

Information Technology, Globalization Through Research and Social Development

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Abstract: Globalization of science and technology is an integral aspect of globalization per se. The main engine of globalization is assumed to be the global economy propelled by global trade and technology transfers, the latter as aspects of globalization of science and technology. International trade and technology transfers are the engines that drive global economy. Much has been written on these drivers but relatively little on what drives globalization of science and technology which constitutes the backbone of international technology transfers. I attempt to fill this knowledge gap by suggesting that the drivers behind globalization of science and technology are the emerging global centers of collaborative research and development (R&D). “Science” throughout this article means both science and technology as the two closely related aspects of the same knowledge system.

Keywords: Globalization; Knowledge System; Science and Technology; Research and Development

1. INTRODUCTION

The world is in the midst of a historical transformation at the turn of the millennium. Like all major transformations in history, it is multidimensional: technological, economic, social, cultural, political, and geopolitical. Yet, in the end, what is the real meaning of this extraordinary mutation for social development, for people lives and well-being? And is there a shared meaning for everyone, or must we differentiate people in terms of their specific relationship to the process of social change? If so, what are the criteria for such a differentiation?

There is a raging debate in the world on the mixed record of the information technology revolution, and of globalization especially when we consider their social dimensions on a planetary scale. As is always the case with a fundamental debate, it is most often framed ideologically and cast in simplistic terms. For the prophets of technology, for the true believers in the magic of the market, everything will be just fine, as long as ingenuity and competition are set free. All we need are a few regulatory fixes, to prevent corruption and to remove bureaucratic impediments in the path of our flight to hyper-modernity. For those

around the world who are not ecstatic about surfing on the Internet, but who are affected by layoffs, lack of basic social services, crime, poverty and disruption of their lives, globalization is nothing more than a warmed up version of traditional capitalist ideology. In their view, information technology is a tool for renewed exploitation, destruction of jobs, environmental degradation and the invasion of privacy. Of course, the real issues are not in-between, but elsewhere. Social development today is determined by the ability to establish a synergistic interaction between technological innovation and human values, leading to a new set of organizations and institutions that create positive feedback loops between productivity, flexibility, solidarity, safety, participation and accountability, in a new model of development that could be socially and environmentally sustainable.

It is easy to agree on these goals, but difficult to develop the policies and strategies that could lead to them. Some of the disagreement comes, certainly, from conflicting interests, values and priorities. But a considerable source of current disarray in social and economic policies stems from the lack of a common understanding of the processes of transformation under way, of their origins and their implications.

This paper aims to clarify the meaning of this transformation, particularly by focusing on the processes that are usually considered to be its triggers: the information technology revolution and the process of globalization.

2. THE NEW SOCIO-ECONOMIC SYSTEM: INFORMATION TECHNOLOGY, NETWORKING, GLOBALIZATION

In the last quarter of this century, a new form of socio-economic organization has emerged. After the collapse of statism, in the Soviet Union and throughout the world, it is certainly a capitalist system. Indeed, for the first time in history the entire planet is capitalist, since even the few remaining command economies are surviving or developing through their linkages to global, capitalist markets. Yet this is a brand of capitalism that is at the same time very old and fundamentally new. It is old because it appeals to relentless competition in the pursuit of profit, and individual satisfaction (deferred or immediate) is its driving engine. But it is fundamentally new because it is tooled by new information and communication technologies that are at the roots of new productivity sources, of new organizational forms, and of the formation of a global economy. Let us briefly examine the profile of this new world we are living in, which in fact is shared by all countries despite the diversity of their cultures and institutions.

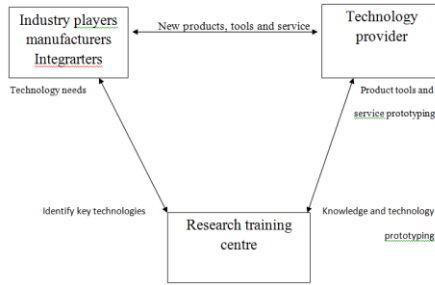
3. INFORMATION AND COMMUNICATION TECHNOLOGY AS A STRATEGIC TOOL

Information technology is not the cause of the changes we are living through. But without new information and communication technologies none of what is changing our lives would be possible. In the 1990s the entire planet is organized around telecommunicated networks of computers at the heart of information systems and communication processes. The entire realm of human activity depends on the power of information, in a sequence of technological innovation that accelerates its pace by month. Genetic engineering, benefiting from this wealth of information processing capacity, is progressing by leaps and bounds, and is enabling us, for the first time, to unveil the secrets of living matter and to manipulate life, with extraordinary potential consequences. Software development is making possible user-friendly computing, so that millions of children, when provided with adequate education, can progress in their knowledge, and in their ability to create wealth and enjoy it wisely, much faster than any previous generation. Internet today used by about

