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**TECHNOLOGICAL DEVELOPMENT AND POVERTY ALLEVIATION:  
CRUEL CHOICES OR POTENTIAL SYNERGIES**

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**TECHNOLOGICAL DEVELOPMENT AND POVERTY ALLEVIATION: CRUEL CHOICES OR  
POTENTIAL SYNERGIES**

by

Atif Kubursi  
Professor  
McMaster University  
Hamilton, Ontario, Canada

### ***Abstract***

*The main purpose of this paper is to examine the complex relationship between technological advancement and poverty alleviation within the present Arab context and challenges. There is a serious debate as to whether technological breakthroughs and globalization are a threat to the poor of the world, or are major vehicles for improvement of their quality of life.*

*There are those who argue that technological breakthroughs and globalization are a threat, bringing with them high levels of unemployment through labor displacement. They also see the spread of globalization as responsible for the erosion of the social contracts that constructed the social safety nets of protection for the weak and dispossessed.*

*There are also those who see in the new technological breakthroughs and globalization the basis for the expansion of opportunities for progress as higher productivity occurs and cheaper and more accessible goods, services, new products and activities are created. They see in trade liberalization the rational allocation of scarce resources and in free market forces the liberation of talents and the engendering of innovation. The latter is considered the major component of the knowledge-based economy of the future.*

*The marginalization and the gap that separates the Arab world from advanced economies will grow unless they can harness the forces of globalization to their advantage and join in the writing of the rules for the global economy to protect their interests.*

*The main themes that the paper touches upon are: the technological imperatives of the new economy, the state, openness of the economy, income distribution and social programs, the current Arab context, and the road forward for Arab countries in technological development.*

## INTRODUCTION

A serious question has arisen as to whether technological breakthroughs and globalization are a threat to the poor of the world or are major vehicles for improvement of their quality of life. Those that argue that technological breakthroughs and globalization are a threat marshal significant evidence relating to the polarization of income and wealth distributions within and between countries. They also argue that these processes have brought with them high levels of unemployment as machines and computers displace workers and as labor remains immobile when greater fluidity in capital and financial flows are rampant. They also relate the spread of globalization as responsible for the emasculation of the role of the State in economic and social development and the erosion of the social contracts that constructed the social safety nets of protection for the weak and dispossessed. Those who see in the new technological breakthroughs and globalization the basis for the expansion of opportunities for progress underline the new opportunities that higher productivity open up as cheaper and more accessible goods and services and new products and activities are created. They see in trade liberalization the rational allocation of scarce resources and in free market forces the liberation of talents and the engendering of innovation. The latter is considered the major component of the knowledge-based economy of the future.

This debate is serious and the issues are crucial. The Arabs must join it; they can not afford watching from the sidelines. Their marginalization and the gap that separates them from advanced economies will grow unless they can harness the forces of globalization to their advantage and join in the writing of the rules for the global economy to protect their interests.

It is certain now that the international economic environment that the Arabs will face in the next millennium will be dramatically different from the world in the 1980s, and even that in the 1990s. International competition is intensifying, space and time are being cumulatively compressed and the basis of economic success is changing. Massive political and economic restructuring are reinforcing technological breakthroughs. Successive rounds of trade liberalization under the General Agreement on Tariffs and Trade (GATT) and the newly created World Trade Organization (WTO) and cross-border investment and financial deregulation have led to major changes in world trade, finance, investment and the rise of multinational corporations. Regional trading blocs dominated by the US, Japan and the European Union are expanding and consolidating their markets and their competitive advantages. The Third World debt overhang (now in excess of \$2.5 trillions) continues to shackle many developing countries and to sap their capacities to grow and meet the basic needs of their growing populations. Income and wealth disparities are growing at alarming rates within and between countries. Social bargains that took labor decades of struggle to wrestle from capital have been eroded and social safety nets are being torn apart or folded.

The main purpose of this paper is to examine the complex relationship between technological advancement and poverty alleviation within the present Arab context and challenges.

## THE TECHNOLOGICAL IMPERATIVES OF THE NEW ECONOMY

For the first time in human history, anything can be made anywhere and sold everywhere.<sup>i</sup> Dramatic improvements in transportation and communication technologies and equally dramatic reductions in these costs made this possible. New systems of command and control became feasible and have allowed the co-ordination of research and design groups in real time around the globe; components can be made anywhere in the world wherever it is cheapest to produce and

delivered to assembly lines that minimize total cost. Finished products can be shipped to wherever they are needed with just-in-time delivery systems.

The new economy of internationalized production was in the making since 1945, but the rapid changes brought about by what Zbigniew Brzezinski dubbed as the "technetronic" revolutions, are more recent. In the last quarter-century, rapid technological changes took a new turn. The most protean symbol of this change is the personal computer. Equally important, though, are flexible manufacturing systems, the information highway of the Internet, the World Wide Web, telematics, fiber optics, and bioengineering technologies.

