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Innovation and uneven development: The challenge for low- and middle-income economies

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ABSTRACT

This essay begins with a recounting of the rise of the Mass Production techno-economic paradigm and the emergence of the systemic economic crisis in the early 1970s. It then explains how this crisis was stemmed by the deepening of globalisation, which accelerated during the 1980s. However, shortly before the turn of the millennium, the internal fissures of the paradigm became more apparent, resulting in a renewed slowdown in growth and global financial crises. In the context of these global developments, most emerging economies are confronted by two structural problems. The first is the prevalence of a massive informal sector; the second is the erosion of the possibilities for a flying geese policy replicating the export success of China. However, crisis presents both challenge and opportunity, and three sets of innovation opportunities are addressed in the paper. These are the largely unrecognised innovative potential within the informal sector, the possibilities opened up by growing regional and South-South trade, and the transformative potential of the heartland technology driving the new techno-economic paradigm, ICTs. Building on seminal contribution to ideas by Freeman, we argue that these are important pillars to build an innovation agenda for inclusion in developing countries. The essay concludes with a discussion of the main policy implications to maximise the development impact of these new opportunities.

1. Introduction

Chris Freeman's life work was characterised by his long-term vision, his capacity to analyse simultaneously at both the micro- and the macro-level, and his unwavering commitment to a more equitable and environmentally sustainable growth path. Although most of his writings were focused explicitly on the high-income and the rapidly growing East Asian countries, the challenges of global development were at the forefront of his concerns. In the early 1970s, he played a key role in the drafting of the Sussex Manifesto;¹ he greatly valued his interactions with students from the developing world, and he was deeply moved by his

visit to the low-income suburbs of Cape Town when he visited South Africa in 1991.

In this essay, we build on four pioneering contributions by Freeman to consider the major innovation challenges faced by low- and middle-income countries. In each case, Freeman played a key role – often *the* key role – in introducing and developing these agenda-shaping discourses. We wish to emphasise that we are *drawing on* Freeman's contributions to the realm of ideas to address contemporary global challenges and not seeking to evidence this discussion through detailed textual references to his works.

The first is the recognition that innovation is endogenous to

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¹ The Sussex Manifesto (Freeman et al., 1970) was a path-breaking and widely cited report prepared for the United Nations. It addressed the implications for developing economies of a global R&D system that focused on meeting the needs of high-income consumers in high-income countries.

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economic growth. New processes and products are created as a consequence of purposive action – belatedly recognised in the development of endogenous growth theory in economics and increasingly also in the political realm. They reflect the economic and social conditions in which innovations are conceived, shaped and made available to users. Whilst technologies do have intrinsic characteristics, technological change is inherently biased (Kaldor, 1961). In his review of Bernal’s contribution to his ideas – Bernal was a teacher and mentor to Freeman – he emphasised that innovations result from explicit investments in knowledge creation and technological development and that this necessarily involved imposing directionality to the technological progress (Freeman, 1992c).

Second, Freeman played a lead role in the development of the neo-Schumpeterian framework which recognises that not all innovations carry the same ‘weight’. Together with Pérez, he categorised four major sets of technological change (Freeman and Pérez, 1988). *Incremental changes* occur on a routine and regular basis as production proceeds. They lead to minor modifications in processes, products and organisations. *Radical innovations* comprise discontinuous changes, generally arising out of research and development. For example, nuclear power stations could not emerge from incremental changes in coal-fired power stations. Changes in a *technological system* comprise limited systemic changes involving several related sectors, often resulting from a combination of incremental and radical innovations. For example, synthetic chemicals are used extensively in the health, plastics and agricultural sectors. The final set of innovations are systems of systems that result in what have come to be called *techno-economic paradigms*. These involve the diffusion of a cluster of innovation systems that are so significant that they affect all sectors of the economy. Crucially, these paradigms are not limited to production technologies. They involve complementary societal-level changes in institutions, in structures of governance, in residential patterns and lifestyles, and in values and behavioural norms.

Third, and distinctively, as with many great thinkers, Freeman provided us with a metatheoretical framework that draws together these strands in the development of his ideas. The techno-economic theory, which he pioneered, provides an integrated and historically informed framework for understanding that many developing economies are confronted by the structural crises that inhibit sustained development, that technology is socially constructed and can be shaped, that some technologies (in the current era, information and communication technologies – ICTs) are disruptive and transformative, and that innovation can be influenced to rebuild a fairer and more sustainable world.

Fourth, Freeman complemented what economists refer to as his ‘positive’ analysis of what and why the world looks the way it does with a ‘normative’ concern to develop a more equitable and sustainable society and environment. This is a thread running through all of his work. For example, ‘The learning economy and international inequality’ (Freeman, 2001) addresses the challenge of confronting and reversing the growth of international and intranational unequalisation after the end of the post-war Golden Age. Similarly, he offered early contributions to what is now a widespread acceptance of the centrality of the green challenge to innovation and policy (Freeman, 1992b, 1994, 1996). *The Economics of Hope* consolidates this combination of positive and normative analyses with a set of policy prescriptions that address the belief that we can reverse the increasing descent into economic, social and environmental decay (Freeman, 1992a).

In this essay, we will draw on these contributions to focus on the innovation challenges required to promote a more inclusive developmental path in low- and medium-income economies. We are less concerned with the ‘Chinas of this world’, that is those few dynamic and successful emerging economies that appear to have developed the capacity to ‘catch up’ with the globally leading economies (1989). Rather, our focus will be on low-income economies and the large number of economies caught in ‘the middle-income trap’. Many billions of the world’s population are marginalised and largely excluded from the fruits of economic growth. We will not consider the hundreds of millions of

people in higher income economies who are similarly excluded – this is an important agenda close to Freeman’s heart, but requires a different set of analysis and policy prescriptions than for those living in lower-income ‘developing economies’.

This essay begins with a recounting of the rise of the Mass Production techno-economic paradigm and the emergence of the systemic economic crisis in the early 1970s.² It then explains how this crisis was stemmed by the deepening of globalisation through the extension of Global Value Chains (GVCs), which accelerated during the 1980s (Ponte et al., 2019). However, shortly before the turn of the millennium, the internal fissures of the paradigm became more apparent, resulting in renewed growth slowdown and global financial crises. In the context of these global developments, most emerging economies are confronted by two structural problems. The first is the prevalence of a massive informal sector; the second is the erosion of the possibilities for a flying geese policy replicating the export success of China. However, crisis offers both challenge and opportunity, and three sets of innovation opportunities are addressed in this essay. These are the largely unrecognised innovative potential within the informal sector, the possibilities opened up by growing regional and South-South trade, and the transformative potential of the heartland technology driving the new techno-economic paradigm, ICTs. The essay concludes with a discussion of the main policy implications required to maximise the developmental influence of these new opportunities

2. The rise and retreat of the mass production techno-economic paradigm³

2.1. The rise and rise of mass production

Mass production as a form of productive organisation was ‘invented’ by Henry Ford in 1908. Three dominant characteristics of Ford’s mass production factories helped shape the economic and social structure of individual economies and the global economy for the next seven decades. The first characteristic was the commitment to standardisation of product and process, which allowed for the interchangeability of components and the reaping of economies of scale. Second, Ford internalised virtually all of the manufacturing cycle into a single plant in River Rouge, Michigan. Third, Ford realised that, for his innovation to be successful, consumers had to have the income to purchase the products spewing from his production line. He doubled the wages of his workers, partly to reduce labour turnover, but also in the belief that this would force other manufacturers to take similar action.

Ford’s introduction and refinement of this mass production organisational system improved the performance and quality of the car and resulted in a significant reduction in its price.⁴ The principles of mass production diffused rapidly to other auto manufacturers and then began to spread to other sectors. Although the productivity gains provided by mass production had become increasingly apparent during the 1920s and 1930s, the scale of the potential gains became graphically evident in the factories churning out weapons during World War 2 (WW2).

The significance of Ford’s innovation was not confined to the production line. It was complemented by profound structural changes in the

² In this essay we distinguish mass production (lower case) at the plant/enterprise level and Mass Production (capitalised first letter) as a techno-economic paradigm, involving a complementary match between scale and standardisation at the productive level and the forms of social organisation, consumption, norms and values which enable mass production at the productive level.

³ For an elaboration of the discussion in this section, see (2021).

