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The Digital Divide and Increasing Returns: Contradictions of Informational Capitalism

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The far-reaching advances in information and communications technologies (ICTs) in tandem with the globalization of trade, investment, business regulation, production, and consumption have signaled the rise of "informational capitalism." This article reflects on the social and economic inequalities of informational capitalism by examining two contradictions of ICTs-led economic development—increasing returns and the digital divide. Two main and interrelated strands of evidence are presented: First, contrary to expectations that rising income per capita will tend to reduce wealth and wage disparities, the distribution of income and wealth both between countries and individuals has sharply skewed in the information age; second, knowledge production is a self-reinforcing cycle that tends to disproportionately reward some and exclude others. The so-called digital divide is as much a symptom and a cause of these broader techno-economic phenomena, and regarding it as a simple issue of connectivity is simplistic and reductive.

Keywords digital divide, globalization, income inequality, increasing returns, informational capitalism, international division of labor, knowledge economy

The accentuation of "knowledge" as the most important factor of production, surpassing land, labor, and capital, along with the rapid development, diffusion and utilization of information and communications technologies (ICTs), has profoundly affected the modes of global economic production as well as consumption. The far-reaching advances in ICTs in tandem with globalization of trade, investment, production, and consumption, as well as the globalization and liberalization of business rules and regulations Braithwaite & Drahos (2000), have signaled the rise of "informational capitalism." The objective of this article is to reflect on and analyze the contradictions of informational capitalism.

We can see two contradictions of ICTs-led economic development—increasing returns and the digital divide. The main argument of this article is that the problems arising from these contradictory phenomena such as worsening income and wage gaps, uneven development, asymmetries in intraregional economic growth in parts of the developing world, and the deepening income inequalities in the developed world after the onset of the so-called informational economy and economic globalization are not unrelated or mutually exclusive developments. They are integral parts of the economic restructuring going on after the onset of economic globalization and the spectacular technological changes of recent times. Therefore, the so-called digital divide, which has morphed in the burgeoning information society discourse into the most cited woe of uneven development since the onset of informational capitalism, is not an accessibility issue as it is being made out to be, but rather an equity issue.[1] Most analysts look at the problem of digital divide in a narrowly construed instrumental sense of the absence of a technical artifact for a large number of people in the world that ostensibly deprives them of the ability to be "online." The digital divide is often portrayed in crassly reductive terms as a mere technological access problem that can be ostensibly addressed by providing cheap computing and communication technologies to the poor. However, the digital divide is not merely a technological problem due to the absence of connectivity or access to cyberspace. This instrumentally informed discourse on digital divide is a modernist tendency to unreflectingly categorize and compartmentalize complex sociotechnological changes into one-dimensional social problems in a bid to resolve them through simple technological fixes.[2]

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There is an asymmetric relation between traditional means and methods of production (dominated by primary, bulk processing and manufacturing industries) and the innovation and knowledge driven industries of "postindustrial weightless economy." While the production functions of the former are characterized by constant or diminishing returns, the latter enjoys the benefits of increasing returns and network effects, issues discussed in detail later. This despite the fact that the introduction of ICTs in the former (e.g., in agriculture or manufacturing) has improved productivity. However, these economic activities do not enjoy increasing returns or network effects or lock-ins, unlike the firms and businesses of the knowledge economy. While those in the knowledge-based economy (knowledge workers, investors, and entrepreneurs as well as others involved in consumption and service sectors) benefit enormously from the value chain of the knowledge-based economy, those who are out of the knowledge economy (producers involved in traditional as well as industrial production) are caught up in the iron law of diminishing returns and decreasing value chain.

The divide between the income rich and the income poor, the technology haves and the technology have-nots, the information rich and the information poor, has become the most serious political economic problem facing the world today. By the time the marginalized group makes any headway in bridging some aspect of these divides, the gap widens to an unfathomable chasm. Attempts to bridge the divides often turn into futile exercises in technological catching up. This aspect of digital economy's exclusion of the majority of the world's population has to be seen as the real issue behind the digital divide discourse. The distributional inequities between the traditional and the knowledge economies are manifested as the digital divide and other forms of informational inequalities.

THE POLITICAL ECONOMY OF INFORMATIONAL DEVELOPMENT AND THE NEW INTERNATIONAL DIVISION OF LABOR

While low value-added production moved to cheaper production destinations in the South (to take advantage of its cheap labor, land, and certain capital resources[3]), those in the North held on to the patents, innovations, and production techniques of technologies from which they derived more value than by producing the goods and delivering the services themselves based on the knowledge they have created.[4] While the manufacturing industry shrank in the North, and consequently so did the jobs and income of many manufacturing workers, the income of the so-called knowledge workers[5] involved in the new informational economy increased disproportionately more than that of the less-skilled workers.[6] It was no accident that the coming of the "weightless economy" saw the most uneven distribution of income and wealth in recent times along with the most spectacular increase in global wealth (specifically concentrated among certain individuals, regions, countries, and corporations).

