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Technology, Inequality, and Underdevelopment: The Case of Latin America

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The conventional wisdom is that the best way to alleviate poverty is to provide the maximum freedom for individual entrepreneurs and corporations to create wealth. Drawing on the case of Latin America, this article contends that there are serious defects in analyses based on such assumptions. New technologies and restructuring of international capitalism have accelerated wealth creation worldwide but amid growing inequalities. Technology is mainly controlled by large multinational corporations and not directed at relieving the deprivation suffered by the world's poor. Pervasive, persistent economic inequality and lack of access to appropriate education and training have all been significant in Latin America's failure to develop rapidly during the twentieth century. Most successful "latecomer" countries in the past two hundred years have adopted heterodox autonomous growth strategies, and the authors suggest that such strategies are necessary now to counter the powerful processes that sustain inequality.

Economic Growth and Inequality: Some Significant Trends

Undoubtedly, economic growth can be beneficial: the poor and the poorest benefit from wealth creation eventually because of the trickle down of wealth and income from the rich, although this may result in massive inequalities. The decisions of firms are dominated by the desire to secure profits from the satisfaction of consumer demand. It can be argued that the best way to alleviate poverty is to foster conditions that encourage individual entrepreneurs and corporations to create as much wealth as possible as quickly as possible. It has been suggested that any restraints on entrepreneurs and corporations that inhibit them from pursuing competitive advantage are liable to

restrict growth in wealth and income and act against the interests of the poor among others (for example, see Organization for Economic Cooperation and Development [OECD] 1997).

Meeting the demands of the relatively rich does indeed provide significant employment and income to some of those who are relatively poor. The creation of mass markets gives opportunity for the use of technology to produce high-quality goods at low prices, which often benefit quite poor people (for example, mass-produced clothing at prices relatively poor people can afford). Nevertheless, the distribution of income and wealth in the world is very unequal, both between countries and continents and within them. Moreover, inequalities have increased during the past two decades in a high proportion of regions in the world.

Since the 1980s, inequalities have grown in many countries. Some of the countries of eastern Europe and the former Soviet Union have seen the Gini coefficient that measures inequality growing rapidly, and inequality has increased in the rich OECD countries, particularly in the United Kingdom, United States, and Sweden (United Nations Development Program [UNDP] 1999, 39). In 1960, the average income of the 20 percent of those living in the rich countries was thirty times the average income of the 20 percent living in the poorest countries; in 1997, it was seventy-four times (UNDP 1999, 3).

Such trends are closely related to science, technology, and education:

Existing research indicates that the comparative advantage of developed countries is derived both from their relative abundance of skilled labour and their technological advantages. . . . Since the 1980s wage inequality has risen within developed countries: wages for highly skilled and educated workers have risen relatively while employment prospects for low-skilled workers in manufacturing particularly have worsened. (Held et al. 1999, 185)

Although average world per capita income grew at an average of 2.4 percent per annum, about a billion people still lack the resources to meet their most elementary needs, and in several countries, the average income is less than it was in 1970 (UNDP 1999, 22, 36). Many human beings live very "short and precarious lives," particularly in South Asia and sub-Saharan Africa, where undernourishment and illiteracy are appalling (Sen 1999, 99-103). Indeed, one of the principal findings of the UNDP research on human development is that poverty is generally more widespread in more unequal societies, and, as shown below in the case of Latin America, inequality can represent a major obstacle to development.

While conventional wisdom based on neoclassical economic thinking assumes that consumer wants and desires dominate the direction of technological

change, it is important to take into account that capitalists and governments also exert powerful influences that are at least partially independent of consumer demand.