⁴ Between 1909 and 1925, the price of the Model T (in current 2020 prices) fell from \$24 270 to \$3 918 (https://en.wikipedia.org/wiki/Ford_Model_T). We have updated the Wikipedia data from 2017 to 2020 prices, using US Bureau of Labor statistics

organisation of society at large, and in the growth of mass consumption. The Great Depression foregrounded the key role to be played by the state in supporting demand during capitalism’s perennial crises of under-consumption, mirroring Ford’s recognition of the need to ensure that mass production required mass consumption. Roosevelt’s New Deal in the US made a head start in resolving the problem of deficient demand, but it was the war economy between 1939 and 1945 that consolidated the dominance of mass production in US (and then European) manufacturing. After the end of WW2, demand was boosted through a massive expansion in house construction, supported by large investments in the infrastructure required to support the massification of personalised automobilization. The advertising industry grew to encourage the rapid increase in demand for TVs and a variety of ‘machines’ (vacuum cleaners, food processors, etc.), which allowed for the mechanisation of the household. In Europe, the expansion of the welfare state was an additional spur to support mass consumption.

What had begun with the introduction of mass production in a single firm in the productive sector resulted in profound and sweeping changes in economic, social and political organisation. It resulted in historically unparalleled rates of economic growth – not just in North America and Europe – but in much of the global economy. But good things generally come to an end and, after the early 1970s, this widespread and sustained growth surge slowed down. Between 1961 and 1973, the US economy grew at an annual rate of 4.6% and that of Europe at 5%; subsequently, economic growth in both regions fell to an average of around 3% and collapsed further to around 1% between 2006 and 2017.

A critical factor underlying this falling rate of growth was a prolonged decline in productivity growth. With the exception of a brief IT-led boom in the US between 1997 and 2006, labour productivity growth fell and continued to fall throughout the high-income world after the early 1970s (Fig. 1). This was because the efficiency gains resulting from the extension of the Mass Production paradigm tailed off through a combination of declining marginal productivity growth within the productive sector, the growing tertiarisation of economic structure (service sector activities are more difficult to mechanise) and a series of limiting factors in the Mass Production socio technical paradigm such as the growth of large and powerful trades unions. Not surprisingly, in the light of falling productivity rates, the rate of investment, which was a necessary driver of sustained productivity growth also declined (Kaplinsky, 2021). Associated with this falling productivity was a decline in the rate of corporate profits (Fig. 2 for the USA; no equivalent data is available for Europe).

The growing scale of production in mass production, and the

increasing requirement for large investments in knowledge creation and marketing, led the corporate sector to spread its operations outside of its domestic economy, not just to other high-income countries, but to the developing world as well. Initially, overseas investments in low-income economies were targeted at exploiting natural resources and meeting (limited) final demand in domestic markets. But, from the mid-1970s, this overseas investment took a new form. In the face of declining productivity growth and declining rates of corporate profitability, a new route to profitability had to be found. This involved the exploitation of cheap labour in developing economies. Not only did developing countries have virtually unlimited supplies of labour but, as a consequence of investments by the state in these economies (many of whom had recently decolonised), an increasing proportion of this labour force was educated and skilled.

The capacity of transnational capital to exploit this low-cost labour force was facilitated by the global spread of neoliberal policies. The liberalisation of global trade, which began with the GATT in the 1950s and then the WTO after the 1990s as an act of volition in the high-income world was imposed on many low-income countries. Whether they liked it or not (and some, such as those in Korea, Taiwan, Singapore and Hong Kong, enthusiastically switched to an outward orientation), investment was increasingly focused on meeting the needs of foreign rather than domestic consumers.

The availability of cheap and increasingly skilled labour in developing economies, and the rapid and systematic liberalisation of the trade regime, was complemented by innovations in transport and communications infrastructure. Containerisation in the shipping and logistics sectors significantly reduced the costs of shipping products across the globe, and advances in communications technologies made it less costly to organise and control global supply chains. Hence, in a structural departure from corporate policies of internalisation, corporate strategy shifted towards a concentration of core competencies and the development of global supply chains, often accompanied by Foreign Direct Investment in producing countries.⁵ The fracturing of production (‘vertical specialisation’) (Feenstra, 1998; Hummels et al., 2001) and the development of global value chains (GVCs) resulted in a major transformation of global trade, which became increasingly concentrated in intermediate products and services (Sturgeon and Memedovic, 2010).⁶ By the early 21st century, more than two-thirds of global trade occurred through the medium of GVCs (UNCTAD, 2013).

There were three primary effects of these developments that are germane to our focus on a future innovation agenda for greater global inclusion. The first was the contribution of low-wage labour in developing economies to corporate profitability in high-income countries. The trend decline in profitability after the 1970s (illustrated in Fig. 2) resulting from falling productivity was reversed (Fig. 3) as GVCs were extended and deepened.⁷

Second, the consequence of the outsourcing of production in global value chains was a growing imbalance in trade performance. Major high-income economies – particularly the giant US economy and the UK – sank into increasingly large trade deficits, mirrored by the surpluses generated in export-oriented Asian economies and some high-income economies such as Japan and Germany. Throughout the advanced

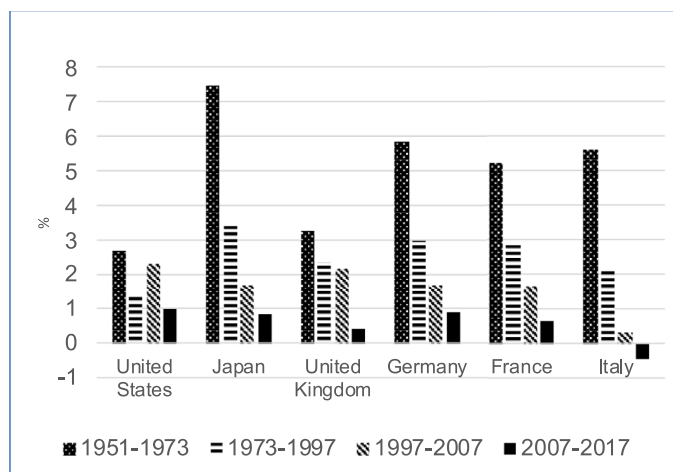


Fig. 1. Labour productivity growth in Japan, USA, France, Germany, Italy and the UK, 1951-2019 (% p.a)

Source: The Conference Board (www.conference-board.org/data/economydatabase/total-economy-database-productivity)

⁵ Not just has the flow of global FDI been greater than that of GDP growth since 1990, but a disproportionate amount of this FDI has gone to developing and emerging economies (UNCTAD, 2017).

⁶ For a discussion of the link between the search for innovation rents and the fracturing of GVCs see Kaplinsky (2019).

⁷ Other factors such as the growth of transfer pricing also played a major role in rising corporate profitability in this period, particularly in retail and knowledge-intensive services. Nevertheless we believe that it is unquestionable that the exploitation of cheap labour through the extension of GVCs contributed significantly to the revival of corporate profitability in the US and other high income economies.

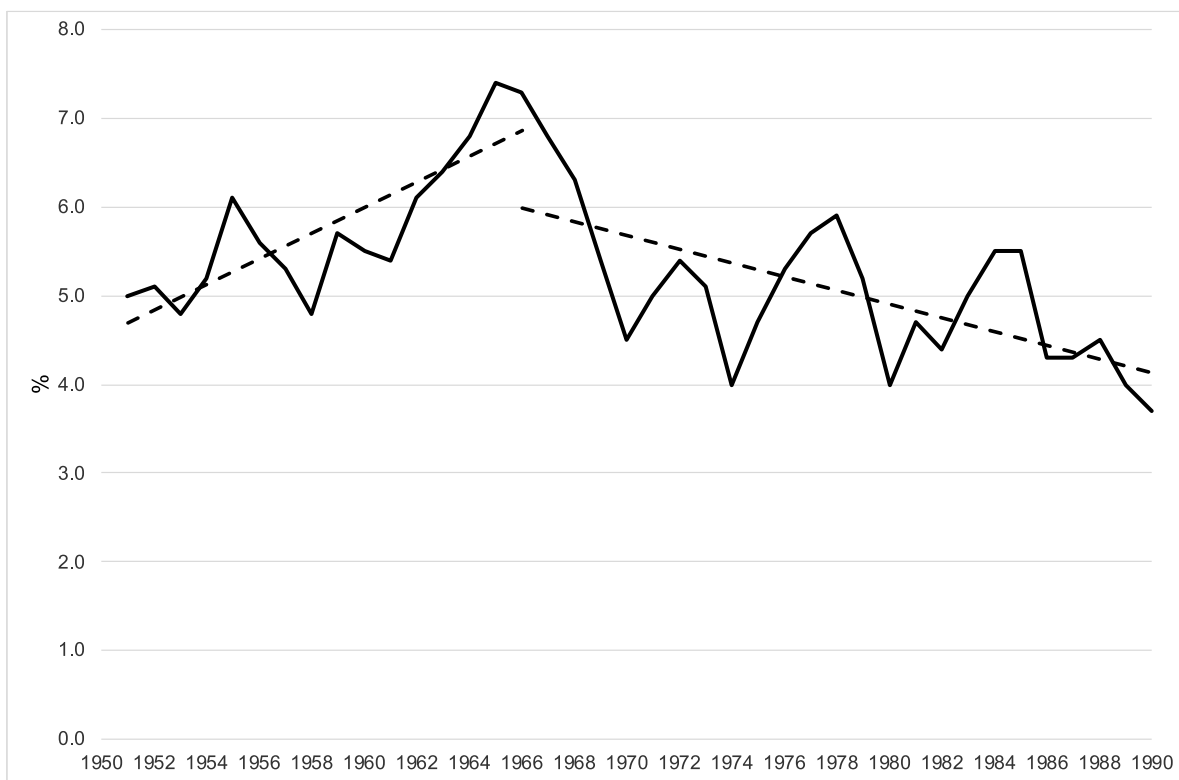


Fig. 2. US Corporate Profitability as Share Domestic Income, 1951-1966 and 1966-1990 (post-tax profits as a share of domestic income, %) Source: Calculated from <https://fred.stlouisfed.org/series/W273RE1A156NBEA>