The income and wage distribution in the United States and other Organization for Economic Cooperation and Development (OECD) countries since the 1970s (the beginning of the age of informational capitalism; cf. Castells, 1996, on this claim) changed unexpectedly, contrary to the trends since the postwar period. In these countries, income inequality has risen sharply and there was a sharp decline in the demand for less skilled workers and a consequent high demand and wage increase for highly skilled workers. This phenomenon is an important aspect of informational capitalism because inequality has been decreasing in industrialized societies up to the 1970s. It has been noticed that all economically advanced states started out the process of industrial development with low income inequality and ended up with progressively worsening inequality as industrialization and economic growth picked up steam. As economic growth continued and as more and more workers entered the high productivity sectors of the economy, income inequality began to recede with increasing income (Kuznets, 1955). Kuznets's prediction of this reverse causal relationship between growth and inequality has been validated for most of the OECD countries up to the 1970s (Aghion et al., 1998). Ahluwalia (1976) found the same reverse causal relationship between growth and income distribution among developing countries, although for a much shorter period because they had begun to chart their course of economic development only after the Second World War when their decolonization began.[7]

A corroboration of Kuznets's hypothesis in the case of the United States could be adduced from the historical fact that the share of total wealth owned by its top 10% richest households rose from 50% around 1770 to 70–80% around 1870, and then receded back to 50% around 1970 (Aghion et al., 1998, p. 9). The sharp reversal of income inequality in the United States and other industrialized countries since the 1970s is portrayed as the Kuznets U-curve "doubling back on itself" (Picketty & Saez, 2003). But, essentially, what this shows is that the Kuznets hypothesis of inverse relationship between income inequality and gross domestic product (GDP) per capita is valid only till the 1970s, which marks the time of the decline of industrial capitalism and the rise of informational capitalism. Picketty's and Saez's argument of the Kuznets curve "doubling back on itself" since the 1970s is an attempt to save the theory (of Kuznets) by promulgating an ad hoc hypothesis (U-curve doubling back on itself).[8] The top 1% of wealthy people's share of income increased from 5% in 1970 to 11% in 1998 in the United States (Picketty & Saez, 2003). Along with the rise in income inequality, the United States also increased its share of global wealth

TABLE 1
Share of world GDP of selected countries and regions, 1500–2001

Year	United States	United Kingdom	Western Europe	Japan	India	China	Mexico	Africa
1500	0.3	1.1	17.9	3.1	24.5	25.0	1.3	7.4
1700	0.1	2.9	22.5	4.1	24.4	22.3	0.7	6.6
1820	1.8	5.2	23.6	3.0	16.0	32.9	0.7	4.5
1870	8.9	9.1	23.6	2.3	12.2	17.2	0.6	3.6
1913	19.1	8.3	33.6	2.3	7.6	8.9	1.0	2.7
1950	27.3	6.5	26.3	3.0	4.2	4.5	1.3	3.6
1973	22.0	4.2	25.7	7.7	3.1	4.6	1.7	3.3
1998	21.9	3.3	20.6	7.7	5.0	11.5	1.9	3.1
2001	21.4	3.2	20.3	7.1	5.4	12.3	1.9	3.3

Note. Data are percent of world total; GDP level of each unit normalized on 1990 international Geary–Khamis dollar. From Maddison (2001, 2003).

compared to other nations and regions in historical terms, as shown in Tables 1 and 2. It is an astonishing historical footnote (with little material significance to the current global economic structure) to note that around 1700, India had 25% of world GDP, while the (would-be) United States had a global GDP share of just 0.1% and the United Kingdom had only 2.9%. Three hundred years later the role has reversed, with the United States commanding 31.4% of global real income while India's share is a miniscule 1.5% (Table 2). See Tables 3, 4, and 5 for global trends in income per capita in historical terms.

A secular rise in income inequality is visible not only in the United States and other OECD countries, but also in developing countries like India, Mexico, China, and Brazil, as depicted in Table 6. It is particularly noticeable that inequality was declining in these countries from 1950s till the 1970s, as predicted by Kuznets.[9] As we can see in Table 3, the ratio of average GDP per capita of 10 highest countries to 10 lowest countries was the lowest during the period between 1970 and 1980. This ratio increased from the 1980 ratio level by more than 50% by 2000. The secular trend in the decline of inequality began to reverse course since the late 1970s in industrialized countries and since the 1990s in developing countries like India, China and Brazil. Structural change in the global economy due to the information revolution is the cause for this trend. Doubling of the share of wealth of the top 1% and the overall economy-wide rise in income inequality since 1976 in the United States is attributed to this trend (Wolff, 2002).