Corporations are directed by individuals or small groups of people. Accordingly, they vary considerably in terms of the determination, intelligence, and sometimes ruthlessness with which they pursue their goals (Senker 2000). However, the principal aims of all multinational corporations include making profits for their shareholders, and they seek large markets because these offer the most profitable opportunities. The largest markets are offered by richer people because they have more buying power: most large markets are offered by the relatively affluent populations who live in advanced industrial countries. A high proportion of the research and development (R&D) carried out in the world is directed by large multinational corporations based in the United States, Japan, and western Europe. "MNCs [multinational corporations] play a major role in the generation and international diffusion of technology, accounting for around 80 per cent of world trade in technology and the majority of private research and development" (Held et al. 1999, 236). In 1997, more than 70 percent of R&D in Japan and the United States was performed by the business enterprise sector and more than 60 percent in all the European countries for which there are data (OECD 1999, 22). Understandably, therefore, most R&D is directed toward creating and satisfying large markets in rich countries.

Whiston (1993a, 1993b) pointed out that 95 percent of R&D is concentrated among northern (OECD) countries and that the vast majority of this R&D expenditure is directed toward meeting the needs of those nations. Research needed to better meet the basic needs of the majority of the world's population in areas such as food, agriculture, and shelter is grossly neglected (Whiston 1993a, 1993b).

"Technology is created in response to market pressures—not the needs of poor people who have little purchasing power" (UNDP 2001, 3). Also,

turning technology into a tool for human development often requires purposive effort and public investment to create and diffuse innovations widely. Investment in creating, adapting and marketing products that poor people can afford or need is inadequate because their incomes are too low and do not present a market opportunity for the private sector. (UNDP 2001, 43)

R&D is concentrated in rich countries,

led by global corporations and following the global market demand dominated by high-income consumers. In 1998, the 29 OECD countries spent \$520 billion

on research and development. . . . OECD countries with 19% of the world's people also accounted for 91% of the new patents issued in 1998. (UNDP 2001, 3)

Furthermore, R&D

is concentrated in fields where it is thought likely to open up big markets in developed countries—for example to produce better cosmetics or slow ripening tomatoes—rather than in those which would benefit developing countries such as anti-malarial vaccines or drought-resistant crops for marginal lands. In summary, money speaks louder than human needs in determining the world's R&D agenda. (UNDP 1999, 68)

The share of developing countries in global R&D actually fell between the mid-1980s and the mid-1990s—from 6 percent to 4 percent (UNDP 1999, 67). There is little or no R&D in most poor regions. Without well-developed R&D capabilities, backward regions find it difficult to gain from advanced technology developed elsewhere. An adequate infrastructure including high-quality labor and higher education institutions are prerequisites for undertaking R&D, and these also are generally lacking in poorer regions (Fagerberg, Verspagen, and Caniëlis 1997).

Education, training, science, and technology are all very unevenly distributed through the world. This tends to increase the gap between the relatively affluent and the poor, both within regions and between them. That trend is also reinforced by North-South economic relations. While markets for goods and services are becoming increasingly globalized—especially in relation to information and communications technology (ICT)—international trade, investment, and financial flows are concentrated in Europe, Japan, and North America, and this dominance seems likely to continue.

Real commodity prices in the 1990s were much lower than in the 1980s. The terms of trade for the least developed countries have declined substantially over the past twenty-five years. Average tariffs on industrial country imports from the least developed countries are much higher than the global average. Developing countries lose about \$60 billion a year from agricultural subsidies and barriers to textile imports in industrial countries. The Uruguay Round (of tariff reductions) left most of the protection for industry and agriculture in industrial countries intact. Tariffs are much higher for the goods with the greatest potential for the poorest countries such as agricultural commodities, textiles, and leather. The United States and the European Union have applied antidumping measures against a wide range of developing country exports—from steel to color television to toys. There is little enthusiasm for removing the bias in the rules of international trade in favor of

industrialized countries in relation to barriers to international trade. Two-thirds of foreign direct investment in developing countries has gone to only eight countries, and half of developing countries have received hardly any foreign direct investment at all (UNDP 1997, 9).

