume. One of the primary conclusions to emerge from the analysis of cluster experience in Africa (Section 3.2) is the fallacy of composition that can accompany the expansion of informal sector production. In the context of slow-growing or limited aggregate demand, policy interventions that promote SMEs and cluster development will only be successful as long as other SMEs' clusters do not respond in a similar way. A shortage of aggregate demand may merely lead to the impoverishment of suppliers, despite the best intention of policymakers, as was the case with Botswana's SME development programme during the 1980s (Kaplinsky, 1991).

[44] This periodisation is loosely based on Perez 2010 and Perez 2016.

Two conclusions follow from this:

- Localised growth can feed localised production. The greater the dynamism of local demand, the more likely the growth of localised clusters; the faster the growth of local clusters, the greater the likelihood of inclusive innovation.

- The limits to the growth of clusters of informal sector enterprises lie in aggregate demand. Steps taken by governments to redistribute income to poorer communities and to disadvantaged areas will enhance the market for the output of poor producers and the inducements to inclusive innovation.

5.4 Turning on the axis: Facing South

As observed, the character of southern economy operating conditions leads to innovation pathways that contribute to inclusive growth. This is reflected in the consequences of South-South trade in machinery and equipment (Section 3.2). Similar processes can be observed on the demand side of the trade and production equation. In economies where trade has switched from high-income to low- and middle-income markets, there has been greater scope for the inclusion of marginalised producers. This is reflected, *inter alia*, in Cameroon exports of timber products and Thai exports of cassava base animal feed (Kaplinsky, Terheggen and Tijaja, 2011). In both of these cases, the switch of final demand from Europe to China led to a move away from standards-intensive Global Value Chains which had excluded marginalised workers and local producers.[45]

For a combination of historical reasons – colonial history, the relative strength of demand in high-income economies and the marketing channels of TNCs – in many low-income economies, the communication infrastructure points predominantly towards the North. This affected a variety of infrastructures, including knowledge flows, air schedules and shipping routes. The greater this northern bias can be corrected and the more developed South-South market links become, the greater are the possibilities for the expansion of trade which promotes more inclusive patterns of growth. To some extent, market forces naturally lead in this direction, but there is also a requirement of intervention by governments to promote and quicken this reorientation, for example, through trade missions and cultural exchanges and the expansion of southern-focused air, sea and land transport infrastructure.

One element of this reorientation is with regard to informalised cross-border trade. This is estimated to affect the incomes of more than 40% of Africa's population (Brenton and Soprano, 2018). Most of this trade occurs below the radar of official trade statistics. Since much of this trade involves small-

[45] However, since the standards in Global Value Chains feeding into high-income markets were targeted to be more environmentally benign, and to protect worker rights, greater inclusion in production was traded off with adverse developmental consequences.

scale and low-income producers selling to relatively low-income consumers, this trade plays an important role in inclusive growth pathways. A recent report suggests four policies that can promote these more inclusive patterns of trade (Brenton and Soprano, 2018):

- Governments need to recognise the significance and impacts of this trade and to respond appropriately to its character and progress.
- The rules and regulations affecting this trade need to be simplified and made transparent.
- Assistance needs to be provided to small-scale traders to reduce the disproportionate risks in this trade. For example, small traders are more vulnerable to extortion by customs officials.
- The important role played by women, and the disadvantages they face in informalised cross-border trade, need to be explicitly addressed.

5.5 Capacities and capabilities

There is near-universal recognition that human resource development is of central importance in economic growth and development. There is also near-universal recognition that, to varying degrees, the market may play a role in the delivery of education and training. However, market failure is pervasive and, in most countries, governments actively support the development of human resources. This support takes four primary forms:

1. financial support for education
2. the delivery of education and training
3. influencing the direction of human resource development in particular subject areas
4. support for Research and Technology Organisations (RTOs) and Business Service providers in the National Innovation System.[46]

Two sets of related policy interventions are required across these support areas to promote more inclusive patterns of innovation and development. The first is to impart directionality in human resource development, particularly with respect to vocational training, education at the tertiary level, and in RTOs. Since, as observed above, ICT is the heartland technology in the emerging techno-economic paradigm, with pervasive applications across sectors, this is clearly a core skillset that needs to be promoted. A similar cross-cutting pervasive skillset may emerge with respect to biotechnology and related technologies, particularly as they affect the agricultural and pharmaceutical sectors.