The array of changes is staggering:<sup>ii</sup>

During the past two decades the global network of computers, telephones and television has increased the information carrying capacity a million times over. More than 50 million people are added to the communication network each year.

Computing capacity apparently doubles every 18 months according to Gordon Moore's Law (after the co-founder of Intel).

Today's \$2000 lap top personal computer is many times more powerful than the \$10 million mainframe computer of the early 1970s.

Three decades ago there were no more than 50,000 computers in the whole world, now they have rocketed to over 200 million. This does not include any of the chips inside cars or singing greeting cards. At the end of 1997, there were over 118 million computers installed in homes and educational institutions world-wide up from 35 million in 1992.

A typical car today has more computer processing power than the first moon-landing vehicle in 1969.

In 1960 a telephone cable could carry only 138 simultaneous conversations. Today a fiber optic cable can carry 1.5 million conversations.

No communication medium has ever grown as fast as the Internet. It has over 100 million users and is doubling each year. In 1993, there were 1.3 million hosts (servers). In 1999, they are expected to reach 43 million.

Anybody with a personal computer and a modem can teleshop, telebank, and telelearn 24 hours a day.

More than 70% of computer companies' revenues come from products that did not exist two years ago.

More than 60% of the workers in the United States today work with computers.

Spending on ICT exceeded \$1.8 trillion in 1997. This is approximately 6% of the aggregate global GDP.

In 1997, this spending was 40% higher than its value in 1992. It has grown 27% faster than global GDP even when the latter has grown by an average 5.6% annually during the same period.

Spending on ICT between 1992 and 1997 has grown in every economy worldwide regardless of their GDP or population growth.

Investments in ICT created a large number of companies in advanced economies---a net increase of 90,000 companies in the US, Canada, Australia, United Kingdom, Italy, France, Netherlands, Japan and Sweden between 1992 and 1997. In the US alone an average of 7,200 new ICT companies were created each year between 1992 and 1997.

Investments in ICT created jobs. In the United States a total of 380,000 jobs were created in the "software and services" industries. In Canada more than 51,000 jobs were also created over the same period in these industries. In France and Finland these increases were more modest at 7,200 and 1,200 respectively.

The implications of these advances and breakthroughs have been many and serious. They Include:

First, ICTs are everywhere, in the home, office, mosque, church and car. Their sheer pervasiveness is staggering. They affect every dimension of life. They have affected blue and white-collar jobs alike. They have replaced jobs in the services industry where most of the gains in employment have been realized in the past five decades.<sup>iii</sup> Speech recognition replaced secretaries, ATMs replaced bank tellers, voice mail replaced operators, synthesizers do the job of musicians, intelligent tutors replace teaching assistants, CADs replaced drafters and engineers, etc. While it is true that ICTs have created jobs they have also been destroying quite a few.

Second, ICTs are inputs and final products at the same time. Unlike electricity or steam power, computers and cellular phones are final products in their own right. This dual purpose make them capital and consumption goods at the same time and one use can dominate and obviate the other.

Third, ICTs prices have experienced vertiginous declines. Prices of most ICT products fell by 30% per year in real terms for the past 2 decades. Computer power cost in 1998 was (1/100) of 1% of what it did in 1970. If car prices had declined the same way a typical car would now cost \$5 and do 250,000 miles to the gallon. Steam power prices remained unchanged between 1780 and 1830. It only halved after that between 1890 and 1930. Between 1890-1930, price of electricity dropped by 65% this translates into a 2% decline per annum. This should partially explain the rapid diffusion of ICT and the slow pace that characterized the adoption of electrical power. Even though prices of ICT products have declined their cost in third world countries remain high. A one-month salary of an industrial worker in the West is sufficient to buy a computer, whereas it takes a three-years salary for most workers in the Arab World to buy one.

Fourth, ICTs made services more tradable by eliminating the direct contact between producers and consumers. Competitors are no longer 10,000 miles away but a microsecond or less. This has intensified competition among unequals, exposing third world producers and service providers to low cost and more productive competitors.

Fifth, ICTs made production and producers more footloose through flexible manufacturing, concurrent design and coordinated networks of decision-makers. Any product can now be produced anywhere and anytime. This opened the possibility for third world producers to participate more fully and more substantively in the production networks of more advanced countries.

Sixth, ICTs have liberated production from space and natural resources. ICTs claim less resources and substitute for more resource intensive production and consumption. At the same time it undermined the prices of natural resources and made more vulnerable economies that depend extensively on natural resources and the sale of natural capital as is the case for the majority of Arab countries.