With the exception of a small minority of newly industrializing countries, the Third World remains marginal in respect to both investment and trade: capital mobility is not producing a massive shift of investment from advanced to developing countries, and labor mobility between countries and regions is very low (Hirst and Thompson 1996, 2-6 ; Castells 1996, 95; Waters 1995, 93).

Social and Geographical Divisions

The prevailing trends of technological and economic change sustain two important divisions, broadly speaking:

1. Between the centers of the knowledge-based and innovation-driven global economy and the other regions: The centers are the old and new advanced countries (the "North") where most R&D is carried out and applied, where economic power is concentrated, and where the human development indices (HDI) are higher; the other countries (the "South") include highly differentiated regions, with high, middle, or low HDI. These countries suffer from economic dependency and from their inability to use advanced education, science, and technology as engines of economic growth.
2. Between people incorporated in the dynamic global economy and the rest of the world population: Castells (1996) presented this dichotomy as follows:

The prevailing model for labour in the new, information-based economy is that of a *core labour force*, formed by information-based managers and by those whom Reich calls "symbolic analysts," and a *disposable labour force* that can be automated and/or hired/fired/offshored, depending upon market demand and labour costs. (P. 272)

Combining both dimensions, we see a world upper class living mainly in the North, various intermediate sectors, and a world lower class of socially excluded people:

They are the majority in some areas, the minority in others, and a tiny minority in a few privileged contexts. But, everywhere they are growing in number, and increasing in visibility, as the selective triage of informational capitalism, and the political breakdown of the welfare state, intensify social exclusion. In the current historical context, the rise of the Fourth World is inseparable from the rise of informational, global capitalism. (Castells 1999, 165)

Global technical changes do offer new opportunities, but it also poses new threats for people in less favored circumstances—especially for people living in the South. This issue is explored further below and subsequently illustrated by the case of Latin America.

New Technologies, Globalization, and Developing Countries

Having developed products and production processes to stimulate and meet the needs of the largest markets in developed countries, multinational companies then try to create and satisfy markets for those products and processes in developing countries. The principal products manufactured and marketed by multinationals worldwide include computers, telecommunications systems, aircraft, cars, the vast majority of pharmaceuticals, electricity power stations, and other capital goods such as machine tools, as well as consumer goods such as hamburgers and Coca-Cola. The vast majority of such products were developed originally to meet markets among the more prosperous people in developed countries. Where R&D was needed to create these products, it was mainly carried out to meet the needs of markets in developed countries. Marketing and public relations include attempts to persuade governments and international organizations to create the best conditions in which those products and processes can be sold. Multinational corporations also try to persuade international organizations to lower the tariffs confronting those products and processes when they are exported to other countries, including developing countries. Further specific examples are given below of multinational corporations' marketing to developing countries' products that were originally designed for developed countries' markets.

ICTs

The development, application, and use of ICTs have stimulated economic growth in numerous countries throughout the world. In advanced regions such as the European Union, the ICT industry has accounted for most of the recent growth in employment of highly skilled workers (Directorate of Employment and Social Affairs 1999, 1-2). In 1995, the developed world accounted for more than three-quarters of world ICT production. There are substantial markets and job opportunities emerging in the manufacture and use of ICT products, which include telecommunications equipment,

computer defense and transportation electronics, factory automation, and electronics products for use in home, office, and car.

Low transport and communications costs make it economically viable to relocate some ICT production processes to developing countries. As a consequence, demand for skills has been growing rapidly in high-technology electronics production in East Asia where the production and use of ICTs have been one of the most important means of achieving competitiveness and growth (International Labour Office [ILO] 1998, 33-41). Globalization also encompasses trade liberalization, the removal of nontariff barriers, and the leveling of tariff rates and involves increasing freedom of capital to move across national boundaries. Direct investment flows are generated increasingly by firms' shifting production across national boundaries to locations that are most cost effective and profitable. Conversely, ICTs have played major roles in the globalization of financial markets: they have been used to reduce the costs of communication and increase its speed. The communications costs involved in financial markets are now so low that financial transactions can, in principle, be carried out anywhere in the world that has a modern telecommunications infrastructure. In an era of low costs of communications and movement of goods, competition between various locations is intensified. Intensification of international competition has been stimulated by rapid growth in world trade and international investment flows, and this stimulates further diffusion of ICTs by putting pressure on corporations to cut their communications costs still further (ILO 1998, 12, 33).