100 million people, and doubling this number every year is a channel of universal communication where interests values of all sorts coexist, in a creative cacophony. Certainly, the diffusion of information and communication technology is extremely uneven. Most of Africa is being left in a technological apartheid, and the same could be said of many other regions of the world. The situation is difficult to remedy when one third of the world is population still has to survive on the equivalent of one dollar per day.

Technology per se does not solve social problems. But the availability and use of information and communication technologies are a pre-requisite for economic and social development in our world. They are the functional equivalent of electricity in the industrial era. Econometric studies show the close statistical relationship between diffusion of information technology, productivity and competitiveness for countries, regions, industries and firms (Dosi et al., 1988). They also show that an adequate level of education in general and of technical education in particular, is essential for the design and productive use of new technologies (Foray and Freeman, 1992). But neither the sheer number of scientists and engineers nor the acquisition of advanced technology can be a factor of development by itself (neither was enough for the Soviet Union see Castells and Kiselyova, 1995), without an appropriate organizational environment.

The crucial role of information and communication technologies in stimulating development is a two-edged sword. On the one hand, it allows countries to leapfrog stages of economic growth by being able to modernize their production systems and increase their competitiveness faster than in the past. The most critical example is that of the Asian Pacific economies, and particularly the cases of Hong Kong, Taiwan, Singapore, Malaysia and South Korea. This is so despite the current financial crisis, which is unrelated to competitive performance and may be related, in fact, to the attractiveness of booming Asian economies to global capital flows. In this regard, what is happening is that regions and firms that concentrate the most advanced production and management systems are increasingly attracting talent from around the world, while leaving aside a significant fraction of their own population whose educational level and cultural/technical skills do not fit the requirements of the new production system.

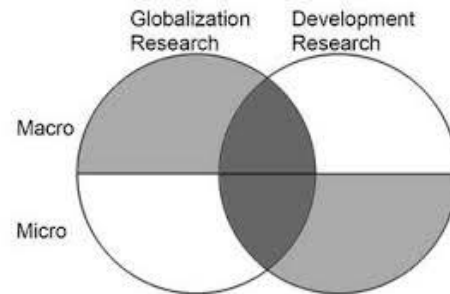


A similar process affects the life chances of individuals. Not everybody should be a computer programmer or a financial analyst, but only people with enough education to reprogram themselves throughout the changing trajectory of their professional lives will be able to reap the benefits of the new productivity. What about the others? It depends on social organization, the strategies of firms, and public policies. But left to market forces, there is an undeniable tendency toward a polarized social structure, between countries and within countries, as I will show below. In sum, information and communication technology is the essential tool for economic development and material well-being in our age; it conditions power, knowledge and creativity; it is, for the time being, unevenly distributed within countries and between countries; and it requires, for the full realization of its developmental value, an inter-related system of flexible organizations and information-oriented institutions. In a nutshell, cultural and educational development conditions technological development, which conditions economic development, which conditions social development, and this stimulates cultural and educational development once more. This can be a virtuous circle of development or a downward spiral of underdevelopment. And the direction of the process will not be decided by technology but by society, through its conflictive dynamics.

4. GLOBALIZATION

There is so much ideology surrounding this notion, and its implications, that it is essential to characterize globalization precisely, and then determine its extent and evolution in empirical terms (see Hirst and Thompson, 1996). Although globalization is multidimensional, it can be better understood starting with its economic dimension. A global economy is an economy whose core activities work as a unit in real time on a planetary scale. Thus capital markets are interconnected worldwide, so that savings and investment in all countries, even if most of them are

not globally invested, depend for their performance on the evolution and behavior of global financial markets.



In the early 1990s multinational corporations employed directly only about 70 million workers, but these workers produced one third of the world's total private output, and the global value of their sales in 1992 was US\$ 5,500 billion, which is 25 per cent more than the total value of world trade in that year (Bailey et al., 1993). Therefore multinational corporations, in manufacturing, services, and finance, with their ancillary networks of small and medium businesses, constitute the core of the world economy. This global economy is historically new, for the simple reason that only in the last two decades have we produced the technological infrastructure required for it to function as a unit on a planetary scale: telecommunications, information systems, microelectronic-based manufacturing and processing, information-based air transportation, container cargo transport, high speed trains, and international business services located around the world.