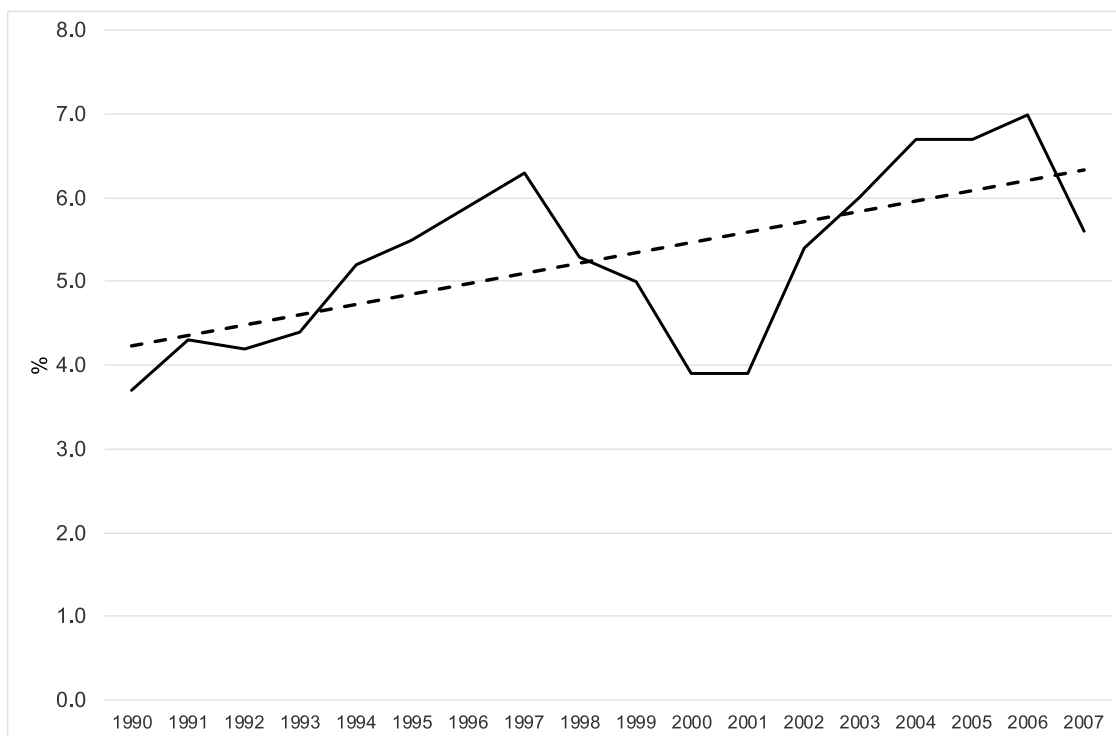


Fig. 3. US Corporate Profitability as Share Domestic Income, 1990-2007 (post-tax profits as a share of domestic income, %) Source: Calculated from <https://fred.stlouisfed.org/series/W273RE1A156NBEA>

industrial world, this led to the displacement of labour and the growth of structural unemployment and poverty. Previously prosperous industrial regions degenerated into rust-belt regions (EU, 2020).

Third, the growing fragmentation of production and the rapid growth of GVCs resulted in the ‘centrifugalisation’ of production reflected in the changing geography of global production and trade. The

share of non-OECD economies in global GDP grew, as did their share of global trade in manufactures (UNIDO, 2016). Significantly, the dynamism of these successful middle-income economies was reflected in the increasing technological intensity of their exports (UNIDO, 2016, Fig. 4). This was largely a consequence of the industrial dynamism of China and other economies in north-eastern and south-eastern Asia. The exports of lower-middle-income and particularly lower-income economies showed no equivalent change in structure.

2.2. Mass production reaches its limits

In Freeman's recounting of the historical experience with techno-economic paradigms, each growth surge lasted approximately five to six decades (Freeman et al., 1982). Yet, demonstrably, the Mass production Paradigm appeared to have a longer life. It was 'invented' in the early 20th century by Henry Ford, had its heyday in the two decades after WW2, and remained reasonably robust until the turn of the millennium. We argue that this longevity was a direct consequence of the surge of deep globalisation through the extension of GVCs after the early 1980s when, in the face of the declining rate of productivity of the paradigm, the corporate sector stretched its operations globally to take advantage of low-cost labour in developing countries. It is worth noting that, although the GVC-led globalisation in the last two decades of the twentieth century prolonged the life of the Mass Production paradigm, it could not have flourished without the increasingly widespread incorporation of ICT heartland technology, which is shaping the post-mass production world. ICTs are central to the control of machinery and equipment located across the globe and are crucial to the functioning of the logistics and corporate control which characterise globalised supply chains.

But, as in the case of the post-war Golden Age, many good things come to an end and, by the turn of the millennium, the functioning and architecture of this global system began to fray. Following changes made in the tax regime by Reagan in the US and Thatcher in the UK, and widely replicated in other high-income economies, speculative investments became increasingly dominant in the allocation of finance.⁸ Deepening financialisation exacerbated many of the underlying contradictions of the maturing Mass Production paradigm. It caused and reflected the growth of short-termism in corporate strategies, which had a dulling impact on long-term and productive investment and in expenditure on innovation. Opportunities for large gains through financial arbitrage diverted entrepreneurs from concentrating their energies on productive activities. Under the banner of maximising shareholder value, senior management and shareholders engaged in a process of systematic 'value capture' (O'Sullivan, 2005; Lazonick, 2017; Mazzucato, 2020), exacerbating the structural shift towards a more unequalising distribution of income and wealth (Alvaredo et al., 2017). And, perhaps most significantly from the perspective of the durability of the Mass Production paradigm, heightened speculation resulted in a 'bubble economy', which in turn led to the high-tech stock exchange crash in the US in 1998/1999 (Pérez, 2002), and the much more destabilising global financial crisis in 2008. The fall in output in OECD economies after 2008 rivalled the collapse of the Great Depression of the 1930s. Instead of reviving demand and production, the quantitative easing programmes adopted after 2008 merely reinforced the speculative economy (O'Sullivan, 2005; UNCTAD, 2017).

Deepening GVC-led globalisation may have reinvigorated corporate profitability (Fig. 3) but, as we have observed, it also contributed significantly to labour displacement in the industrial heartlands of most high-income economies. When imports from low-wage emerging economies did not displace labour, they resulted in the stagnation of earnings

amongst unskilled workers – real wages of unskilled labour in the US and parts of Europe were lower in 2008 than they were in the early 1970s and were further eroded by the 2008 financial crisis (Kline, 2018). The combination of growing unemployment and stagnant and falling wages fuelled discontent with the social and political regime that had developed after WW2 to support the deployment of the Mass Production paradigm. Increasingly, the legitimacy of liberal democracy (which Fukuyama (1989) had claimed in 'The end of history' to have supplanted all other forms of political governance) was eroding. Fuelled by the rise in migration (in large part a consequence of the unevenness of global growth in mass production), this resulted in the rise of populist governments (Kaplinsky, 2021). The clarion calls of this populist movement in the world's dominant economy – the US – was to retreat from the global free trade order, accompanied inter alia by the introduction of protectionist trade policies. As in the Great Depression in the 1930s, this was mirrored by the imposition of tariffs on US trading partners. It also led to sustained attacks on the Bretton-Woods institutions of global governance that had developed after WW2 to support the global deployment of mass production.

Coterminous with the growth of these internal contradictions in the Mass Production paradigm was the increasingly rapid maturation of ICTs. The widespread diffusion of this heartland technology in individual applications led to the reinvigoration of productivity growth, not just in regard to labour productivity, but also capital productivity (cheaper machinery and slimmed inventories) and materials productivity as well. Thus, labour-saving and flexible ICTs increasingly enable profitable production in high-wage environments, and this reduces the imperative to depend on global supply chains. The trajectory of productive geography thus increasingly shifts from the centrifugalism of mass production to the centripetalism of the ICT techno-economic paradigm – from the global to the (relatively) local (Kaplinsky, 2021).