Software markets seem to offer particularly attractive prospects for developing countries, as the world market for software is large and growing rapidly. Several developing countries including Chile, India, Singapore, and Taiwan have entered low-value segments of the international software export market with the expectation that cheap labor would help them to secure competitive advantage (Millar 1998). Claims processing, electronic publishing, secretarial work, airline ticketing, and customer support are examples of applications being undertaken by developing countries for corporations in advanced industrial countries. Taking advantage of excellent telecommunication and low wages, the Eastern Caribbean carries out computer work such as data entry for many U.S. companies. India's output of ICT products, especially software, has increased dramatically in the past decade (UNDP 1999, 61): revenues increased from \$150 million in 1990 to \$4 billion in 1999 (UNDP 2001, 3). Production of software requires abundant resources of sophisticated skills, which India possesses as a consequence of its heavy investment in education (ILO 1998, 128-29).

Although developing countries only account for a quarter of world ICT production, they have been increasing their share, especially in consumer

electronics where they produce nearly half of world production. Local production of both hardware and software has been made possible through the availability of a few highly educated and trained engineers supported by a small skilled workforce.

ICTs have played major roles in reduction of poverty in the tiger economies of Singapore, Hong Kong, Taiwan, and South Korea. But advanced countries still dominate production and use of higher value-added ICTs, and examples of economic success in developing countries are exceptional and very small in scale in comparison with the extent of world poverty. Moreover, ICTs are not the most important technologies for developing countries. "Information is only one of many needs. E-mail is no substitute for vaccines and satellites cannot provide clean water" (UNDP 1999, 59).

More important for the future is perhaps the fact that ICTs expand the type of occupations that can be assigned to what Castells called the disposable labor force, composed of less highly educated people who tend to be the vast majority of the economically active population in the South. For example, more than 80 percent of the new jobs in Latin America belong to the informal sector, where employment is fragile and working conditions are usually very hard.

Agriculture, Health, and Biotechnology

Since the mid-twentieth century, a group of agricultural technologies has been developed and marketed successfully worldwide by large corporations. These technologies include uniform high-yield variety crops, mechanical and energy inputs, and synthetic chemical pesticides—the principal means of controlling pests, especially on commercial crops. Agricultural genetic engineering is now part of this package encompassing international legislation and trade restrictions designed to tighten corporate control over food production. Predominant agricultural development patterns and technologies have resulted in ill effects from use of agricultural chemicals, water depletion, and erosion of soil and genetic resources. These impacts raise costs to agricultural producers and undermine their profits. Despite yield increases, millions of people still go hungry (Corner House 1998).

Corporations have lobbied governments in favor of chemical-intensive approaches, mainly developed originally to supply markets in developed countries. In many countries, this chemical dependency has been encouraged by government incentives such as tax subsidies and by agricultural credit policies that require farmers to use prescribed chemicals. Although some pesticides can help raise productivity, their continued use has had several severe

adverse ecological and socioeconomic effects. Farmers' costly inputs of chemicals become ineffectual and self-defeating as a consequence of pest resistance. Many pesticides harm human health. The technologies do not meet farmers' needs and local conditions in the risk-prone diverse environments where most of the world's rural people live (Thrupp 1996, 1-7).