The rapid pace of computerization of the workplace and the diffusion of information and communications technologies in the production processes and organizational settings with the concomitant high premium paid for the cognitive skills of those with higher education are the prime factors responsible for the sharp rise in the wages and earnings of the well-off (Bresnahan, 1997; Autor et al., 1998; Wolff, 2002; Caselli, 1999). A rapid decline in the price of computers and ensuing surge in computer diffusion had a pronounced effect on wage dispersion due to changes in the production function (Krueger, 1993). Stiroh (2002) shows that aggregate labor productivity accelerated in industries that either produced information technology (IT) or used IT most intensively in their production function. Autor et al. (1998) attribute two distinct features associated with technological change for the acute wage disparity between skilled and unskilled workers. First, the long-run secular increases in the relative demand for highly skilled workers are associated with (a) biased technological change[10] and the consequent changes

TABLE 2
2001 Share of world income of selected countries and regions, real and purchasing power parity (PPP), adjusted

Type	USA	UK	South Asia	Japan	India	China	Mexico	Africa[a]
Real	31.4	4.6	2.0	14.5	1.5	3.6	1.7	1.0
PPP	21.3	3.2	6.8	7.5	5.5	11.7	1.9	2.4

[a]For Sub-Saharan Africa.
Note. From World Bank (2003).

TABLE 3
Ratio of GDP per capita of 10 highest to 10 lowest countries: 1950–2001

Year	1950	1960	1970	1980	1990	2000	2001
Ratio	36.2	33.9	32.7	32.2	34.2	47.0	47.2

Note. From Sutcliffe (2004) based on Maddison (2003).

TABLE 4
GDP per capita of selected countries and regions: 1500–2001 (1990 international Geary–Khamis dollars)

Year	United States	United Kingdom	Japan	India	China	Mexico	Africa	World
1500	400	714	500	550	600	425	400	565
1700	527	1250	570	550	600	568	400	615
1870	2445	3191	737	533	530	674	444	867
1913	5301	4921	1387	673	552	1732	585	1510
1950	9561	6907	1926	619	439	2365	852	2114
1973	16689	12022	11439	853	839	4845	1365	4104
1990	23214	16410	18789	1309	1858	6097	1385	5154
1998	27331	18714	20418	1746	3117	6655	1368	5709
2001	27948	20127	20683	1957	3583	7089	1489	6049

Note. From Maddison (2001, 2003).

TABLE 5
2001 Per capita incomes of selected countries and regions, real and purchasing power parity (PPP), adjusted

Type	United States	United Kingdom	Japan	India	China	Mexico	Africa[a]	World
Real	34870	24230	35990	460	890	5540	470	5140
PPP	34870	24460	27430	2450	4260	8770	1620	7570

[a]For Sub-Saharan Africa.
Note. From World Bank (2003).

TABLE 6
Gini Index (in percentage) of selected countries 1950 and after, for various years

Brazil										
Year	1960	1970	1976	1980	1985	1989	1992	1995	1996	1998
Gini	53.0	57.6	60.0	57.8	58.9	57.0	58.1	59.9	60.1	60.7
United										
Year	1950	1960	1965	1970	1975	1980	1985	1990	1994	1997
Gini	37.9	36.4	35.6	35.3	35.7	36.5	38.9	39.6	42.6	45.9
China										
Year	1953	1964	1970	1975	1980	1985	1987	1990	1992	1995
Gini	55.8	30.5	27.9	26.6	32.0	31.4	34.3	34.6	37.8	45.2
Mexico										
Year	1950	1957	1963	1968	1977	1984	1989	1992	1994	1996
Gini	46.0	50.0	49.0	49.0	50.0	50.7	53.1	53.4	56.7	58.0
India										
Year	1950	1960	1965	1968	1975	1983	1986	1990	1994	1997
Gini	41.0	47.3	42.8	46.3	40.5	31.5	30.5	29.7	34.5	37.8

Note. From WIDER (2000) and World Bank (2003).

in the production processes, (b) large-scale organizational changes at the workplace and shop floors, and (c) capital deepening. Second, the impact of the technological change was felt in the strong demand for more skilled workers and the decline in demand and wage for unskilled workers. Caselli (1999) presents persuasive theoretical arguments and empirical evidence to support strong skill biased technological change and consequent increase in wage inequality as a result of the information revolution in the United States. The information revolution is skill-biased because new skills (learning investments) to use and operate ICTs equipment are more expensive to acquire than the skills required for older types of equipment, which most non-IT workers use at workplaces (Caselli, 1999). This, in effect, results in deskilling of those (unskilled) workers who are shut out of the information revolution. Evidence of pervasive skill-biased technological change was also found internationally, especially in OECD countries (Berman et al., 1998). One of the significant changes that occurred during this process of biased technological change was the large employment shift toward nonproduction workers (Davis & Haltiwanger, 1991; Berman et al., 1994). Wolff (2002) shows that the ratio of GDP to PEP (persons engaged in production) declined from 2.58 during the 1947–1976 period to 0.93 during 1979–1997 in the United States, a drop of nearly 3 times.