These combined developments in the atrophy of mass production and the maturation of ICTs resulted in trends, rather than a binary switch in the global economy. But the trend-change is real and is reflected in the slowdown in the trade-GDP ratio of global growth and the share of GVCs in global trade. The sharply rising share of GVC trade in global trade, which almost doubled between 1993 and 2007 (the heyday of globalisation) fell sharply after the 2007 financial crisis (Fig. 4).⁹

3. The structural turning point and the challenges posed for low-income and many middle-income economies

Where do these developments leave the developing world, particularly those countries outside of the rapidly growing East Asian region? We focus on three interrelated factors that we argue have particularly prominent implications for the distributional outcomes and innovation trajectories that were central concerns of Freeman. The first is the prevalence of marginalisation and the size of and the role played by the informal sector. The second reflects the changing trajectory of trade, from global to regional markets and from North-South to South-South trade. Third, the new heartland technology that succeeds mass production – ICTs – provides manifold opportunities to promote more sustainable and equitable growth paths. In a later section, we argue that each of these innovation-determining factors reflects a structural break in the character of the global economy as the Mass Production paradigm atrophies and new accumulation paths emerge. Each provides opportunities for new innovation paths and is redolent with policy implications.

3.1. Marginalisation and the informalisation of production

The deepening of globalisation had complex distributional and

⁸ Pérez (2002, 2010) argues that the dominance of financial speculation was not unique to the latter stages of mass production and was a characteristic of the evolution of all three previous techno-economic paradigms.

⁹ A similar trend, but with less recent data, is evident in Ignatenko et al. (2019).

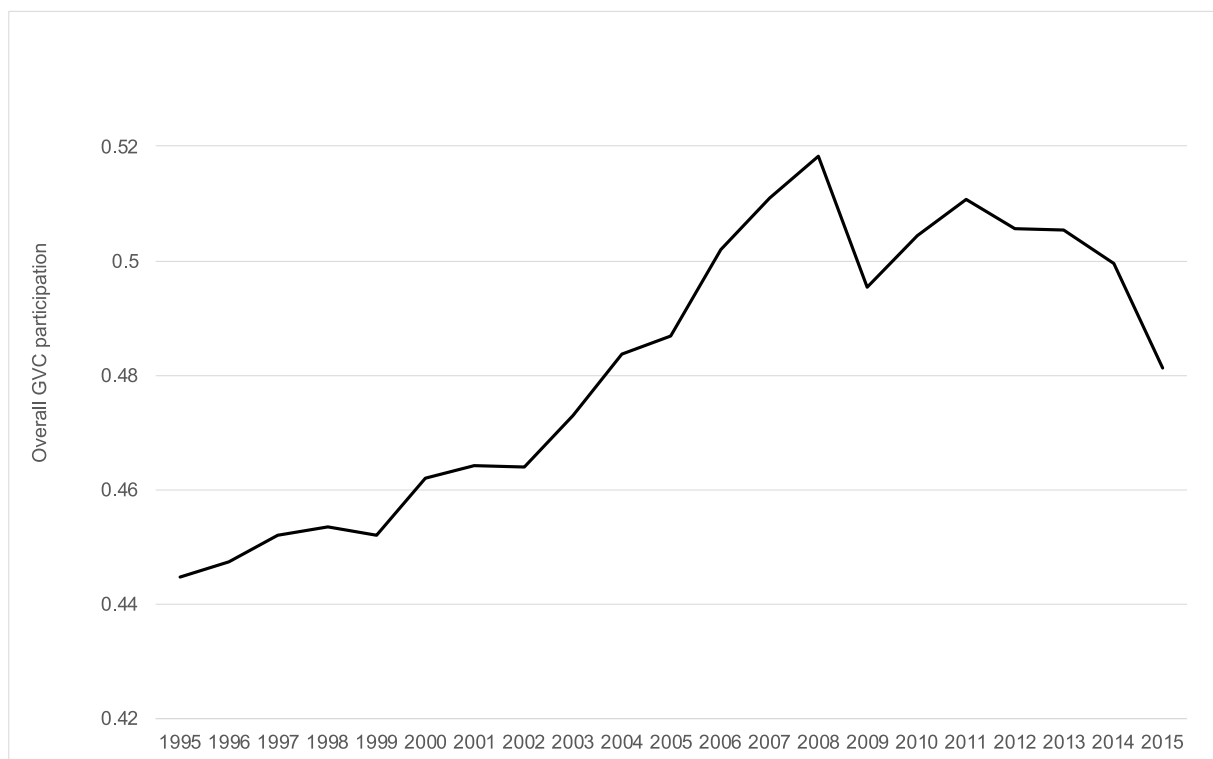


Fig. 4. Share of GVCs in Global Trade (%)
Source: Calculated from World Bank (2020)

employment effects. For those who thrived on access to larger markets – skilled workers and some developing economies, particularly China and other economies in the south and northeast Asian region – the outcomes were positive. Employment rose, incomes grew and consumers benefitted from the greater availability and falling price of consumer goods and services. However, many in the global economy were unable to participate gainfully in GVC-led trade. As we observed above, employment and incomes in the previously prosperous industrial regions in high-income economies fell and livelihoods became more precarious. In many low- and middle-income economies, large swathes of the population were marginalised in what has come to be referred to as ‘the informal economy’.¹⁰

The informal economy accounts for half (or more) of employment outside agriculture in most of the developing world (Table 1). It is estimated that the share of informal employment is 75% in Africa, more than 60% in south and southeast Asia, and more than half of the labour force in Latin America. When the agricultural sector is considered, the share of informalised employment is even higher.

Informality has a bright and a dark side. On the bright side, it has the capacity to channel entrepreneurial energy and to provide employment and incomes to those excluded from the formal sector (Williams and Nadin, 2010). The relationship between the formal and informal economies in developing countries is complex, dynamic and multidimensional¹¹ - sometimes characterised as exploitative (Harris, 1990) while others as symbiotic. In this latter respect, informal actors source inputs and in some activities use the waste from the formal sector, while providing some inputs and cheap wage goods that support the successful

¹⁰ The International Labour Organization (ILO) defined the informal economy as “all economic activities by workers and economic units that are – in law or in practice – not covered or insufficiently covered by formal arrangements.” (ILO, 2002 :25). This definition includes both informal sector enterprises and informal employment and does not cover illicit activities.

¹¹ For a review see Meagher (2013)

Table 1

Share of the informal economy in non-agricultural employment (most recent year, later than 2012)

	Share of the informal economy in non-agricultural employment
Sub-Saharan Africa	74.5
Western Africa	81.5
Central Africa	78.7
Eastern Africa	71.2
Southern Africa	63.6
Southern & South-Eastern Asia	63.7
Latin America and the Caribbean	54.7
Western Asia	48.8
Northern Africa	48.3
Central Asia	39.1
Transition countries	21.7

Source: Adapted from Charmes (2020)

operation of formal-sector enterprises (Hande, 2019). Informal enterprises play an important and largely unrecognised role in trade across borders. Informal and unrecorded trade, largely undertaken by women, is estimated to be at least equivalent to formal-sector trade (Kaplinsky and Morris, 2019). Mold and Chowdury (2021) review evidence that unrecorded trade by the informal sector accounts for somewhere between 11% and 40% of total African intra-regional trade. On the dark side, there is a clear link between informality, poverty and insecurity, particularly in developing countries (Chen et al., 2006; Kabeer, 2014), and harmful emissions (Hanlin and Kaplinsky, 2016). Many individuals and households in marginalised communities have low education levels and no formal training and are trapped in precarious and low-paid work with little or no access to social protection.

There is a widespread tendency to view the informal sector as a homogenous residual category. Barriers to entry and exit are low in the

Table 2
Primary characteristics of innovative informal-sector enterprises.