Seventh, ICTs have raised the knowledge intensity of production and the value of skills, education and know-how. There are two sorts of knowledge that ICTs promote and expand. The first is *knowledge about technology*, which is known as simply know-how. Examples are birth control, nutrition, software engineering, accounting, etc. Typically developing countries have less of this know-how than more advanced countries. There are real *knowledge gaps* among countries. The second is *knowledge about attributes*, such as the quality of a product, the creditworthiness of a borrower, the health record of an applicant for insurance and the diligence of a worker. All of these are crucial for the working of effective markets. The difficulties posed by incomplete knowledge of attributes are referred to as *information problems*. Mechanisms to alleviate information problems, such as certificates, product standards and credit reports are fewer and weaker in developing countries.<sup>iv</sup> Reducing the knowledge gap and dealing with information problems cannot be ironed out without full recourse to ICTs. The latter have exacerbated the technological and informational gaps between the North and South.

Eighth, ICTs have facilitated dis-intermediation and have in the process eliminated many intermediaries particularly those in middle management positions, to clerks, to salespersons, etc. This has again reduced costs of transactions but also eliminated many jobs.

Ninth, ICTs have contributed to speeding the processes of innovation, downsizing, outsourcing and re-engineering to levels where growth in productivity (and/or job losses) have grown faster than output growth resulting in what is now known as "jobless growth". Innovation and knowledge-based production are at the center stage of economic and social development. Innovation and creativity do not result from decrees and can not flourish in oppressive and stifling socio-political systems. Freedom, democracy and accountability are considered necessary conditions for unleashing people's talents and for providing the enabling environment for change and progress.

Tenth, ICTs have materially contributed to the deterioration of the bargaining power of labor versus capital. Internationalism—once a propaganda weapon of the workers' movement against war-mongering governments and capitalists—has now crossed over and is working for the other side.<sup>v</sup> Besides, the free mobility of capital, knowledge, technology and even goods has not been matched by a commensurate relaxation of the constraints on the mobility of labor. Unfortunately, there has been a more pronounced movement of capital and technology towards richer than poorer countries. Capital has abandoned labor and moved to areas with less labor-intensive production.

The implications above are only a part of the pervasive changes experienced by the Arab World as part of the world system. There are a number of connecting impacts that are accommodated by technological factors but require additional support from other segments of the society and economy. Technology alone cannot bring about the desired transition. Equally necessary and important are the institutional changes, the building of the requisite infrastructure and above all the political will and administrative reform. Of no less importance are also the changing economic circumstances that manifest themselves in the internationalization of production, trade, investment and labor.

The rapid pace of technological change in the early 1990s has further quickened and has increased the value and importance of research and development and knowledge-based industries as the basis for competitiveness in the world markets. The new ICT technologies are changing the nature, pace and location of economic activity. They are creating new products, markets, institutions and values. They are widely accessible, relatively inexpensive but changing at a dizzying pace. Software has replaced hardware as the major ingredient for improving efficiency and realizing competitive advantage. Advanced materials are replacing natural resources as substitutes resulting in drastic declines in the resource intensities of products.

Combined with human intelligence, information technology has replaced physical capital as the leading factor of production. In an era of human-made brainpower industries, the distinction between labor and capital has become blurred.

Skills and knowledge, human capital, can be created by the same investment funds that create physical capital. Raw labor still exists, but it has increasingly become much less important in the production process and can, in any case, be accessed cheaply from large pools of unemployed or underemployed workers around the globe.<sup>vi</sup> Knowledge stands alone today as the only source of sustainable comparative advantage. Silicon Valley, Bangalore, and Boston's Route 128 are where they are simply because that is where the brainpower is.<sup>vii</sup> Success and failure in this world is now increasingly more dependent on whether a country is making a successful transition to the human-made brainpower industries of the future, not on the size of any particular activity, sector or investment budget.

At the heart of the problem facing developing countries and particularly the Arab region are some central and critical questions: Is Globalization and its embedded technological revolution no more than a confusing buzzword whose impacts are greatly exaggerated? Is Globalization a source of economic growth and prosperity whose impacts are real, staggering but necessary? Is technological change a critical component of globalization that it cannot take place without it? Can the Arabs bring about the technological advancement that will bring them the rewards of globalization? Can technological advancement in the Arab World happen in the present stifling sociopolitical environment?

These are not merely academic questions. The future of many countries and the entire region lies in the balance. Policy makers must make quick and hard choices. These choices must be based on hard facts and not fiction. It is difficult, indeed, to sift through the many historical facts and logical arguments debaters marshal in support of their positions. It is clear, however, that the issues are complex and that there are not yet many settled and some strategic choices remain to be made.