Over the past thirty years, commercially bred hybrid seeds have increasingly been bought by farmers from seed merchants. In northern parts of the world, almost all farmers use them. In southern countries, although non-hybrid crops are commonly used by smallholders for growing vegetables and staple foods, hybrid seeds have become the norm for many grain crops. Hybrids do not breed true in the second generation; they are either sterile or their seed is not uniformly like the parent seed, and thus there is a reduction in overall performance when hybrid seed is saved and replanted. In northern countries, many farmers no longer use farm-saved seeds—partly because of lower yields but also because of the insistence of food processors and retailers on crop uniformity (Corner House 1998).

Biotechnology is now increasing rapidly in significance. It is unlikely that poorer countries will benefit disproportionately in terms of employment: indeed, such trends as it is possible to discern indicate that advanced countries may well benefit at their expense. The Third World's need for new pharmaceuticals such as diagnostics and vaccines is widely recognized, but nobody yet knows how such developments could be financed (Senker 1992). Genetic engineering in agriculture is motivated by the aim of securing profits from rich markets in the developed world rather than by any drive to feed the hungry. Research has been directed at meeting the commercial needs of food processors rather than the nutritional needs of poorer people. For example, Monsanto's high-starch potato has been developed to make commercially grown potatoes more suitable for the deep-fry vats of northern fast food outlets, not to be a better or cheaper food. A leading U.S. chemical industry analyst has been scathing about claims made by the United Nations, chemical companies, and scientists that genetically modified (GM) crops will alleviate hunger in developing countries. "Let's stop pretending that we face food shortages. There is hunger but not food shortages. GM food is for the rich world. The money from GM is in developed countries" (Vidal 2001). Few of the foods produced so far or being researched and developed are foods that the hungry can afford. Moreover, the high costs of genetically engineered crops are likely to squeeze many small farmers out of business, with the result that fewer people will be able to grow or pay for the food they need (Corner House 1998).

Genetic engineering is being used to increase poor people's dependence on the corporate sector for seeds, agricultural inputs, and produce,

reinforcing farmers' dependence on chemical herbicides and fertilizers. Like the green revolution of the 1960s and 1970s, it is liable to set in train the further evolution of plants and insects resistant to the chemicals, resulting in unprecedented pest outbreaks and weed problems. At the same time, it is likely to reduce crop biodiversity, to trigger crop failures, and to cause ecological degradation, thereby exacerbating food security for the poor.

A further threat posed by genetically engineered crops to the livelihoods of small farmers arises from attempts by the industry to deny farmers the possibility of saving seeds from previous harvests, forcing them to buy their seeds annually from seed companies. Companies are trying to prohibit farmers from saving seed for their own use. When farmers buy seed engineered to be tolerant to proprietary herbicides, they have to sign contracts stating that they will not save any transgenic seed for the next year's planting (Lappé 1985).

There have recently been widespread protests against such policies, and they may have some effect. For example, Monsanto appears to have bowed to pressure to renounce the "terminator" plant technology that had led to accusations the company was trying to dominate world food supplies by forcing farmers to buy fresh seed from it each year. Monsanto made a public commitment not to commercialize sterile seed technologies such as the one dubbed "terminator" (Brown 1999).

Several multinational companies are at present exploring and seeking to exploit the biodiversity of the developing world. In particular, they are seeking to exploit the potential of the active ingredients of plants used in traditional herbal medicine. Through patent protection, they seek to appropriate traditional remedies for exploitation in developed countries that offer the most profit potential and try to prevent people in the developing world from using their traditional remedies. The neem tree, which yields natural pesticides and medicines and which has been used by Indian villagers for more than two thousand years, is a prime example. Chewing neem tree shoots protect teeth from bacteria. Indian cottage industries have been selling neem products for forty years, and Calcutta Chemicals has been selling neem toothpaste for decades. Since 1985, however, several patents have been taken out by U.S. and Japanese companies for exclusive rights to neem tree products. Such patents are supported by a multilateral agreement on intellectual property—Trade-Related Aspects of Intellectual Property Rights (TRIPS)—that came into effect under the World Trade Organization (WTO), which was established in 1994. The Neem Campaign was initiated in 1993 in India to mobilize worldwide support to protect the neem tree from piracy by Western and Japanese companies using property rights regimes established under WTO and TRIPS (UNDP 1999, 67; Shiva 1997).