Declining unionization in both industrialized and industrializing countries also contributed to the lowering of wage shares of low-skilled workers because unions with low membership lost their power for collective bargaining on behalf of the workers. In 1997, only 14.1% of workers in the United States were members of labor unions (Wolff, 2002). Reich (1991) argues that "symbolic analysts" who use IT equipment and produce knowledge have been able to increase their incomes due to the advantages accrued to them consequent to economic globalization. Wood (1995) and Green et al. (2001) assign the globalization and liberalization of trade as an important contributor to the declining employment and income levels of low-skilled workers in recent decades. After joining NAFTA and opening its economy to technology, trade, and investment, Mexico's trade volume with its northern neighbors multiplied by many times. But some 10% of Mexicans at the top of the income pyramid gained most of the new wealth after globalization and liberalization of its economy (Thompson, 2002). Income and wealth inequality became so acute in recent years that the Mexican middle class has pretty much disappeared. This is in a country where middle and working classes made up some 60% of the population in the 1970s. The empirical findings of income inequality in Mexico in Table 6 corroborate Thompson's argument. Table 6 also attests to the worsening income inequality, since the 1990s, in other large developing countries like Brazil, China, and India.

Lucas and Sylla (2002, p. 3) argue that the spectacular innovation clusters centered on the Internet and other information technologies show "signs of further increasing global inequalities." Antonelli (2003) argues that the digital revolution is "engendering a global digital divide because of composition effects." That is, nations and regions that are equipped with the infrastructure to adopt ICTs in their production functions and organizational settings are further advantaged by this ability in terms of sharp increases in their productivity levels and international competitiveness. Those nations and regions that cannot get on the digital bandwagon are further disadvantaged because of their inability to compete, a clear case of increasing returns and positive feedback phenomenon at work in the economy. This compositional effect is not confined to developed nations alone, but also to regions within both developed and developing nations. The sharp rises in their productivity levels associated with the information revolution caused severe skewing of income within, and the international competitiveness of technologically advanced states allowed them to increase their share of global wealth vis-à-vis the poor countries and regions that were left out of the information revolution. ICTs have become the most potent instrument for accessing the global economy, and the poor integration of these technologies in the economy is another key element in the cascading cumulative causation of events leading to further marginalization of the marginalized (James, 2001).

THE DIGITIZATION OF INEQUALITY IN THE KNOWLEDGE ECONOMY

While great wealth was created for those connected to the winning camp of globalization and the knowledge-based economy, these also spawned the most unequal distribution of income and wealth in human history. The average income differential between peasants and manual workers and those we band under the category of "mental" or "knowledge" workers (estate managers, teachers, physicians and priests) in feudal societies was about 1:100.[11] It was an extremely unequal society with a weak central state, with real power vested in the landed feudal lords and the aristocracy. When these feudal societies were transformed by capitalism into industrial societies, the income inequality between the industrial workers involved in manufacturing and those involved in "knowledge" work (the professional class made up of managers, physicians, engineers, designers, university teachers) declined considerably. Williamson and other prominent economic historians have established the phenomenon of a general convergence and narrowing of income disparity since the beginning of the industrial revolution till the 1970s.[12] Despite the iniquities of the hard times faced by the working class of industrial societies,[13] the industrial revolution had a leveling effect on socioeconomic and political differences (between classes) compared to its much more iniquitous agrarian/feudal predecessor. The income differential between the industrial workers and the elite groups reduced to about 1:10, relative to the feudal epoch.[14]

As industrial societies began to enter the postindustrial stage with the onset of the so-called knowledge-based economy that is being constantly challenged by the creative destructive forces of Schumpeterian innovators, the income differential between those who do physical ("unskilled") work and those who do mental ("knowledge") work became worse than that of the feudal period. We can reasonably argue that the income differential between unskilled workers and the knowledge and "symbolic analysts" has widened to an astonishing 0:1 ratio.[15] This is precisely what is meant by the claim that either you are "in or out" of the "winner-take-all" knowledge economy. The significance of Drahos's (1995, 2003) work citing similarities between feudalism and informationalism makes sense in this context—the rent-seeking behavior of knowledge economy firms (by ratcheting up the intellectual property right claims) is essentially the same as the rent-seeking feudalists. Although the real value of relative wage earned by the unskilled workforce is not exactly zero, one can imagine the income differential between those in the knowledge economy and those who are out of it to be extremely high. What is being argued is that the knowledge elite take a disproportionate share of the wealth of the digital economy in the information age. This is a clear example of the income inequality bred by the "winner-take-all" markets of globalization.[16]

As pointed out in Table 7, the income differential in the knowledge (digital) economy, ironically, follows the (digital) logic of Boolean algebra. This is the prospect that the digital divide and the new international division of labor have for those people and nations that are out of the new economy. While Marx and Engels (in 1848) spoke of the technologies and markets of industrial capitalism knocking down the Chinese Walls of "barbarian" and feudal societies, the information, communications and biotechnologies of the information age is compelling, under the threat of "extinction," all poor nations to join the bandwagon of economic globalization. But the result of any forced participation is further marginalization of the marginalized.