#### THE STATE, OPENNESS OF THE ECONOMY, INCOME DISTRIBUTION AND SOCIAL PROGRAMS

Dani Rodric (1997) notes that due to the increased importance of trade, the options available to national governments have narrowed appreciably over the past three decades. Governments are now scrambling to maintain international competitiveness. In the process they are loosening their grip on their economies and retreating from their traditional role of providing social safety nets and moderating the negative outcomes of the market.

Ironically, a key component of the implicit social contract between labor and capitalists in the advanced economies throughout the 1950s and up to the late 1980s has been the provision by government of social insurance and social safety nets that included unemployment insurance,



severance payments, universal medical insurance, etc. in exchange for the adoption of freer trade policies and stances.<sup>viii</sup> Today Globalization and freeing of trade are eroding these social contracts and their programs leaving labor and vulnerable groups helpless and defenseless in the face of massive restructuring of industry, biased and polarized income distribution regimes and massive employment losses. Rodrik points to two seemingly contradictory trends in the post-war period in both developed and developing countries—the growth of trade and the growth of government. Before the Second World War, government expenditures averaged about 20% of GDP of the industrialized countries. By the mid 1990s this figure had more than doubled to 47%. These increases in the government role in the economy is more striking in countries like the United States where it increased from 9 to 34 per cent, in Sweden where it increased from 10 to 69 percent or the Netherlands where it increased from 19 to 54 percent. It should not come as a surprise that the more open an economy is the more the government has to do to minimize the social impacts of openness to the international economy. It is now clear that the social welfare state was the flip side of the open economy. It is here where Globalization is perhaps sewing the seeds of its demise. Openness and freer trade are increasingly eroding social programs and polarizing labor markets and income and wealth distribution. Greater and more pronounced openness of the economy is taking place against a backdrop of government retreating from the provision of social programs and from playing the adjudicating force over negative market outcomes.

Real GDP per capita in the United States increased by 3% between 1973 and 1995, but the real hourly earnings of non-supervisory workers declined by 14% during the same period. In the decade of the 1980s all of the increase in earnings went to the top 20% of the workforce and 64% of that went to those at the top 1% of the income distribution scale. If incomes rather than earnings are examined, the top 1 per cent gets even more—90 per cent of total income gains.<sup>ix</sup> In 1995, four fifths of all male employees and workers in the United States earned 11 per cent less an hour in real terms than they did in 1973.<sup>x</sup> In the old days of the 1960s, John F. Kennedy summed up the fifths of all male employees and workers in the United States earned 11 per cent less an hour in real terms than they did in 1973.<sup>xi</sup> In the old days of the 1960s, John F. Kennedy summed up the expectation of rising prosperity for all in a simple statement. “When the river rises, every boat on the water rises too.” The effects of Globalization are making the kind of an economy to which this metaphor no longer applies. Today the richest 1 per cent of households has doubled its income since 1980, and the half-million super rich now own a third of all private wealth. The top managers in US corporations, on average, had an income that was forty times more than their ordinary employees made. Now the ratio is 120:1. The pay of the average Fortune 500 CEO goes from 35 to 157 times the average production worker. CEO salaries tripled in France, Italy, and Britain and more than doubled in Germany between 1984 and 1992.<sup>xii</sup>

The change in the labor market has encompassed nearly the entire world labor. Between 1973 and 1995, 43 million workers lost their jobs.<sup>xiii</sup> The great majority soon found new work, but in two-thirds of the cases with far lower earnings and with no or little benefits. In 1980 more than 20 per cent of the workers joined a union, today this figure has declined to 14 per cent. In France it is now less than 9%. (ILO, 1995).

The income distribution inequality between industrial and developing countries is also rising. According to the United Nations Conference on Trade and Development (UNCTAD), the share of world income owned by the richest quintile has increased by 14 percentage points since 1965, to 83 per cent of the world GDP in 1990. In 1965, average income per capita in the richest quintile was 31 times the income in the poorest quintile; in 1990, it was 60 times and in 1998 it has increased to 75 times. Earnings gap inequality has also increased within countries, as the wages of skilled workers have tended to rise faster than those of the less skilled. This has been

particularly true in Latin America where, with the exception of Chile, Costa Rica and Uruguay, real earnings of unskilled workers actually fell between 1990 and 1998.

The widening of the income and wealth gap between rich and poor in the same country and between countries are threatening the social stability of many countries and regions. It is difficult to believe that one can lock poverty for long. It will eventually travel either in large and massive illegal immigration and boat people (witness the recent flood of boat people from China to both Canada and the US, drugs, terrorism and political and social violence. The globalized world is increasingly a less stable and secure world.