However, if the new global economy reaches out to encompass the entire planet if all people and all territories are affected by its workings not every place, or every person, is directly included in it. In fact, most people and most lands are excluded, switched off, either as producers, or consumers, or both. The flexibility of this global economy allows the overall system to link up everything that is valuable according to dominant values and interests, while disconnecting everything that is not valuable, or becomes devalued. It is this simultaneous capacity to include and exclude people, territories and activities that characterize the new global economy as constituted in the information age. Similar processes of selective, segmented globalization characterize other critical instrumental dimensions of our society, including the media, science, culture and information at large.

Globalization and liberalization do not eliminate the nation state, but they fundamentally redefine its role

and affect its operation. Central banks (including the new European Central Bank) cannot really control the trends of global flows in financial markets. And these markets are not always shaped by economic rules, but by information turbulences of various origins. National governments, in order to maintain some capacity to manage global flows of capital and information, band together, creating or adapting supranational institutions (such as the International Monetary Fund, the European Union, NAFTA, or other regional co-operation agencies), to which they surrender much of their sovereignty. So they survive, but under a new form of state that links supranational institutions, national states, regional and local governments, and even NGOs, in a network of interaction and shared decision making that becomes the prevalent political form of the information age: the network state. In sum, globalization is a new historical reality not simply the one invented by neo-liberal ideology to convince citizens to surrender to markets, but also the one inscribed in processes of capitalist restructuring, innovation and competition, and enacted through the powerful medium of new information and communication technologies.

5. NETWORKING

No major historical transformation has taken place in technology, or in the economy, without an interrelated organizational transformation. The large factory, dedicated to mass production, was as critical to the constitution of the industrial age as the development and diffusion of new sources of energy. In the information age, the critical organizational form is networking. A network is simply a set of interconnected nodes. It may have a hierarchy, but it has no centre. Relationships between nodes are asymmetrical, but they are all necessary for the functioning of the network for the circulation of money, information, technology, images, goods, services, or people throughout the network. The most critical distinction in this organizational logic is to be or not to begin the network. Be in the network, and you can share and, over time, increase your chances. Be out of the network, or become switched off, and your chances vanish since everything that counts is organized around a worldwide web of interacting networks.

The strength of networks is their flexibility, their decentralizing capacity, their variable geometry, adapting to new tasks and demands without destroying their basic organizational rules or changing their overarching goals. Nevertheless their fundamental weakness, throughout history, has been the difficulty of co-ordination towards a common

objective, toward a focused purpose, that requires concentration of resources in space and time within large organizations, like armies, bureaucracies, large factories, vertically organized corporations. With new information and communication technology, the network is, at the same time, centralized and decentralized. It can be co-ordinated without a centre. Instead of instructions, we have interactions. Much higher levels of complexity can be handled without major disruption. It does not follow, however, that large corporations are being replaced by small and medium businesses, or that multinationals are obsolete. We observe, in fact, the opposite: there is merger mania around the world. Bigger appears to be increasingly beautiful, as Citicorp marries Travelers Insurance, Bank of America leaves its heart in San Francisco but moves its money to North Carolina, Daimler Benz swallows Chrysler, Volkswagen upgrades itself to Rolls Royce status, and American banks digest Asian banks and financial corporations, in a historical revenge of the West against the high-growth areas of the Pacific. But the concentration of capital goes hand in hand with the decentralization of organization.

Large multinational corporations function internally as decentralized networks, whose elements are given considerable autonomy. Each element of these networks is usually a part of other networks, some of them formed by ancillary small and medium businesses; other networks link up with other large corporations, around specific projects and tasks, with specific time and spatial frames. Yes, ultimately all this complexity boils down to the need to assure a profit. But how, and for whom? Once CEOs have served themselves, lavishly, there is still most of the capital to be distributed among increasing numbers of shareholders. Earnings do not remain in the firm (whether dedicated primarily to manufacturing, finance, or services): they are invested in the global casino of inter-related financial markets, whose fate is ultimately determined by a series of factors. Only some of those factors have to do with economic fundamentals..