INCREASING RETURNS AND THE DYNAMICS OF THE DIGITAL ECONOMY

Economists offer various explanations on how productivity growth (key to income and wealth generation) actually happened. Smith, List, Marx, and others offered the classical explanation on economic growth and wealth accumulation through technological change. The general consensus is that pushing the production possibility frontier through new innovations is the means by which nations grow and acquire wealth (Parayil, 1999). Increase in the stock of human knowledge attained by advances in science and technology and institutional technological progress through innovations is the way to improving productivity (Mokyr, 1990). And accentuating the importance of "useful knowledge" (Mokyr, 1990) is the key to informational capitalism. However, structural conditions and class relations operating within the society and economy determine the actual distribution of the increased income and wealth attributed to productivity increase.

Long before neoclassical economists (such as John Kendrick, Edward Denison, Moses Abramovitz, and Robert Solow) empirically explained the hidden logic behind productivity growth and wealth creation, Joseph Schumpeter had challenged neo-classical economists' claim that economic growth occurs only when existing factors of production are optimized. The idea that any intrusion of external factors in the economy should be avoided was shattered when Schumpeter argued that it was the innovating entrepreneurs who disrupted the economic equilibrium through technological innovation (under conditions of multiple equilibriums and eventual selection of particular technological solutions) that actually brought about economic change. Schumpeter's theory of "business cycles" and Kondratieff's idea of "long waves" of economic activity leading to clustering of innovations, and, subsequently, the various models of innovation propounded by neo-Schumpeterian evolutionary theorists have enriched the study of how the application of science

TABLE 7
National income and wage for manual work and knowledge work in historical perspective

Mode of production	Nature of the economy	Wage for manual/physical work	Wage for knowledge/symbolic work
Agrarian/feudal economy	Primary/extractive	1	100
Industrial economy	Secondary/manufacture	1	10
Informational economy	Tertiary/service/symbol analysis	0	1

and technology could unleash the wealth of nations in the capitalist economic system.

But what constitutes innovation and how do we create an environment conducive to innovation? It is more or less agreed that a society's or firm's ability to create knowledge is crucial to technological innovation. Technology is essentially society's repository of knowledge regarding industry, agriculture and other productive ventures (Mansfield, 1985). That is, technology is knowledge (Layton, 1974). Knowledge is a cumulative resource that does not diminish when others use it because it is a nonrival and nonexclusive entity. In fact, its value and content are enhanced as it is used more efficiently and effectively. Discovery of new ideas and ways of doing things to solve problems, which is what innovation is all about, enhances the capability of a community or nation to grow economically and socially. This self-reinforcing capacity of a society to produce, reproduce, disseminate, and share knowledge as a public good reaches a critical mass to propel it from a subsistence economy to a dynamic economy that is capable of generating and exporting knowledge-based products and services.

Innovation could be the creation of radically new or better products and processes. It could be the substitution of a cheaper material in an existing product, a cheaper way of producing it, better marketing, or supporting the product or service. It is both a value-adding and value-creating process. It is adaptation of ideas or inventive activities into new and more efficient products or processes. Innovation is an interactive learning process that is rooted in a learning milieu (microfoundation of innovation) formed by the cooperative efforts of various users, producers, and other relevant social actors (Lundvall, 1992). Innovation is about creating useful knowledge through the facilitation of adaptive social systems of innovation such that "learning organizations" are "able to adapt to knowledge" (de la Mothe, 2004). Innovation is about creating knowledge systems based on an algorithm of mixing indigenous, acquired, and learned knowledge. Although creativity plays an important role in promoting innovative activities, the ability to amass useful knowledge is critical. However, knowledge creation and transfer at present involve costs because of knowledge being proprietary (an imposed socially constructed concept and not a "natural" or "manifest" kind), and almost all useful knowledge these days is being enclosed by large corporations and businesses through ratcheting up intellectual property rights claims.

Knowledge has become the key to well-being and alleviation of poverty. Rich nations create most of the technological knowledge and hence are the repository of almost all innovative activities and proprietorial technologies. They have the resources to invest in science and engineering education and in cutting-edge research and development (R&D) activities, and the infrastructure to create knowledge out of knowledge, while poor nations are falling behind at an alarming pace as they lack these resources critical for innovation. As the rich nations create more income by riding the waves of innovation, they are able to create more jobs and economic opportunities and, consequently, accumulate more income and wealth. As innovations yield increased returns to scale, the gap between those nations and regions that are able to innovate and those that are unable to innovate widens.