Second, capacities exist in the abstract and only translate into the capabilities that support growth and development when they are exploited in a productive context. For example, there is a growing call for engineering faculties in universities to be more integrated with the productive sector, and not just in low- and middle-income economies (Bell, 2009). This requires a closing of the (often yawning) gap

[46] These and other issues related to the role played by the National Innovation System in inclusive innovation strategies are discussed in United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) (2018, forthcoming)

between capacity development and specific capability building. But which needs in the productive sector should this capability-building seek to address? In the current environment, meeting user needs predominantly translates into the formal, large-scale and capital-intensive sectors of the economy, reinforcing trajectories of exclusion. To promote more inclusive innovation and growth, this bias needs to be addressed in a systematic manner, including through the development of value chain task forces (see below). The shift of health sector training for doctors and paramedics from Havana and other cities to the countryside is an exemplary case in this regard (Section 3.4). It involved the translation of *capacity*-building to *capability*-building (that is, incorporating direct community involvement in training programmes) and in imparting inclusionary directionality to capability-building. Similarly the role played by knowledge workers in the Bogota wetlands, both as scientists and as lobbyists, shows how innovation systems can be redirected in more inclusionary directions.

There is a particular challenge to be met in developing the capabilities in ICT to meet the needs of the informal sector. Here the opportunities are manifold, given the pervasive applications of these heartland technologies. For example, in Indonesia, GO-JEK is an extraordinarily successful indigenously owned company. Originated as a bike-hailing app in 2010 with 20 motorcycle drivers, by 2018 it was valued at more than $5bn, drawing on the services of more than 1 million riders, many of whom were previously in the informal sector. Its range of services has extended from ride-hailing to transportation, logistics and a host of other services. This application of ICT to reduce the costs of intermediation and develop new services (as in the case of GO-JEK) and to provide access to microfinance (as in the case of M-Pesa) offers manifold opportunities to informal sector enterprises, including with respect to those enterprises located in clusters. But all of these developments require a range of digital skills, and education and training systems need to be geared to provide these capacities.

5.6 Foresight and value chain restructuring coalitions

The sterile ideological standoff between market-led and statist industrial policy has given way to a more nuanced recognition that both state-failure and market-failure are central to economic transformation (Rodrik, 2004). This calls for a cooperative and synergistic alignment between the efforts of the private and productive sectors in meeting growth and developmental objectives. Traditionally, this alignment was pursued at a sectoral level. But, in recent years, it has been recognised that the fragmentation of value chains and the consequent specialisation and trade in intermediate products has eroded the usefulness of sectors as an organising framework for policy support. Instead, support needs to be provided at both the sectoral and inter-sectoral levels, focusing on the interrelationship between links in the value chain as well as on enhancing capabilities within links. For example, enhancing agricultural production requires working with buyers and retail chains, as well as with input suppliers, rather than focusing on the narrow capabilities within the farming sector. There will also be an important role to be played by policies on purchasing in state institutions to use products contributing to inclusive growth and development. Achieving systemic value chain efficiency also requires the participation of institutions in the National Innovation System and, in some cases, NGOs.

A further contemporary industrial policy development involves foresight programmes that enable the restructuring coalition to peer above the short-term horizons governing profit-oriented decision-makers, and to direct innovation resources to the medium- and longer-term. Market discount rates are such that they do not incentivise firms to invest in emerging innovation horizons that have long gestation periods.

The challenge for inclusive growth is to meld these two elements – restructuring coalitions and foresight – in a way that promotes different and more inclusive innovation pathways. These pathways need to be embedded in the decisive strategic commitment to inclusive growth outlined above. Two of the case studies presented in Section 3 provided glimpses of how these strategic visions can be developed and delivered – Cuba's health sector, where there was a systemic and wide-ranging commitment to preventive public healthcare, and Unilever's involvement of low-income women entrepreneurs in innovative forms of market development.