Features of innovation in the informal sector	Description
Market-pulled	Labour-intensive processes and basic product characteristics reflect low-income consumer markets
Constraint-based	Forces innovation under conditions of scarcity
Inter-enterprise division of labour	Small size of firms induces specialisation along the chain
Non-R&D based	Incremental innovations, links to NSI are non-existent or limited
Adaptation of existing technologies, although increasing use of ICTs in accessing suppliers and customers and in logistics	Adaptation and reverse engineering of imported equipment and adapting foreign products to local conditions
Intellectual property rights (IPRs)	IPRs absent and access to technology through spillovers and open exchange of ideas
Fast diffusion in local systems	Social dynamics in informal settings result in sharing practices and cooperation in procuring inputs and accessing markets
Waste is minimal but effluents high	Extensive reuse, recycling and repurposing of societal waste, but little concern for harmful environmental emissions

informal sector, and many enterprises are ‘survivalist’, showing little signs of dynamism. However, this characterisation is inaccurate and fails to recognise the existing and potentially innovative dynamism of many informal producers (Kraemer-Mbula and Wunsch-Vincent, 2016). Table 2, largely drawn from the African experience, offers a summary of the innovative character of these informal-sector producers. Informal enterprises characteristically operate under significant constraints in both input and product markets, which forces them to innovate in order to survive. Market-pulled innovation by low-income consumers, who are either cut off from or unable to afford the output of the formal sector, spurs process and product innovation. The informality and small size of enterprises militate against mechanisation and economies of scale. However, this often leads in turn to the growth of specialised-component suppliers along the chain (Atta-Ankomah, 2014). Innovations are incremental, links to the formal national system of innovation are thin, and there is an absence of formal R&D. Formal modalities of knowledge appropriation (through intellectual property rights) play little role, so spillovers to neighbouring enterprises are high (Kraemer-Mbula and Wunsch-Vincent, 2016). Reverse engineering and technology adaptation predominate, although ICTs are playing a growing role in input supply, logistics and marketing (Seetharaman et al., 2019). However, despite this innovative dynamism and potential, in most contexts, these incremental improvements do not provide a ladder for graduating into the formal sector. Production scale is generally achieved by clusters of informal producers, rather than by individual producers, and in Africa, there is a correlation between innovation intensity and exports, particularly to regional markets (Kaplinsky and Morris, 2019).

3.2. Market destination, technological choices and technological trajectories

In recent years, intra-regional trade has grown more rapidly than inter-regional trade. The share of intra-regional trade in developing and emerging economies, which barely changed between the 1960s and 2000 (24% and 27% respectively) rose markedly, reaching 42% in 2019.

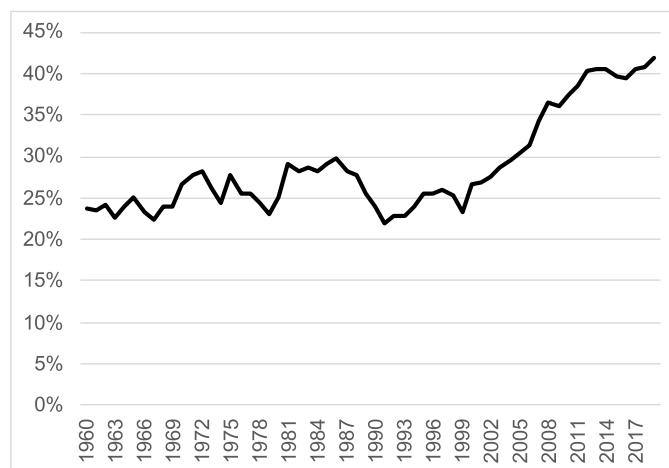


Fig. 5. Share of Intra-Regional Trade, Emerging and Developing Economies, 1960-2017.

Source: <https://www.worldbank.org/en/publication/wdr2020>

(Fig. 5). Moreover, since many low-income economies are heavily dependent on commodity exports, if these are stripped out, the proportion of intra-regional trade is considerably greater than the data presented in Fig. 5.¹² Several factors explain this transition in the structure of global trade. Most East-Asian exports have resulted from production in regional value chains (RVCs). What surfaces as a ‘Made in X’ country product is characteristically often better described as being ‘Made in East Asia’, with inputs sourced from neighbouring regional economies.¹³ Second, the dominance of Chinese-sourced (and often regionally produced) imports in high-income country markets has left little space for exporters from other regions. Hence, to reap economies of scale, producers have been forced to target sales to neighbouring economies. Third, the economic slowdown in the high-income countries has contrasted with rapid growth in many developing economies. And fourth, the character of final consumer markets in low-income countries has tended to exclude competitive suppliers from high-income countries. All these factors have acted to spur the growth of South-South trade.

South-South (S-S) trade has increasingly led to more trade in ‘appropriate products’ and ‘appropriate technologies’, and this provides scope for more inclusive growth paths. But this growth in South-South trade is not without its costs in relation to both labour and environmental standards. We support these conclusions by focusing on the distinctive nature of low-income markets and the character of Southern-origin capital goods.

The distinctive character of Southern final markets is best understood through the lens of the techno-economic paradigms highlighted by Freeman. Rapid growth in the post-war period – the golden age of mass production – was driven by virtually unlimited demand, fuelled by a combination of the reconstruction of infrastructure and housing and shortages in the supply of many consumer goods. But, as basic needs were met, final consumers became more discerning. Instead of settling for standardised, low-quality products being churned out of large-scale mass-producing factories, they demanded frequent product innovation and differentiated product offerings (Piore and Sabel, 1984), and were increasingly concerned with the provenance of supply chains. At the

¹² For example, oil exports account for 90% of Angola’s trade. If these are stripped out, the share of intraregional trade jumps from less than 10% to more than 75% (Mold and Chowdury, 2021).

¹³ The iPhone4, for example, was ‘Made in China’ and exported at a unit value of \$179 to the US, where it sold for \$399. The Chinese share of value added was only \$6, with many of the components being sourced from the Asian region (Xing and Detert, 2010).

same time, as we observed above, internalised production systems were fracturing into extended supply chains. And these supply chains were becoming increasingly global in nature. The only way these developments could be handled effectively by the lead firms was through the growth of standards, affecting both product characteristics and the structure of production processes. There is an extensive literature on the growing standards-intensity of GVCs, particularly on the extent to which these chains contributed to economic and social inclusion (Nadvi, 2004; Ponte, 2019). Workers and firms that were unable to meet these standards due to the illiteracy and innumeracy of their labour forces, enterprises that lacked the capacity to record and formalise production processes and lacked finance to invest in modern equipment, were marginalised and excluded from the fruits of GVC-led growth.

By contrast, markets in low-income countries are much more like those in post-war Europe and the USA. The majority of consumers in these countries seek the least-cost products, trading off price with variety and quality, and show little concern for the social and environmental provenance of the chain. The value chains feeding into these markets are seldom replete with standards. This absence of standards in both product and process removes many of the obstacles to the participation of SMEs and the informal sector in export trade. In this sense, S-S trade is substantially more inclusive than South-North (S-N) trade. But at the same time, since many standards are designed to protect the environment, the growth of S-S trade has led to adverse environmental outcomes. These developments are evident in the transition of exports from Europe to China in the case of timber from Gabon, and animal feed from Thailand (Kaplinsky et al., 2011).

So much for the consequences on the output side of growing S-S trade. But analogous developments can be observed on the input side. Here we begin with the directionality of technical change, which was of ongoing concern to Freeman (1979, 1992a, 2000). Technologies originating in the high-income countries reflect relative factor and input prices and consumer preferences in these economies. They are thus characteristically relatively capital intensive and require high-quality and reliable infrastructure. Research undertaken by Freeman's colleagues at Sussex in the 1970s and 1980s concluded that developing-country producers had little alternative but to use these technologies, since more 'appropriate' technologies originating in developing countries were inefficient.¹⁴ But with the growth of productive and innovative capabilities in low-income countries (and particularly in China), it is no longer the case that technologies originating in low- and middle-income countries are inefficient. A recent series of studies in East Africa, focusing on a comparison between Chinese and Indian capital goods in the clothing, furniture and agricultural sectors, concluded that, although producing 'lower quality' final products and breaking down more frequently, Southern-origin capital goods were cheaper, much more labour intensive and operated at lower levels of scale than their European and Japanese counterparts (Agyei-Holmes, 2014; Atta-Ankomah, 2014; Botchie, 2015; Hanlin and Kaplinsky, 2016). They were thus 'efficient' appropriate technologies, providing the scope for more inclusive growth paths. Not surprisingly, and driven by market forces, the share of China in capital goods imports into Africa, Latin America and South-East Asia grew from virtually 0% to more than 25% in the short period between 1992 and 2018; the share for South Asia grew from around 5% to around 40% in the same period (Fig. 6). But, as in the case of the changing character of value chains noted above, this changing source of capital goods had adverse environmental effects.

¹⁴ During the late 1970s and early 1980s, researchers at the Science Policy Research Unit (SPRU) and the Institute of Development Studies (IDS) at Sussex University, working under the direction of Freeman's close colleague and friend Charles Cooper, collaborated closely with the World Employment Programme at the ILO. This resulted in path-breaking empirical studies documenting the extent to which technically efficient technologies were available in a range of developing economies and sectors.