Now, how do knowledge and innovation increase productivity, wealth, and income? Analytically, the basic assumption is centered on the simple input–output relationship, such that output is a function of independent input variables or factors of production (capital, labor, and knowledge). Productivity is determined by the efficiency with which the input factors are combined. The efficiency of combination of the input factors—tangible (codified knowledge, machines, resources, and people) as well as tacit (knowledge and skills)—is the real measure of technological progress. The key difference between traditional economy products and informational economy products is the difference in the cost function. Because of the increasing unit cost of production beyond certain economies of scale, traditional-economy firms operate in diminishing returns to scale mode. The reverse is the case for informational-economy firms, which are operating mostly in the increasing-returns mode because of diminishing or almost negligible unit cost of (re)production. The increasing-returns economy products have little congealed physical resources, but they have high knowledge intensity. Ironically, increasing returns to scale (nonconvexities) in industries or sectors was considered an anomaly, a crucial aspect of modern economic theory that economists refused to pay attention to because it did not conform to their inherited worldview (Arthur, 1994).[17]

Increasing returns firms and businesses are the integral part of informational capitalism—dominated by computers, information, communication, and bio-informatics technologies. In an increasing returns firm, the marginal cost of production is initially relatively high compared to the marginal revenue (unit product price) because of the high production cost of the first unit such as a software (an operating system such as Windows), hardware (a DRAM), or a bioengineered (patented) drug. In general, the initial design, production, R&D, and marketing costs of these products could be high, but this need not be the case in every instance. The higher initial production cost is not a norm because in many areas of the IT industry, such as open-source software and Internet content development, product development cost is usually very low. However, the high up-front cost is involved only in the production of the first unit or first few units of a product or service. After that, the replication or manufacturing cost (of a CD or software or drug) is rather negligible because of the steep decline in the marginal cost curve, which eventually merges with the supply curve. That is why new-economy (increasing returns) high-tech products are heavy on know-how and light on resources, in contrast to traditional-economy (diminishing returns) products and processes, which are high on congealed physical resources and light on know-how (Arthur, 1998).

The rate of profit for a knowledge economy firm is dependent upon the rate at which it can create new products, based, again, on the rate at which new knowledge (ideas leading to inventions and innovations) is created and how strongly intellectual property rights claims could be established. Thus, in theory, all informational economy firms can reap unlimited profits as long as they can create the demand (through timed obsolescence, shortening product cycles, rapid introduction of new versions, and other marketing gimmicks) and stay in the market. The demand for the informational economy products is further reinforced by lock-in and economy-wide network effects. That is, many high-tech products like PCs, operating systems, software, mobile phones, and so on must be compatible with a network of users. The more users there are who use a product, the better and more rapidly it captures the market share through the network effect. Market instability (markets tilts to favor a product that gets ahead), unpredictability (whether and how long a product stays in the market), and multiple potential outcomes are the other hallmarks of increasing returns products (Arthur, 1998). As Arthur (1998, p. 75) puts it most imaginatively, "Increasing returns are the tendency for that which is ahead to get further ahead, for that which loses advantage to lose further advantage." This is the grim reality of the darker side of digital capitalism that we need to grapple with to square grounded empirical reality in the global economy, where one part (digital economy) appropriates disproportionately more value than the other players. What this shows is that knowledge production is a self-reinforcing cycle that tends to disproportionately reward some and exclude others.

The means by which knowledge-economy (increasing returns) firms create value is through the intensification of intellectual property (IP) rights protection. In a market economy, intellectual property protection does provide incentives for innovation and useful knowledge creation. However, the welfare gain to society due to intensifying IP protection yields diminishing returns due to monopolistic and rent-seeking behavior of the firms. Like too much of all good things, too much IP protection does not reward society (Drahos, 2003).[18] The intensification of intellectual property benefits the owners of the innovations, while society at large suffers welfare loss due to rent-seeking or monopolistic behavior of knowledge economy firms that depend on patents, copyrights, and other IP rights regimes as their source of profit.

The critical economic development problem facing poor nations is the knowledge gap between them and rich nations. This knowledge deficit gets translated into a technology gap. The technology gap that was there historically facilitated the "unequal exchange" between the advanced industrialized nations and the developing countries. According to Sachs (2001), today's world is divided not by ideology, but by technology—a world of technology haves and have-nots. A small part of the globe made up of North America and parts of Europe and East Asia accounts for nearly all of the world's technology innovations and patents granted. Much of the globe is technologically backward or excluded, able neither to innovate nor being able to adopt and adapt new technologies (Sachs, 2001). This is the real face of the digital divide.

CONCLUSION

The contradictory phenomenon of social, economic, and technological exclusion of certain peoples and societies has been an enduring facet of modernization despite the ethos of universality embedded in it. What makes the current social, economic, and technological exclusion—and its contemporary morphing in the form of digital divide—different is the extent to which the exclusion has deepened despite the promised benefits of integrating markets, technology and nation states through neo-liberal economic globalization.

The structural ramifications of informational capitalism on the economies of developed and developing economies are manifested differently. However, the distributional and equity implications are the same. It has been shown that the digital divide, income inequality, increasing returns, and other aspects of informational capitalism are not random or unconnected phenomena, but inseparable parts of it. Any claim that informational capitalism and globalization create only a win–win situation (cf. Friedman, 2000) for all is not borne out by the income, wealth, and new technology distribution in the global economy. While Marshall's diminishing-returns industrial world of bulk processing and mass production of goods involving high congealed resources with low knowledge intensity prevails for most people in the world, Arthur's increasing-returns world of high-tech products and services involving high congealed knowledge and low resource intensity pervades the informational economy of a few. The increasing returns and competitiveness gains unleashed by the information revolution benefits only a few; the majority that is left out of the information revolution suffers a corresponding double loss due to lack of access to (or any tangible benefit from) the knowledge economy and the diminishing returns economy in which it is trapped.