#### THE CURRENT ARAB CONTEXT

In a comparative assessment of the global economy and the capacities of states and societies to adjust to its endemic changes, the American historian, Paul Kennedy, observes that "more than any other developing region" the countries of the Middle East and North Africa (basically inclusive of all the Arab countries) remain least prepared to meet the challenges of the next century.<sup>xiv</sup> Many basic structural weaknesses in the Arab economy hamper its ability to adjust to global change, meet the challenges of "peace" and protect itself from the adverse and rapid changes in the international economic environment. By and large, the Arab economies are still at "a very low entry point into the Information Age".<sup>xv</sup> Over the 70s and 80s the Arab economy's "success" was based on deriving a huge rent on oil exports, which masked many structural problems and allowed the Arabs to coast into the 1990s without having to restructure or reform their economies to improve their productivity. The harsh economic realities of the new millennium leave no options for the Arabs but to adjust, adapt, struggle, confront and face the challenges of the globalized economy or face the prospects of being left behind.

The future of the Arab economy in the new millennium will, however, depend on its ability to deal with its structural problems and lessen its dependence on unsustainable income sources. It will critically depend on the Arabs' ability to anticipate and harness global change, alleviate water shortages, manage effectively oil reserves, prices and production, derive real dividends from "peace" and prepare themselves to capture new opportunities provided by the information and "digital economy". At the same time, they should be able to protect their economies and societies from globalization's many negative consequences. Ultimately all of this will depend on the extent to which the Arabs can engender meaningful collective action to face these challenges and on how their governments, businesses, investors, workers, and communities respond to the challenges before them.

There has been some notable successes and considerable progress in many areas but particularly in raising the life expectancy of people at birth by 15 years in the past three decades. Infant mortality rates have been cut by two thirds during the same period. There are more people of school age at schools and female's participation rates in education have substantially increased. But there are a few issues and problems that need serious attention. These include:

- Labor productivity has been low and declining. Total factor productivity declined at an average annual rate of 0.2% during the 1960-1990 period and is still declining.
- Compared to the Asian Tigers, per capita output of the Arab economies was higher than higher in the 1960s, today it is half of that of Korea.

- The productivity of an Arab industrial worker was 32% of the North American comparable worker in 1960, by 1990 it declined to 19%. The decline has continued.
- At the 1990s annual growth rate of 0.5%, it will take an Arab citizen 140 years to double his income, while in many other regions their citizens able to do that in less than 10 years
- Arab adult illiteracy dropped from 60% in 1980 to about 43% in the mid 1990s and female literacy tripled since then. Yet 65 million adults are still illiterate and almost 2/3 of them are women.
- As a group the Arab countries spend a higher percentage of their GDP on education than any other developing region. By 1995, 75% of females and 90% of males' school age cohorts were enrolled in primary education. A comparably high percentage is shown for secondary school participation rates with 60% of males and 50% of females were enrolled in secondary education. Looked at it differently, still 10 million children in the school age cohorts were out of school.
- Declines in government funding of education have deprived principally vulnerable groups (females and rural poor) from access to education. Increasingly quality education is available to the well to do Arabs.
- There is considerable evidence that suggest that the quality of education in the Arab World has deteriorated.
- The mismatch between the labor market and the outputs of the system of education is staggering.
- Open unemployment is estimated at 15% of the labor force. About 12 million Arabs are currently unemployed. Twice this average is believed to be in the ranks of disguised unemployment.
- The Arab region has the lowest level of ICT access of any region with 0.6% of the population using the Internet and only 1.2% of households have a personal computer.
- Lack of well established clusters of firms. It is becoming widely recognized that over the long run, sustainable competitive advantages develop in clusters of linked industries. The Arab industrial structures are typically fragmented and weakly articulated. There have been some successful attempts in large industrial cities (e.g., Yanbu and Jubiel in Saudi Arabia), but much more is needed than building on technical affinities.
- A shortage of medium-sized and large firms with a home base in the Arab world. The branch plant organization of multinationals have often resulted in poor local skill development and fewer spin-off industries developed in the Arab region than in other regions of the world. Small firms are not capable of massive efforts in research and development and are too fragile to compete on the increasingly globalized world markets.
- Under investment in training and slow adoption of flexible workplace organizations compared to other more advanced developing countries.
- Inadequate financing for technology and export oriented companies.