5.7 Innovating public goods

It is widely recognised that there is a public policy requirement in the development and delivery of public goods in which market failures – for a variety of reasons – are endemic. In these markets, reliance on the Schumpeterian innovation motor provides suboptimal outcomes. As a consequence of the character of public goods, there is a combination of underinvestment in some potential inclusive innovations and/or the development of innovations that fail to internalise the costs of negative externalities, including harmful environmental impacts.

International PPPs have played a critically important role in filling some of these gaps, for example in the response to pandemics such as Ebola and Zika. These partnerships are inclusive in the sense of both developing inclusive products (new drugs to meet the needs of the poor) and inclusive processes involvement of communities in public health delivery). For example, the Global Vaccine Alliance (GAVI) brings together country and donor governments, international agencies (such as the World Health Organization, UNICEF and the World Bank), the vaccine industry, RTOs, CSOs and charitable foundations (such as the Bill and Melinda Gates Foundation).

Another driver of public goods provision is a response to the absence of cash incomes among the poor to spur inclusive innovations appropriate to their needs. International NGOs such as Oxfam and Practical Action have sought to fill these gaps in terms of product development and institutional design. Another widely diffused example is the Grameen Bank's micro-finance initiatives aimed at entrepreneurial development, often focused on gender exclusion.[47] Another example can be found in the growth of networked grassroots innovation programmes, such as the Honey Bee Network in India. Honey Bee is a repository of more than 50,000 grassroots innovation practices, innovations and traditional knowledge practices in more than 585 districts (Gupta et al, 2016). It is the largest and best-known set of grass roots innovations globally.

[47] See: www.grameen-bank.net.

5.8 Appropriating innovation rents and the promotion of inclusivity

The final policy agenda that needs to be addressed in transitioning to more inclusive growth and innovation pathways is complex and requires a diversity of societal responses. As observed in Section 2, the spur to innovation in capitalism is the quest for profit. Competition erodes profitability and, to escape from competitive pressures, entrepreneurs innovate to create new products, production processes, forms of organisation and business strategies. This momentum is referred to as the Schumpeterian motor, and it is one that has driven forward productivity growth, structural transformation and growing living standards since the Industrial Revolution. Those who command innovation rents earn high incomes; those without innovation rents either have stagnant incomes, or in situations of high competition, may suffer from declining incomes (Kaplinsky, 2019, forthcoming).

This has important implications for the role that innovation plays in providing for sustainable and inclusive income growth. If the poor – individuals, households, farms, firms, regions and economies – are locked out of the production and appropriation of innovation rents, they may participate more actively as producers in the economy, but see little of the returns from innovation. Consider, for example, the generalised phenomenon of the descaling of production made possible by advances in ICT and renewable energy. These technologies are highly knowledge-intensive, and their development requires heavy investment. These investments are protected by a variety of barriers to entry and are amortised over large sales. Hence we can observe the simultaneous reduction in economies of scale in production processes (promoting inclusivity in process) and increasing economies of concentration in the development of technology (skewing the distribution of income to the rich) (Kaplinsky, 1990 and Kaplinsky 2019 forthcoming). Low- and middle-income economies and marginalised producers may, therefore, experience only limited gains from the deployment of these scale-reducing flexible technologies which allow for distributed production.

The policy response to these developments is both easy to conceive and difficult to implement. The objective is to enable marginalised producers to actively participate in the generation of technologies, as well as in the appropriation of returns from these innovations. Achieving this objective requires, at the minimum, inclusion in innovation processes, the associated development of capacities and capabilities, and the introduction of regulatory regimes (such as property rights) which allow them to appropriate some (or all) of the innovation rents that are generated.

This is easily said – less easily achieved. But that is the development challenge.

Acknowledgements

I am grateful to Tebello Qhotsokoane for constructive comments on an earlier draft.

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