The distributional aspect of informational capitalism harks back to the preindustrial era of feudalism (cf.

Drahos, 1995; Drahos with Braithwaite, 2002). Despite the iniquities and hard times of the industrial era, the Industrial Revolution had a leveling effect on income distribution (between classes) vis-à-vis its much more iniquitous preindustrial predecessor. As industrialism began to give way to informationalism, the income differential between those who do physical ("unskilled") work and those who do mental ("knowledge") work became worse than in the feudal period. Increasing diffusion and adoption of ICTs in the economy results in rapid upskilling of skilled labor, which, in turn, leads to wage hikes for skilled labor due to productivity increase. Unskilled labor that either is slow in picking up new skills associated with ICTs or is unable to be part of the new economy loses the productivity game and suffers relative and absolute wage loss vis-à-vis skilled counterparts. Unskilled labor members get trapped in the traditional ("ghettoized") economy, suffering both a digital divide and diminishing marginal returns to their "outdated" skills. This is because the information revolution that is unfolding in the present global political economic context is, largely, a skill-biased technological change. We have already seen the sinusoidal shaped inequality formation in income and wealth distribution during this historical transition in the empirical data presented earlier.

While information and communications technologies, like any other general-purpose technology cluster, have the potential to benefit all, it is the unfair political economic context within which they are developed, deployed, and diffused that needs to be reformed or better reconfigured for equitable development, constituting a major research question that dwarfs the present one in its complexity and urgency. What is most urgent is to find ways to integrate informational economy with traditional economy in a fair manner such that the asymmetric relationship between the two could be overcome. This would require strategies that employ ICTs for developmental purposes in a meaningful way and do not simply bridge the digital divide in an instrumental sense.

NOTES

1. The digital divide is one of the most misunderstood and misused concepts in the mushrooming discourse on information society. Since the literature on the digital divide is vast, no theoretical discussion of the concept is carried out in this article. However, it may be pertinent to note that the very idea of a digital divide has been progressively constructed into a growth industry by both digital utopians and dystopians. A simple web search can unearth a veritable dot-com industry on the digital divide. A Google web search of the term "digital divide" provided 774,000 hits on19 October 2002, 871,000 hits on 11 February 2003, and 1,960,000 hits on 17 November 2003. There has evolved a huge digital philanthropic enterprise in the past decade or so, with its headquarters in the United States, to transform the digital divide issues into "digital dividends." Smith (2002) identifies this initiative as "digital corporate citizenship."

2. According to Brian Loader (1998), this is precisely due to many information society analysts' proclivity to view technological development as apolitical and outside the purview of political economy. Mark Poster (1997) also questions the modernist attitude to view the Internet like a "hammer," a mere material configuration to do some simple tasks. One must view it, he argues, like "Germany," a socially and politically mediated complex space, rather than as a "hammer," a thing without agency (although human agency is involved in constructing a hammer).

3. I am cognizant of the fact that capital is not cheap in developing countries vis-à-vis developed countries due to higher rental cost consequent to higher real interest rate in the former. The plant cost (part of fixed cost) in developing countries is lower due to the availability of cheaper building materials, land, transportation cost, and so on. Also, sophisticated plant machineries are still sourced and procured overseas for local manufacturing.

4. The rise of "free trade" on a global scale with the rise of the World Trade Organization (WTO) on the global stage in the 1990s is an important event here. The establishment of the WTO saw the strengthening and globalization of the intellectual property rights (IPR) regime through the implementation of such legal instruments as Trade-Related Intellectual Property Rights (TRIPS) and General Agreement on Trade in Services (GATS). For more on the WTO and the ratcheting up of IPR, see Drahos with Braithwaite (2002). The nature of the manufacturing arrangement after the globalization of production took many forms, such as the original equipment manufacture (OEM) contract, whereby the developing country firm would assemble ICTs (such as computers or telecom equipment) for foreign multinational corporations (MNCs) and sell these under the MNCs' original brand names.

5. It is not implied that "knowledge workers" is a homogeneous category. There are different kinds of work involved in the knowledge economy and all are not paid equally well. While on the low end software-code and data-entry and call-center workers are paid low wages, on the high end software engineers, programmers, and chip designers are paid disproportionately higher wages. Call-center work is compared to sweatshop work in term of its long hours and poor work and wage conditions.

6. The bursting of the dot-com bubble and the consequent decline in the fortunes of many "silicon snake-oil" (Stoll, 1995) peddlers should be seen as one of the many contradictory acts of informational capitalism.

7. As mentioned earlier, Kuznets (1955) hypothesized an inverse relationship (U-shaped) between income inequality and per capita GDP.