7. Links between Informational Capitalism and the Growing Social Crisis

These, however, are simply observations of a growing social crisis (and not exempt from controversy concerning the selection and interpretation of data). What does the analysis mean? What is the relation of these trends, if any, to the structure and dynamics of informational, global capitalism? First, the extreme social unevenness of the process is linked to the flexibility and global

reach of informational capitalism. If everything, and everyone, who can be a source of value can be easily connected and as soon as he/she/it ceases to be so, can be easily disconnected (because of individualization and extreme mobility of resources) other the global system of production is populated simultaneously by extremely valuable and productive individuals and groups, and by people (or places) who are not, or are not any longer considered valuable, even if they are still physically there. Because of the dynamism and competitiveness of the dominant system, most previous forms of production become destructured, and ultimately phased out, or transformed into subdued tributaries of the highly integrated, dynamic, globalized system. Second, education, information, science and technology become critical as sources of value creation (and reward) in the informational economy. While formal education has increased throughout the world, the quality of education becomes essential.

Most public schools, both in developing countries and in the United States, are simply not up to the task of producing the new, informational labour force. But even in countries with a decent educational system, the overall cultural and technological environment that is required to exercise informational skills does not mirror the dynamism of the system. So lack of education, and lack of informational infrastructure, leads most of the world to be dependent on the performance of a few globalized segments of their economies, increasingly vulnerable to the whirlwind of global financial flows. Third, as new technologies, new production systems and the organization of international trade eliminate traditional agriculture (still employing two-thirds of the people in the world in this end of millennium), a rural exodus of gigantic dimensions is being propelled particularly in Asia. Rural people are destined to 9 Information Technology, Globalization and Social Development be painfully absorbed into the informal economy of overcrowded megacities on the edge of ecological catastrophe. Fourth, since states are bypassed by global flows, disciplined by the enforcers of these flows (such as the IMF), or limited by the supranational institutions they have initiated to survive somehow in the midst of globalization, welfare states come under attack, regulations break down, and the social contract, wherever it has existed, is fundamentally challenged. New technologies do not induce unemployment, as has been repeatedly demonstrated by empirical research (Carnoy, 1999). Indeed, at the world level there is a massive creation of jobs but, in most cases, under conditions of overexploitation: the most telling development is the employment of about 250 million

children at the time work is supposedly ending. But there is unemployment in Western Europe when firms facing tight labour rules, high wages, and generous social benefits refuse to create jobs.

8. THE FOURTH WORLD

This world is composed of people, and territories, that have lost value for the dominant interests in informational capitalism. Some of them because they offer little contribution as either producers or consumers. Others because they are uneducated or functionally illiterate. Others because they become sick or mentally unfit. Others because they could not afford the rent, became homeless, and were devoured by life in the streets. Others who unable to cope with life became drug addicts or drunks. Others because, in order to survive, they sold their bodies and their souls, and went on to be prostitutes of every possible desire. Others because they entered the criminal economy, were caught, and became inhabitants of the growing planet of the criminal justice system (almost 3 per cent of adult males in the United States). Others because they had an incident with a cop, or a boss, or some authority and got onto the wrong track. And places, entire places become stigmatized, confined by police, bypassed by networks of communication and investment. Thus, while valuable people and places have been globally connected, devalued locales become disconnected and people from all countries and cultures are socially excluded by the tens of millions. This fourth world of social exclusion, beyond poverty, exists everywhere, albeit in different proportions from the South Bronx to Mantes-la-Jolie, from Kamagasaki to Meseta de Orcasitas, and from the favelas of Rio to the shanties of Jakarta. And there is, as I have tried to show, a systemic relationship between the rise of informational, global capitalism, under current conditions, and the extraordinary growth of social exclusion and human despair.

9. Conclusion

We are living in a globalizing age where everything, almost everything, from politics to crimes, cultures, economies, the environment, knowledge, and knowledge transfers are becoming increasingly interconnected on a scale unprecedented in human history. Starting with science and technology as the driving forces for economic globalization—a topic much discussed in my earlier works, the focus in this paper shifted to what may constitute the drivers behind globalization of science technology themselves; that is, the ever-increasing networks of collaborative research and development (R&D)

activities among scientific institutions and workers spread across the world. The policy implications for world governments, nongovernmental economic development agencies, and the United Nations should be obvious in view of these unsettling scenarios of the future of globalization of R&D, information technology, the economy, and worldwide positive social change to lift all boats

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