- Widespread income and wealth inequality within and between Arab states which manifests itself in limited domestic purchasing power. This, in turn, reduces the capacity of the local market to sustain local production and also undermines health and education opportunities for the masses, which in turn hampers labor productivity growth.
- The education attainments of Arab labor do not prepare it for international competition. In 1992 the average year of schooling of Arab labor was equal to 3.6 years, the 2010 forecast is for 4.5 to 5.5 years. In comparison, in China it was 5.2 years in 1992 and the 2010 forecast is for 5.4 to 6.1 years. The poor performance of Arab countries is particularly evident when one considers that mean schooling in East Asia and OECD in 1992 exceed the 2010 forecasts for the Arab world: in 1992, mean schooling in East Asia was 6.9 years, while the OECD average was 9.2 years.<sup>xvi</sup>
- The lopsided industrial structures of many of the economies of the Arab world compromise the ability of these economies to sustain stable investment environments and provide local opportunities to local labor. The Arab economy is primarily an "old" economy. The Arabs have not ventured, in a serious manner, into the new economy. Primary manufacturing production still dominates the Arab structure of production. The Third Industrial Revolution is rooted in solid state electronics and information computer technology (ICT). The Arab countries have not been able to develop even a rudimentary base in these industries. Conversely, newly industrialized countries in Southeast Asia have successfully developed an export oriented electronics industry. Employment in agriculture in the 30-70% range is still the mainstay in the most populated Arab countries. One also sees a high level of employment in services, which reflects basically inefficient bureaucracies. For example, employment in services in the Gulf Co-operation Council countries represents 65% of total employment and 76% of the employment in Jordan.
- Manufacturing activity is still relatively modest in all Arab states. The region seems to depend rather strongly on primary production. With the exception of Morocco, Jordan and Tunisia, Arab manufacturing activity has remained limited or stagnant. Notably, though, the North African countries show higher shares in manufacturing than their counterparts in the Middle East.
- For all practical purposes the Arab economies are all export oriented economies and show very high foreign trade percentages (exports + imports as percentage of GDP). Arab oil producers typically show export shares that exceed 70%. Non-oil Arab economies are also highly exposed to trade. This exposure measured by the share of exports of goods or non-factor incomes (exporting the producer) in GDP is also relatively high. It is perhaps important to note here that the high share of exports to GDP is more the result of non-factor incomes than the exports of merchandise.
- While exports from East Asia and the Pacific grew at 9.8% between 1980 and 1990, they declined in the Arab region at the rate of 1.1% per year. Between 1990 and 1995, the disparity between the two regions is even more stark: while exports in East Asia grew at 17.8% per annum, Arab exports fell by 4.7% per annum. Using 1987 as the base year, the terms of trade (ratio of export prices import prices) declined from 130 in 1985 to 96 in 1990. While terms of trade have improved slightly in the mid-1990's, the region has still not counteracted the reverses it suffered in the 1980s. Indeed, while most regions of the

developing world experienced declines in their terms of trade none were as severe as those of the Arab region.

- Primary products accounted for over 98% of the Arab exports in 1965. This share declined to 87% in 1990 and to 75% by 1996. This is still an excessive share and symptomatic of the heavy reliance on the export of natural resources and the limited shares of manufactured exports. Machinery and equipment are less than 1 percent of total exports in 1965 and in 1990. Chemicals and refined petroleum exports increased as did textiles and clothing, but the increases in these exports remained modest, particularly in comparison with other successful developing regions. Actually, exports of machinery and transport equipment increased in most regions between 1965 and 1990 except in the Arab region.
- Until now, no Arab State has established an adequate science and technology system. Although there are more than 10,000 consulting firms and over 100,000 contracting firms in the Arab world, these remain small and narrowly specialized in the areas of civil engineering. A number of constraints impede the work of these consulting and design organizations. There are little or no financial services provided to these institutions on a par with their OECD competitors. They typically undertake projects in their home base and rarely outside it because they lack access to risk coverage. While Asian countries that are serious about developing domestic technological capabilities have emulated OECD practices, the Arab countries have not.<sup>xvii</sup>
- In 1995, Arab scientists and professionals published over 7,077 articles and notes in international refereed journals. About 80% of this published research were carried out in academic organizations. The two leading fields are applied chemistry and clinical medicine. The Arab world scholarly output in 1995, as measured by the number of publications per million inhabitants was 26. By way of contrast, Brazil had 42, France 840, Switzerland 1,878 and South Korea 144. To compare the advancement of South Korea relative to the Arab World, one need only note that in 1985, the scholarly output of the Arab world was equal to that of South Korea at 15 per million inhabitants.<sup>xviii</sup>
- In 1995, more than 1,000 Arab organizations published one or more scientific papers. It is estimated that the full time equivalent of researchers working in research centers in the Arab world is about 10,000. In the same year, the departments of basic and applied sciences in Arab universities were staffed with 50,300 faculty members of whom 32,200 held a Ph.D. degree in science and technology. Zahlan estimates that there are roughly 50,000 Ph.D. professionals in science and technology in the Arab world. They have limited output and limited effectiveness on account of low R & D budgets and in the absence of S & T systems.
- In 1995, 33% of all scientific publications were produced in the GCC countries, which constitute only 9% of the Arab population. Egypt accounts for 32% with a 25% of Arab population. Maghreb accounts for 18% of the publications with 31% of the population. Lebanon, Syria and Jordan account for 8% of the publications and 9% of the population. Only 29 organizations published 50 or more scientific papers in refereed international journals, and only 5 organizations published 200 or more papers. King Saud University (Rayadh) had 422 publications and was the leading research organization in 1995. Cairo University was next with 330 publications. King Fahd University of Petroleum and Minerals (Dhahran) had 320 publications.<sup>xix</sup>