Like companies operating in agricultural markets, pharmaceuticals companies are also mainly interested in large, profitable markets, and these are most readily secured by developing and marketing treatments for the illnesses prevalent in the developed world. While 18 percent of the global disease burden is accounted for by pneumonia, diarrheal diseases, and tuberculosis, mainly in developing countries, only 0.2 percent of the world's health-related R&D is devoted to developing treatments for these diseases (UNDP 1999, 68).

In summary, we can see that privatization of knowledge is one of the most urgent problems of our time.

Employment and Education

The principal trends in techno-economic change favor, in general, highly educated people. Indeed,

benefits of intensified competition and accelerated learning are growing productivity, lower prices and a higher level of consumption. . . . In newly industrialised areas there may be quite dramatic increases in per capita consumption especially for the well-educated segments of the labour force. (Lundvall 1998, 5)

The rise of a knowledge-based economy strengthens a well-established relationship:

Not only in the advanced world, but also within third world countries, it has been shown in countless studies that more educated people receive higher earnings. The robustness of this relation between education and earnings, the world over, is impressive. (Ashton and Green 1996, 57)

Moreover, poor people in the North, especially those engaged in low value-added manufacturing sectors and processes, suffer from erosion of demand for their services. For some, this results in pressure from employers to reduce their wages still further; for others, it results in unemployment. As quality standards rise in global markets, some of the poorest and least well-educated people in the South who have previously found work are no longer able to do so.

In the past decades, important, innovative efforts to improve education and training have been made in many developing countries. As a result, while in 1965 less than half the adult population in those countries was literate, that rate rose to 70 percent in 1995; also, "in 1995 more than 47 million students were enrolled in higher education in the developing world, up from nearly 28

million in 1980" (World Bank, United Nations Educational, Scientific, and Cultural Organization 2000, 27). Nevertheless, the higher education "enrollment rate in industrial countries has remained roughly five to six times that of developing countries" (World Bank, United Nations Educational, Scientific, and Cultural Organization 2000, 26, 27). This gives rise to the possibility of a worrying trend: "The gap between industrial and developing countries in per capita incomes and standards of living will widen unless the corresponding gaps in knowledge and access to knowledge are successfully addressed" (World Bank, United Nations Educational, Scientific, and Cultural Organization 2000, 34).

This analysis suggests that inequality now generates inequality in the new knowledge-based economy to a greater extent than in previous eras. Inequality is a very significant factor retarding Latin America's development—a factor that is deeply rooted in history of the region. This issue is considered further in the next section.

Latin America in the Twentieth Century

In this section, we point out some reasons for understanding why inequality has fostered underdevelopment in Latin America, without attempting to give a general explanation of Latin America's inability to close the gap relative to the "North," as this would be outside the scope of a short article.

Two interrelated features have characterized the "Latin American style of development" (Fajnzylber 1983):

1. Income inequality is remarkably high, and
2. few people can secure productive jobs and benefit from technical progress.

These features are deeply rooted in history and are mutually reinforcing. The persistence of income inequality is a significant factor in understanding why Latin America failed to develop rapidly during the twentieth century (Arocena 1998; empirical support for this can be found in Arocena 1997; Bethell 1991; Economic Commission for Latin America and the Caribbean 1990; Fajnzylber 1983; Halperin Donghi 1988; Katz and Bercovich 1993; Lingarde and Tylecote 1998; Sábato and Mackenzie 1982; Sutz 1997, 1998; Thorp 1998; Villaschi 1994).