8. Faced with conflicting empirical evidence, Picketty and Saez are trying to save Kuznets's theory (its relevance beyond 1970s) by inventing an ad hoc hypothesis of the U-curve doubling on itself, a tendency called "saving the phenomenon" (which actually means saving a theory under threat due to inconsistent empirical data) in the philosophy of science. Here is a classic example of saving the phenomenon. Faced with the negative evidence of weight gain when materials were burnt, the supporters of the phlogiston theory of combustion put forward the ad hoc hypothesis (to support their beleaguered theory) that phlogiston had negative weight, an ingenious but improbable claim. In fat, the weight gain was caused by the combining of oxygen with the material that was heated or burned. This paradigm shift from the phlogiston theory of combustion to the oxidation theory of combustion is called the great chemical revolution of the late 18th century, which Kuhn (1970) cites to support his theory of scientific change. For a sophisticated

discussion of ad hoc hypothesis and saving the phenomena, see Hempel (1965).

9. It is important to point out that historically, extreme inequality existed in countries such as Brazil, Mexico, China, and India due to skewed distribution of land and other productive assets. But land reforms (in China and parts of India, in states like Kerala and Bengal), industrialization, and modernization had allowed some from the ranks of the poor to escape semi-feudal living conditions in the rural/agrarian sector.

10. Biased technological change means the change in the production function due to changes in the relative price of the factors of production (capital and labor). Biased technological change can be either labor-saving or capital-saving, depending upon the changes in the marginal rate of technical substitution of labor or capital for each other. Skill-biased technological change means learning investments required by new capital equipment (such as computers) are greater than required for current machines in operation (Caselli, 1999). Skill-biased technological change due to the information revolution reallocates capital from slow- to fast-learning workers (Caselli, 1999). Biased technological change also leads to the substitution of labor with capital with declining capital costs due to advances in ICTs (inverse relationship between the price of computing power and technological change attributed to Moore's law among others).

11. We must note that most of the wealth and income accrued to the owners of the feudal estates as land rent. The number of people in the "knowledge" class was very low compared to the serfs who lived in abject poverty and deprivation. The "knowledge class" was patronized by the landed aristocracy as the serfs were largely incapable or not allowed to seek the services of the knowledge class. I make no claim that this ratio was the same for all feudal societies. What is claimed is that on a global scale, the average of this ratio would be about 1:100. It may have been lower in European feudal societies while higher in China. Although wage differential during feudal times may be difficult to compute, a proxy can be found in the distribution of wealth between the rich and the poor segments (e.g., the top and bottom deciles) in historical terms. For works on income and wealth distribution and studies on standard of living through the ages, see Burnette and Mokyr (1995), Lindert and Williamson (1995), Mokyr (1990), Maddison (1982, 2001, 2003), and Brenner et al. (1991).

12. This is despite the caveat of the Kuznets curve in income distribution during the industrial era. What is important to note here is that the average income inequality across time between feudalism and industrialism would make the former more unequal than the latter.

13. This harrowing phase of British industrialism was eloquently portrayed by Dickens in his numerous neo-realist novels and Marx in his many political economy tracts on industrial capitalism.

14. Again, this ratio is a global average. The United States, which did not have a feudal past but only an agrarian past when industrialization took off, was much more egalitarian than imperial Britain. However, with social democracy making headway in England and other European nations, income inequality declined there in absolute and relative terms. The income differential may have been as low as 1:5 in some countries, while it could have been 1:20 in others. The claim of the global ratio of 1:10 should be taken as an average reference point of departure to compare with the past and the present (and the future of knowledge society?). For excellent studies on income inequality and wage differentials since the industrial revolution in the United States, England, and other European countries, see Brenner et al. (1991), and Lindert and Williamson (1995). For other parts of the world, including the West, see Maddison (1982, 2001, 2003) and Burnette and Mokyr (1995).

15. This is an improbable mathematical expression because it implies the absolute income of the knowledge class to be infinity ($1/0 = \infty$). The binary symbolism highlights the sharp contrast in income rather than the real income.

16. Arthur (1998) describes the unimaginable wealth created by high-technology industries due to increasing returns as akin to casino gambling. Frank and Cook (1995) vividly describe the growth of "winner-take-all markets" in the United States since the onset of informational capitalism nearly two decades ago.

17. This was because most of the central tenets of economics are still based on nineteenth century physics which was again based on Newtonian mechanics. Economic theories are also seen through the lens of entropy law (second law of thermodynamics). Although there were a series of paradigm shift in physics—from Newtonian mechanics to Einsteinian relativity to quantum mechanics and chaos and complexity theories—economists seem to be oblivious to these fundamental shifts. Economics is more of a behavioral social science that is more amenable to chaos and complexity theories than to the laws of physical nature.

18. Plotting IP protection rate on the horizontal axis and welfare on the vertical axis will yield an inverted semicircular curve. The ideal state of IP protection that yields maximum welfare will be in the top middle of the curve. Regions on the extreme left of the curve will lead to free-riding and low welfare, and regions on the extreme right will lead to rent-seeking and low welfare.

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