- The Arab countries collectively spent \$750 million on research and development in 1995, this is about 0.2% of their GNP. Industrial countries devoted \$500 billion on research and development in 1995, which represents about 3% of their GNP. NICs devoted 1-3% of their GNP towards R & D. The Arab world devotes few resources towards this crucial activity and far below what it could and should.
- There are very few patent applications, grants of patents or patents in force in the Arab world. In 1990, Algeria had 185, Egypt 789, Iraq 322, Tunisia 144 and Saudi Arabia 455. By way of contrast, Netherlands had 53,514, South Korea 31,387, Israel 3,908 and Japan had 376,792.

#### THE ROAD FORWARD

Technologies are developed and diffused by individuals and institutions; the processes of development, selection, shaping and application are social processes. In many countries and particularly in the OECD countries, the selection process is heavily influenced by perceived competitive advantage, expected profitability and timesaving potential. Economic, social and technological factors interact within what Carlotta Perez's calls a "techno-economic paradigm" that represents a more meaningful concept than the commonly used one "technological paradigm". Nonetheless, it is true that some technological trajectories, once launched, tend to have their own momentum and are able to attract additional resources by virtue of past performance. In the end, both the technological system and the economic system get "locked in" to dominant technologies once certain linkages in supply of materials, components, and sub-assemblies have been made, economies of scale realized, training systems and standards established and so forth. Consequently individuals, firms and societies are not quite so free in their choice of technology as might appear at first sight.<sup>xx</sup> The real issue is about the interactions between technology and institutions. The more coordinated this relationship is, the smoother the social transition to the new technology and the greater the benefits to be derived from it.

In the early days of computing ICT was not a dominant technology and had to struggle for survival in a world that was geared to a totally different technology and institutions. Even supposedly well-informed industrialists and captains of industry, such as T.J. Watson, the head of IBM, did not believe that there would be any large commercial market for computers. He actually thought that there will be a demand for a few very large computers in government, military and scientific applications. Early computer users had major difficulties in obtaining reliable peripherals, people with the necessary skills and the appropriate software.<sup>xxi</sup> However, even in these early days, computers had already demonstrated their revolutionary technical superiority. The electronic industry remained wedded, albeit uncomfortably, to the old Fordist paradigm.

The full advantages of any new technology will not be apparent until the social framework has been transformed to accommodate it. Transition into the new economy requires a specific institutional set up, a workable infrastructure (infostructure) and a value system that can accommodate it, otherwise it will not be possible to proceed through the various stages of the transition from the old regime to the new one. There are necessary conditions for this transition. These are, as mentioned above, the infrastructure, the value system and the institutional framework within which they operate. But these conditions are not sufficient. A policy framework and a complete set of instruments and targets that will guide and facilitate this transition and ensure its progression into the transformation of the old economy into a new economy are equally important and necessary.

The policy accent of this framework is on the correct and enabling environment and policy choice, institutional and administrative reform and political will for change. These can reflect better and accommodate faster the transition of the economy and society from Fordist structures to ICT and knowledge-based structures.

If transition to the global economy is no longer a choice, it is fortunate that economies have a number of options and alternatives that can be adopted to make the transition smoother and more appropriate to their conditions. As the Arabs ponder their options for transition to the New Globalized Economy, there appears to be three fundamental systems. These include the National Innovation System adopted by Japan, Malaysia and other South East Asian countries, the sectoral-lead transition that typifies the Brazilian experiment or the entrepreneurial-lead transition that the US has generally adopted.

While these options are presented as if they are mutually exclusive, the way they have developed are far from that. Each option delineates a system that has a good deal of similarity to the other systems and episodes, but what distinguishes one from the rest are the most basic salient and most critical features that are specific to it.

The Arabs can begin with developing a National system of innovation. These are complex systems, reflecting the particularities – the histories, cultures and institutions – of the many countries that adopted and nurtured them. National systems were identified as important, partly because of their intrinsic ability to shed light on the nature of competitiveness and partly because of their potential as a tool of comparative analysis. In this latter respect, the idea of national systems was thought of to be able to help explain different national experiences of economic growth. The notion that knowledge flows – and need to flow – between individual knowledge-producing entities if firms are to remain competitive gives rise at a higher level of analytical integration to the idea of national systems of innovation. These are typically rooted in the theoretical findings of the “new growth theories”. These differ from the old neo-classical economics of growth and represent a paradigm shift in thinking and policy prescriptions.