Fig. 6. China's Share of Capital Good Imports, Latin America, S.E. Asia, South Asia and Sub-Saharan Africa, 1992-2018 (%)

Source: World Integrated Trade Solution (WITS) | Data on Export, Import, Tariff, NTM

For example, Chinese rice tillers were more prone to oil spillages, were much noisier and had more adverse health effects on the labour force than tillers imported from Japan (Agyei-Holmes, 2014).

3.3. Paradigm transition and the diffusion of ICTs in low- and middle-income countries

The widespread use of digital technologies marked the beginning of a 'digital age' or new ICT techno-economic paradigm (Freeman and Louçã, 2001; Freeman et al., 1982). Much of the attention given to the influence of the ICT technological revolution on low- and middle-income countries focuses on the harmful consequences of export-oriented growth due to the improved opportunities for automation in high-income countries. However, the rapid diffusion of digital technologies has provided manifold opportunities for developing economies. As we observed, their participation in GVCs could not have occurred without the extensive use of ICTs in communications and logistics, and increasingly also in machinery controls. Moreover, some developing economies – and India is perhaps the most striking example – were able to 'leapfrog' the historic structure of technological dependence and develop a world-frontier software sector. In 2018, India exported \$74bn of IT software and services.¹⁵

These developments overwhelmingly reflect the opportunities opened to the formal sector. But, at the same time, there has been an increasing stream of ICT-related innovations that have begun to transform the opportunities for the informal sector and marginalised populations. The initial primary driver of these innovative developments was the rapid diffusion of mobile phones. They did not depend on a centralised grid and hence could be used in rural areas. They were cheap to acquire, pricing structures allowed for limited and incremental use, and their size and mobility allowed for shared use. Most low- and middle-income countries got off to a slow start with mobile telephony. While mobile phone penetration in the year 2000 was close to 50 subscriptions per 100 people in advanced economies, in developing countries (especially in the Least Developed Countries) it was close to zero. But, after this initial slow beginning, mobile phones diffused at a spectacular rate. By 2017, the penetration of mobile phone subscriptions reached 98.7% of the population in developing countries, higher than

¹⁵ <https://www.statista.com/statistics/320753/indian-it-software-and-services-exports/>

access to water or electricity.¹⁶

The introduction of ICTs as a general-purpose technology opens up a myriad of new possibilities of recombination and applications that generate a self-reinforcing process of fast technological change. However, change is not immediate; it takes time for economic agents to grasp the full possibilities of a general-purpose technology before its transformational potential is realised. Now, some fifty years after the key technological developments, trends are becoming visible in the developing world, illustrating the role they can play in more inclusive patterns of development. There has been no systematic study of the rate of diffusion of digital technologies in developing countries, but the pace of adoption is undoubtedly rapid and their impacts visible.

The evidence indicates that the adoption of ICTs in developing countries is uneven, and largely contingent on available resources and firm size. Empirical studies note the positive impact that ICTs have on innovation and productivity in firms in the Global South (Santoreli, 2015; Lorenz and Kraemer-Mbula, 2021). While mobile phones are widely used by informal actors (Deen-Swarraj et al., 2013), the use of more sophisticated ICTs is rare. In the case of Chile, Santoreli (2015) shows that although general-use ICTs (such as personal computers, basic software and internet) are widespread across firms of all sizes, more complex ICTs (such as Client Relationship Manager (CRM), industry-specific software or e-commerce) are hardly used by the more vulnerable micro-enterprises. More recently, Lorenz and Kraemer-Mbula (2021) show that digital technologies, such as social media, are used by about a third of a sample of micro and small enterprises (including informal) in Johannesburg (South Africa), with the likelihood of adoption increasing with firm size.

One category of diffusion has seen the emergence of dynamic SMEs. Initially, they serve the local market; then they become increasingly formalised as they grow; and a selected few mature into firms with operations across the region. ICTs have driven a range of digital start-ups, as well as digitally enabled players such as tech hubs, maker-spaces and fabrication labs. Digital start-ups represent a new wave of entrepreneurship in developing countries, often with low barriers to entry and low capital investments (Nambisan, 2017). They are characterised by flexibility in their offerings of products and services, which continuously evolve and expand. Tech hubs have been proliferating in developing countries. For instance, there were over 600 tech hubs in Africa in 2019, having doubled in only three years.¹⁷ Among these, a new type of hub – the co-creation/maker spaces – has grown rapidly. These are collaborative workspaces for making, learning, exploring and sharing. They make intensive use of ICT-controlled equipment such as 3D printers, laser cutters, CNC machines, electronic components, microcontrollers and microcontroller software (for example, Arduino kits), and low-cost microcomputers (for example, the Raspberry Pi). Ushahidi – an open-source software platform – is currently a tech leader in Africa. It started in a co-creation space providing a mobile platform to report on election monitoring and the response to crises, and now operates in nine countries. An increasing number of these rapidly expanding SMEs, which have developed into fast-growing ‘gazelles’¹⁸ and even in some cases into ‘unicorns’¹⁹, can be traced back to grassroots innovation by creative, young technopreneurs.

Mobile phones have been a source of the extraordinary dynamism of SMEs in the logistics and services sectors, initially targeting the needs of low-income consumers, and then widening their scope to high-income

markets and, in some cases, expanding into regional markets. Go-Jek was launched in Indonesia in 2010 with 20 motorcycle drivers, and by 2018 was working with one million drivers. In mid-2020, it was valued at \$12bn and had expanded into regional markets.²⁰ GRAB, based in Singapore, is even larger than Go-Jek. In mid-2020, it was able to raise \$856m to further its expansion and worked with nearly three million drivers.²¹ Rappi, starting as a food-delivery service in Colombia, currently operates in nine Latin American countries. It offers a broad range of products and services available for delivery – including cash and personal belongings.²² Often the value chains developed by these rapidly growing start-ups have positive inclusionary impacts. For example, both Go-Jek and GRAB began with motorcycle taxis. Motorcycles are far cheaper than cars and reduce the barriers to entry for delivery drivers who lack the financial resources required to purchase a car. GRAB recruits drivers from the informal sector, gives them smart phones and teaches them how to use their app. These ride-hailing services, particularly those using motorcycles, also provide cheaper transport for customers than privately owned cars, taxis and, in some cases, also public transport. However, while these app-based services open opportunities for new entrants, they also alter employment relations. In the absence of strong and locally relevant regulations, they can result in exploitation and precarious work conditions for drivers (Melia, 2020; Mabasa and Qobo, 2021).

ICTs have promoted growth and inclusion in the financial sector. Financial technology (fintech) has created new opportunities not only for consumers (broadening access to financial services for underserved populations), but has also opened adjacent services facilitated by fintech. In Africa, which is home to half of the world’s mobile money services,²³ mobile money has helped to transform adjacent consumer services. For example, using the same business model as Mpesa, Mkopa combines mobile money with low-cost renewable energy and has spread rapidly across the East African region.²⁴ In Tanzania, a pay-as-you-cook service uses cellular Internet of Things (IoT) to monitor and control gas usage. Customers use mobile money to purchase gas in affordable quantities for clean cooking.²⁵ Humanitarian agencies are making use of mobile money platforms to make faster and more transparent cash transfers to refugees and displaced persons.²⁶ There are new experimental businesses connecting informal workers to suitable jobs, where they can receive their payment via mobile money.²⁷

But it is in the agricultural sector in low-income countries where ICTs are likely to have the most positive distributional and growth effects in the advent of a climate crisis. Agricultural livelihoods and productivity, and the ability to prepare for adverse environmental events, all depend on access to specialised knowledge on pest control, fertiliser use and flood prevention. The more remote the region, and the poorer the community in those regions, the more valuable this specialised knowledge becomes. Although the evidence as yet is anecdotal, it would

²⁰ <https://www.cnn.com/2020/06/16/gojek-disruptor-50.html>

²¹ <https://www.statista.com/statistics/1034777/apac-number-of-active-drivers-of-ride-sharing-companies/> m

²² <https://en.wikipedia.org/wiki/Rappi>

²³ In 2020, Africa had over 500 million of the world’s 1.2 billion registered mobile money accounts, with a transaction value of \$495 billion, almost two-thirds of the global value. The number of reistered mobile money accounts is more than double than those registered in 2015 (GSMA, 2021).

²⁴ <https://www.gsma.com/mobilefordevelopment/programme/digital-utilities/m-kopa-solars-new-funding-a-landmark-for-off-grid-energy-service-companies/>

²⁵ <https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2018/02/KopaGas-Mobile-enabled-Pay-as-you-Cook™-service-in-Tanzania.pdf>

²⁶ https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/04/Essential_Considerations_for_Using_Mobile_Money.pdf

²⁷ <https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/06/Mobile-Money-Driving-formalisation-and-building-the-resilience-of-MSMEs.pdf>

¹⁶ According to the World Bank Development Indicators.