During the last half of the nineteenth century, an outward-oriented period of growth started in Latin America, based on the export of raw materials to emerging industrial nations. Unlike the Japanese ruling classes, the so-called oligarchic order in Latin America concentrated the resulting large surplus in

the hands of small traditional elites who imitated the consumption patterns of European upper classes, rather than seeking to enhance their countries' education technology and production.

In 1900, the roles of Scandinavia and Latin America in the world economy were somewhat similar—based on primary exports to the industrialized countries. But income distribution in Scandinavian countries was more equal, and cultural traditions were relatively favorable toward technology. Such factors enabled those countries to use the surplus from their external trade to develop internal markets for their products, to build up manufacturing capacity, and to foster types of technical progress adapted to the needs of peasants and cooperatives. In this sense, equality fostered equality.

The great world crisis of the 1930s led Latin America into a new period of inward growth based on import substitution industrialization (ISI). There were some tendencies to diminished inequality during this period, when the oligarchic order ended. The following were among the causes of this: the progress of democracy that weakened state control by small elites, expansion of the economic and social role of the state, growth of the working class and of trade unions, and the diminished influence of foreign enterprises.

Those processes contributed to the expansion of internal markets, to the development of national manufacturing firms, and to some improvement in education and in technological capabilities.

Public agencies played a crucial role during the ISI period, developing the scientific and technological infrastructure, training human resources, and designing and financing the erection of large-scale production facilities.

Thus, during the decades following 1930, diminishing inequality was positively correlated with development.

But strong traditional elites fought against ISI policies. Traditional cultural attitudes placed low value on technology, and such attitudes persisted. As a consequence, states did not firmly back the upgrading of technological capacities and industrial activities needed to facilitate the production of capital goods. Firms were not well oriented toward innovation activities. The industrialization process was not able to sustain itself; it depended on permanent high protection and on growing imports of machinery and technology.

Nevertheless, economic growth in the best years of the ISI period was relatively rapid. In the 1950s, it was widely believed that there were very good prospects for development in some countries in Latin America.

It is often forgotten today that in the 1950s the prospects for growth in Latin America seemed far more favourable than those in Asia. United States investment was substantial and the levels of industrialisation were well above those in Asia. Argentina was regarded as already almost “developed” or industrialised

and per capita incomes generally were much higher in Latin America. (Freeman 1996, 162)

In the late 1950s and early 1960s, industrialization failed to reach a point at which it was self-sustaining, and many Latin American countries fostered foreign investment as means of securing capital and know-how. Most notably in Argentina and Brazil in the 1960s, foreign investment was highly favored. Military governments encouraged multinational corporations to establish industrial plants where consumer durables were manufactured to be sold in the internal markets of those countries. While in the United States or West Europe such products could be bought by many people, in Latin America only a comparatively small wealthy segment of the population could afford them. This restricted expansion of the internal market for manufactured consumer durables, and the expansion of manufacturing employment, accordingly, did little or nothing to reduce inequality. Thus, the expansion of the internal market for industrial products was related to favoring that sector. The military governments of the period adopted such policies, and the trend to reduction of inequality was reversed. This applied particularly to Argentina, which had been the most advanced Latin American economy during the first half of the century and where inequality had been sharply reduced in the 1940s and 1950s.

Industrialization produced by inward investment and by internal consumption of expensive products could only be sustained in Latin America in a period when external funding was easy to obtain. This came to an end with the debt crisis of the 1980s. Latin American GDP annual growth rate declined to 0.5 percent in the 1980s—in contrast to East Asia where it averaged 6.3 percent.

That was the “lost decade” of Latin America: per capita production in 1990 was less than in 1980, and poverty was much more widespread. The period of inward growth was over. New outward-looking strategies were adopted; a significant amount of exports was dedicated to servicing the debt. Now, exports were promoted by what the Economic Commission for Latin America called “spurious competitiveness,” based on low wages, an unqualified labor force, and irresponsibility in relation to natural resources and the environment.

The 1990s was the decade of structural adjustment, promoted by the so-called Washington Consensus (Williamson 1997) of the international financing institutions; the main actions were oriented to open up economies, to privatize publicly owned firms, and to reduce the role of the state. In this process, public R&D structures were frequently dismantled, and very valuable capabilities were lost. Policies that aimed to favor endogenous generation of

knowledge were reversed, and now techno-economic change is shaped principally by multinational corporations.

A new wave of external funds came to countries whose policies had been shaped by the Washington Consensus and where high interest rates and low prices of public assets attracted foreign investors. Money flowed in and out, as in Mexico in 1995 or in Brazil in 1999, but nevertheless a new period of growth started, albeit with fluctuations. This growth is based on natural resources, on commodities, and on products with little domestic added value; on external investment; and on high consumption, not on the knowledge-based, most dynamic activities of contemporary economies. So, economies have become fragile and unable to sustain human development. It was widely suggested around 1990 that poverty and inequality in Latin America were a scandal: the situation has hardly changed since then.

In sharp contrast with countries that have achieved sustainable economic growth, the great majority of the Latin American population find it very difficult to gain access to advanced training and to formal education at secondary and tertiary levels. Consequently, they are deprived of access to formal modern jobs and to opportunities that could be offered by the use of new technologies. "In a knowledge-based and innovation driven economy, accumulation of knowledge is the name of the game" (de la Mothe and Paquet 1996, 23). When individual and collective accumulation of knowledge is small, it is very difficult to escape from poverty, so inequality sustains inequality.

In the developing world as a whole and in Latin America, economic change continues to be stimulated in directions that represent a continuing process of favoring already affluent people. The high levels of economic inequality that prevail in Latin America serve to lock the continent out of the emerging knowledge society.

Conclusions

Widening inequalities on a world scale, the domination of the R&D agenda by multinational corporations based in the industrialized world, and inadequate education and training in developing countries are powerful forces that tend to restrict the use of science and technology to alleviate world poverty. The worldwide system of knowledge generation and use of knowledge is embedded in a dynamic process that favors those people with relatively good education and high-level skills who live in the world's innovation- and information-rich economies. As time passes, numerous countries, regions, and individuals have escaped, and more will continue to escape, from the vicious circle of exclusion from information- and innovation-rich

parts of the world economy. While this “trickle down” is very significant, it is insufficient to overcome the stronger forces that sustain worldwide inequalities in many countries and regions. International bodies such as the World Bank and the International Monetary Fund promote the view that there is “one best way” to promote development. However, most successful late-comer countries in the past two hundred years have adopted heterodox autonomous growth strategies. To counter the powerful processes leading to inequality necessarily involves opposing the forces sustaining orthodox economic policies.

“The huge divergence in growth rates which is so obvious a feature of long-term economic growth over the past two centuries must be attributed in large measure to the presence or absence of social capability for institutional change” (Freeman 1999, 110). Very important institutional changes are needed today, in countries in the South, in the North-South relations that include the role of the international financing institutions, and in the world R&D agenda.

In particular, high-quality postsecondary education and training together with science and technology capabilities would have to be more evenly distributed between countries. Stronger efforts to reduce inequalities and a new commitment to endogenous generation of knowledge by and for the South would also be needed. Local movements, cooperatives, and trade unions are usually strongly in favor of such goals, and their involvement could be expected to represent powerful forces contributing toward their realization.

We have outlined some patterns of worldwide technological development. We have shown that while trickle down does have significant effects in terms of creating pressures to reduce inequality and poverty, there are other powerful trends in technology and its use that counteract these tendencies and tend to sustain inequality. There are several other important factors that prevent development, including wars and the illegal appropriation of massive resources by corrupt politicians, that may be very important in some regions of the world. Consideration of such factors is beyond the scope of this article. Here, we have shown that in the particular case of Latin America, inequality itself tends to inhibit development by sustaining inequality, a process that may well also be significant in other undeveloped economies.

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