¹⁷ According to research conducted by Briter Bridges and the GSMA Ecosystem Accelerator Programme, <https://www.gsma.com/mobilefordevelopment/blog/618-active-tech-hubs-the-backbone-of-africas-tech-ecosystem/>

¹⁸ A ‘gazelle’ company is a young fast-growing enterprise (less than 5 years old) that experiences sustained revenue growth by at least 20% annually (Ahmad, 2008)

¹⁹ ‘Unicorns’ are firms valued at more than \$1bn at their time of flotation.

appear that applications of ICTs to agricultural extension and in response to environmental challenges are relatively poorly developed by comparison with their diffusion in the financial, logistics and urban-based manufacturing sectors. Nevertheless, there are examples of the potential offered by ICTs to improve agricultural productivity. In Nigeria, IBM's mobile open-source Hello Tractor platform provides AI-based on-demand tractor access to farmers (Assefa, 2018). iCow in East Africa is a mobile agricultural connecting platform for farmers and input providers, agricultural financial service providers, veterinary experts, agricultural extension service providers, NGOs and government in the agricultural ecosystem. The app uses videos to share agricultural practices in animal and crop production and is available in Kenya and Tanzania in English and Kiswahili, and in Ethiopia in Oromiffo, Amharic and Tigrigna.²⁸

These examples of the application of ICTs in low- and middle-income countries reflect developments of historical significance and illustrate the transformative potential of this new heartland technology. They illustrate that the disruptive nature of ICTs has transformed the innovation agenda in these countries. In many cases, they illustrate the potential for what Soete (1985) refers to as 'leapfrogging'. As in previous transitions in the techno-economic paradigm, the countries that previously dominated the global economy have often been locked into the path-dependency of their historical expertise. The true potential of the new heartland technology may thus potentially be realised in new geographical centres. And, whilst this is largely reflected on the global stage in the rise of formal-sector enterprises in middle-income countries such as China, the dynamism of ICT-based innovation in Africa, Latin America and South and Southeast Asia suggests that leapfrogging also applies at the level of small-scale production. In the context of the extensive marginalisation of populations reflected in Table 1, this is a development of considerable historical and distributional significance.

4. From the positive to the normative

During the late 1930s, Freeman was an active member of the Communist Party. So the inscription on Marx's gravestone (*The philosophers have only interpreted the world, in various ways. The point, however, is to change it*) is perhaps an apt doorway through which we can pass from what economists refer to as 'positive' analysis (what is, and why) to 'normative' analysis (what can and should be). What policy implications does the discussion in the previous sections have for innovation policies that meet Freeman's concerns about sustainable growth, equity and the environment?

We begin by briefly restating our central argument. Most low- and middle-income economies are confronted by two overlapping crises. Deep globalisation is in retreat, and the flying geese model replicating China's growth strategy of exporting to high-income countries is unlikely to be viable outside of a few East Asian economies (for example Vietnam), and in some sectors in South Asian economies (such as Bangladesh and India). At the same time, deep globalisation has been associated with massive marginalisation, poverty and insecurity. Even outside of agriculture, more than half of the population in most low-income countries earn their livelihood in the informal sector. These developments represent a structural crisis in the development strategy agenda. We have argued that this structural crisis reflects the atrophy of the Mass production Paradigm, the emergence of which was pioneered by Freeman and colleagues from the late 1970s (Freeman et al., 1982). But, as in all crises, there is both threat and opportunity. The opportunities we have identified for more inclusive and economically sustainable growth paths arise from the growth of innovative entrepreneurship in increasingly educated developing economies, the opportunities opened up by the growth in regional South-South trade, and the manifold opportunities offered by the ICT heartland technology, which

Freeman observed will power the post-mass production techno-economic paradigm.

Before focusing on the implications for innovation policies in low- and middle-income countries, we necessarily must preface this discussion with a few provisos. First, there is enormous heterogeneity in the 'developing world' – context is of course important. Second, change takes time, and the boundaries between paradigms are fuzzy. We have argued the case for a 'structural break', but picking at the details, the indicators of crisis and specific inflexion points are not clear-cut. Moreover, transition to a new paradigm does not occur in a day, or even in a decade. However, at points of major global crises (such as the 2008 financial crisis, the current Covid-19 pandemic and, we believe, the probability of a future global financial crisis in an increasingly leveraged world), the choices faced by all societal stakeholders may be acute and urgent. And third, there is the issue of what constitutes 'innovation'. As Freeman observed in much of his work, innovation cannot be reduced to new products and new processes. Specific innovations are embedded in complex social processes involving organisational design, consumer behaviour and power disputations between and within firms, classes and regions. So much of what is in effect 'innovation policy' is addressed through other policy agendas, such as industrial and macroeconomic policy.

Bearing these caveats in mind, we first focus briefly on three sets of innovation policy issues – how to respond to the changing geography of global trade; how to take advantage of the innovative dynamism of the informal sector; and how to promote the widespread adoption of the new ICT heartland technology.

4.1. The changing geography of global trade

In the earlier discussion, we observed the growing importance of regional product markets and the growth of South-South trade in capital goods. In both cases, we recognised opportunity and threat – trade-offs between developmental objectives are an inherent part of the innovation agenda.

Cross-border trade in commodities, intermediate and final products provides a spur to productivity growth, both because augmented demand allows for enhanced mechanisation and a greater division of labour within the firm, and because it leads to the emergence of specialised suppliers. This is true of all trade, but there are specific elements that reflect regional trade and trade with similar economies in other regions. The first is that there are major market opportunities in low-income consumer markets which, as we observed above, tend to require less product and process standards in their value chains. Second, the bulk of exports from developing economies to high-income countries comprise raw materials and finely fragmented trade in complex GVCs. By contrast, outside of East Asia, most South-South trade takes the form of unprocessed raw materials and final products which are traded at arms' length rather than in chains governed by dominant lead firms. Third, South-South trade is predominantly in merchandise products rather than in services. And fourth, the social and environmental provenance of South-South trade is thin, involving low wages, poor working conditions and environmentally damaging production processes.

Many of the policy responses to this set of challenges are relatively clear. The flow of knowledge (for example, the range of suppliers and marketing channels) across Southern boundaries tends to be inferior to that when trading with high-income economies. Thus investments in knowledge flows are indicated. Trade facilitation also requires investments in physical infrastructure and in border controls. This latter factor is a particular concern for informal-sector traders, who routinely have to bribe their way across borders (Bensassi and Jarreau, 2019). A key innovation agenda for the corporate sector concerns business strategies. To achieve scale economies over time requires a greater degree of sophistication in the organisation of their value chains. Controls over logistics need to be sharpened and, as in the case of GVCs feeding into higher income markets, relationships along the chain and across borders

²⁸ <https://disruptingafrika.com/index.php/iCow>

in many cases need to transition from an arms' length to long-term and more trust-intensive links (Gereffi et al., 2005). Finally, governments need to take steps to reduce the impediments to trade by reducing tariff and non-tariff barriers, as is currently occurring in the new African Continental Free Trade Area (AfCFTA).

There are particular challenges and opportunities that are opened by increased South-South trade in capital goods. It is likely that the lower sophistication of these technologies provides more scope for adaptation by local users than do technologies imported from high-income countries. In the Kenyan woodworking industry, local machinery producers innovated hybrid technologies combining Chinese and European machinery (Atta-Ankomah, 2014). In Tanzania, the greater propensity for Chinese rice tillers to break down compared to Japanese tillers led to the growth of repair shops in rural areas addressing the needs of other users as well (Agyei-Holmes, 2014). Taking advantage of the gains resulting from S-S trade will require the national system of innovation to purposefully address the needs of technology adaptation in importing enterprises to foster indigenous technological progress.

4.2. Promoting innovation in the informal sector

Conventional policy approaches to the informal sector have focused on formalisation in response to the 'dark side' of informality such as corruption, lack of compliance, tax evasion and worker exploitation. However, such an approach to policy fails to acknowledge and nurture the 'bright side' of informality and its contribution to entrepreneurship, employment generation and innovation. This recognition has recently prompted more integrated approaches to supporting the transition to formalisation, intending to diminish the negative impacts of informality. In this respect, the International Labour Office calls for coherence and coordination across a broad range of policy areas to ensure appropriate coverage and protection of all categories of workers and economic units, particularly those in the most vulnerable circumstances (ILO, 2015).

There seems to be little consensus about which policies to prescribe to promote innovation in the informal sector. This stems largely from dissenting views on the reasons for the existence of the sector, the connection between the formal and informal sectors, and the informal sector's relationship with the state (Skinner, 2018). Lack of policy coherence is also the result of tensions among different levels of government, since economic development resources tend to be concentrated at the national and provincial level while local municipalities are generally responsible for the management of cities in developing countries where the informal sector predominates (von Tunzelmann, 2009).

An integrated approach to the informal sector requires adopting a more systemic perspective of informality. It requires the acknowledgement that rather than a series of binary divisions, the economic reality of most developing countries is comprised by a range of actors and organisations with different levels of (in)formality who exchange and share ideas, knowledge, human resources, goods and services (Kraemer-Mbula and Wunsch-Vincent, 2016). Freeman's contribution to the understanding of innovation processes in firms as part of a system, in interaction with their social, institutional and economic surroundings, provides a useful departure point to think about systemic innovation policy approaches to the informal sector. For example, one of the main problems with informal-sector firms is not their size or their informal status, but their isolation from the broader innovation system (Lundvall et al., 2009; Kraemer-Mbula et al., 2019).

Adopting a systemic approach to innovation policy to help the informal sector to better capture the benefits of its innovations, as well as to scale up and eventually formalise, requires widening the scope of innovation policy to include policy areas that directly affect informal economic actors (such as labour, welfare, urban planning and social policies) as part of the innovation policy mix. It also implies expanding the reach of conventional innovation policy instruments (such as grants for innovation, skills-upgrading programmes and initiatives that support

inter-firm collaborations and those of firms with other stakeholders) to make them available to informal firms (Kraemer-Mbula and Konte, 2016).

But, above all, designing, implementing and monitoring the distributional effects of policy interventions suitable for the informal sector require an adequate knowledge base. This requires developing countries to embark on large-scale data collection to capture the extent, the character and the drivers of innovation activities in the informal sector. While fully capturing the distributional effects from innovation policy interventions may be difficult, the absence of data and appropriate indicators to measure informal economic activity prevents policy makers from understanding not only the dynamics of informality, but also how the informal economy may react to specific policy approaches targeted at both formal and informal actors. The eight characteristics of innovation in the informal sector set out in Table 2 provide an agenda for knowledge generation, and then for subsequent policy support – the character of the final market, the constraints faced by producers, the inter-enterprise division of labour (including their location in clusters), access to formal R&D, the extent of adaptation of process technologies and products, the barriers to entry (including IPRs), the path of diffusion of innovations, and the extent to which informal-sector enterprises use waste and displace waste into the environment.

4.3. Speeding the diffusion of and providing directionality to ITCs in developing countries

Digital technologies have transformed societies and economies worldwide over the past two decades. Although most low-income regions have been late adopters, all evidence suggests that ICTs have rapidly penetrated the economic and social fabric of developing countries, presenting considerable opportunities for inclusive and sustainable growth. The previous sections have argued that developing countries are at a turning point where ICTs have entered the scene and are likely to shape future prospects. However, widespread ICT adoption can also result in unsustainable outcomes if the public policy and regulation fall far short of the challenge. The prospect of a digitally enabled inclusive pattern of development is only possible when digital technologies become broadly accessible to marginalised and vulnerable communities (for example, informal workers, women, the unemployed and rural populations), and when digital technologies are deliberately steered to advance a broader sustainable developmental agenda. This poses the challenge of imparting directionality to both ICT-intensive innovations and their diffusion.

One important avenue of policy direction is to address the digital divide by improving the connectivity of marginalised communities. While the adoption of mobile phones has grown very rapidly, most of the population in developing countries remains unconnected to the internet – connectivity in higher income countries (87% of individuals in 2019) is far higher than in developing economies (19%).²⁹ Those excluded are predominantly women, people with lower levels of education, people in poverty and those residing in rural areas (Pathways for Prosperity Commission, 2019). The persistence of a digital divide triggers a crucial policy debate on how to provide internet access to the majority of the population in developing countries addressing not only affordability but also the lack of infrastructure resulting from intermittent electricity supply and the limited availability of ICT facilities.

Another policy challenge is to address imbalances in digital skills. The digital economy is often reserved for those who not only have access but also have the necessary digital skills to take advantage of emerging opportunities. The development of an adequate digital skills base in developing countries requires not only specialised training programmes, but redressing a larger set of issues related to poor education outcomes.

²⁹ See www.itu.int. It is important to note that access to mobile telephony does not necessarily imply access to the internet.

Investments in ICT infrastructure and connectivity will not do much if communities lack the skills to apply such knowledge to use and sometimes to develop new digital products and services (Shenglin et al., 2017).

A third policy challenge requires a deep understanding of the local context and local needs. Returning to Freeman's systemic perspective on innovation, the success of new digital products and services depends on a broad ecosystem providing essential ingredients for them to flourish. And for digital innovations not only to succeed but also to benefit society more broadly, they need to be made accessible to disadvantaged individuals and businesses. However, the evidence shows that large-scale digitalisation initiatives often have not paid sufficient attention to the dynamic, historically contingent and embedded social dimensions of digital technologies. For instance, the One Laptop per Child (OLPC) project – also dubbed 'the \$100 laptop' – which launched in 2005 aiming to make low-cost computers accessible to the world's poorest children, presumed that mere access to the gadgets would support children's empowerment via education, achieving limited results (James, 2010; Saxe and De Kirby, 2018). The effectiveness of such initiatives hinges on systemic aspects, related to global suppliers of the gadgets, national infrastructure, and the match between available educational content (e.g. digital resources) and the educational curricula. Without a deep understanding of the local context and needs, ICT policy interventions may yield little or negative results.

And finally, digital technologies have the capacity to support the implementation of broader social policies. For instance, technologies such as digital identification and digital payments, have been used to effect cash transfers in the humanitarian sphere (e.g. the World Food Programme), or in public policy programmes such as Bolsa Familia in Brazil, reducing administrative costs significantly from 15% to 3% (Pathways for Prosperity Commission, 2019). In this respect, digital innovations can help build not only a more inclusive productive fabric, but also social protection systems. India's ambitious programme to provide every citizen with a digital identity as a means to deliver social security and health services illustrates the complexities of addressing such systemic challenges.

5. Meta policies to impart directionality – power distribution and policy as process

Freeman did not fall into the *ceteris paribus* trap of neo-classical economics, which holds the 'social and political' constant in the pursuit of 'positive' analysis and loses sight of the trees in the forest of detailed microeconomic enquiry. He pioneered a meta-framework that has spurred the intellectually exciting and policy-relevant school of techno-economic paradigms and sociotechnical theory. This provided both a meta-analysis of global developments and integrated the economic with the social and political. Hence, reflecting on our suggestions for policies designed to take advantage of the changing geography of global trade to foster the greater inclusion of marginalised populations and the need to hasten and provide directionality to the diffusion of ICTs, Freeman would surely have challenged us to address the meta- and social context in which these policies are embedded. This wider discussion is central to the concept of techno-economic paradigms which he helped to pioneer.

The elephant in the room in the analysis we have provided in this essay is one that haunts the school of Innovation Studies. It is the failure to centrally problematise the importance of power relations in society at large. Under what political dispensation are the policies that we and others have suggested politically feasible? Can they be implemented in a world in which income and wealth, and the ability to shape social attitudes, are increasingly concentrated in a few hands? These few hands are no longer confined to high-income countries. In 2017, the countries with the largest number of billionaires were China (819), the USA (571), India (131), the UK (118), Germany (114), Switzerland (83), Russia (71) France (51) and Brazil and Canada (with 49 each). Even in Africa, the

poorest continent in the world, there were 29 billionaires in 2015 (Kaplinsky, 2021).

Some of the policy agendas we have discussed above do not require the substantial redirection of economic and political power. The corporate sector in the developing world will take advantage of the spaces opened by South-South trade – expanding consumer markets as informal sector incomes grow along with the opportunities provided by ICTs for enhancing profitability. But it is likely that this corporate sector will be rather different in nature to that which flourished in low- and middle-income economies in recent days. Nationally owned firms will grow at the expense of foreign investors from high-income countries; SMEs and 'small capitalists' will thrive; and the dynamic and increasingly educated youth grasping the opportunities offered by ICTs will play a prominent role and may be more demanding of an open and democratic political system. All of these developments will affect the balance of societal power, the structure of politics, the engagement of civil society and the form of lifestyles in ways that undermine the historical power of the mass production elite.

Finally, throughout his life, Freeman was a team player. Few of his intellectual and personal contributions could have been made without the participation of others. And so it is with policy at large. As in innovation management within firms, specifying a range of interventions in itself is the easy part of transformative agendas. The critical driver of real change is the assembly of restructuring coalitions involving a range of actors – the state (at various levels), the private sector (large, medium, small and informal firms), and civil society organisations. The precise assembly required to deliver particular outcomes is contingent, as is the identity of which party will lead a particular restructuring agenda. Notwithstanding these contingent factors, the centrality of social processes as the primary driver of change is critical.

Authors' contribution

Both authors contributed equally to the development of the Conceptualization, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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