There are no short cuts to a successful transition and there are many issues that need to be tackled simultaneously and aggressively. The following constituent elements appear to be critical for the transition:

First, the Arabs need a societal program that involves all Arabs in the ICT revolution. Of special importance here is the democratization of the policy making process and the engagement of key players and stakeholders in the regional agenda building. The transition is a process; it works best when it is inclusive, total and democratic. Particularly, when it involves finding a method to generate long-term goals and societal perspectives on science and technology and industrialization by an interactive process that includes the relevant ministries, other public organizations, universities, consulting houses and other stakeholders.

Second, the Arabs need to revamp their educational systems and skill development institutions. There are major gaps in the quality of education, in maintaining a proper balance between secondary and tertiary education and between science and technology and other fields. There are critical shortages of qualified scientists and technologists and there is a critical need for raising the proportion of students in the science and technology fields and in raising the proportions of those in tertiary education while improving the quality and experience of graduates at all levels. The preparation of people for the transition to the New Economy involves the provision of smart learning for all. Every school should be totally and completely connected to the Internet in due time and according to a well-developed plan. An Arab multimedia University should be

established as soon as possible and basic computer literacy program for all Arabs must be implemented. It also advisable to lay down the grounds for the provision of electronic distance education for all. Skill development should target the development of decision support systems to aid workers and managers alike, the development of indigenous business re-engineering knowledge and tools, and the promulgation of a knowledge-intensification skills' development program.

Third, building the requisite infostructure is at the foundation of this social project. The building of this infostructure means building broadband network technology, mobile computing technology, every house/premise must be linked to the network, and every new road/building must have conduit ready structure.

Fourth, the Arabs need to develop the supporting laws and regulations, networks and clusters of firms and the affordable applications. The latter will comprise indigenous content development, interactivity and information systems, edutainment and infocommunication.

Fifth, the Arabs should be careful to balance their adoption of new knowledge and techniques while they maintain traditional values. Acculturation should be promoted through the comprehensive education system, and through on-line information services, networked electronic communities, IT appreciation through the media and above all programs that strengthen traditional values.

Sixth, many national innovation systems could have been more productive if the social, technical and economic linkages in the system and the incentive regime rewarding efficiency performance had been stronger. The Arabs need to make sure that links among their technological institutions are strong and horizontal. Strong, visible and credible incentives that encourage innovation at the enterprise level should be implemented and improved. There is a strong need to integrate the R&D, production and technology at the firm level. Furthermore, the user-producer linkages that were very important in many industrial countries are very weak or almost non-existent in many Arab states. This interface between users-producers should be enriched and developed quickly and cumulatively. Sub-contracting networks should be formed at the enterprise level or at least for specific clusters of firms and these should be complemented by science-technology networks. A strong emphasis should be made on forging strong linkages between production and R&D and reverse engineering, on developing and using consultancy systems, improving and strengthening the technology import capability, and on discouraging harmful and wasteful turn-key projects.

Seventh, a major plan is needed to transform key Arab states into centers of excellence in multimedia and content building. These centers of excellence in key areas can leverage the transformation of the entire region and its full transition into the New Economy.

Eighth, much of what is recommended above cannot bring about the Arab transition to the New Economy if a given minimum threshold of Arab technological development is not achieved. This threshold will need a top-down social priority that will be lead by the State. The full development of the technological transformation will, however, require a complementary bottom-up strategy that calls for the participation of all stakeholders if not the entire society. That is why we have called for a full societal program to achieve this transition along the lines suggested by the experience of Malaysia.

Ninth, a favourable and accommodating macroeconomic environment that can lead and oversee the transition is of critical value. The recent development of the literature suggest that a fixed exchange rate regime and a stable and credible monetary policy are strong requirements for a



smooth and an economic way of acquiring technology for a world that is still heavily dependent on importing technology.

It is abundantly clear that a transition to the new economy is not possible within a society hobbled by poverty and shackled by oppression. Freedom and human security of all citizens is a necessary condition for the success of the Arab transition strategy. Dealing with poverty and unemployment directly and forcefully and through the empowerment of vulnerable groups particularly women and rural populations are pre-requisites for a sustainable transition strategy that will work and can take root into the presently technologically hostile Arab environment.

## ENDNOTES

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- i Lester Thurow (1996). P.115.
- ii The data in the section below are derived from a number of sources but particularly from: C. Freeman and L. Soete (1994), from the Economist, September, 1996 and subsequent editions in 1997 and 1998, and from International Data Corporation study for the World Information Technology and Services Alliance in 1998. Much of this data can be viewed at WWW. Wista.org.
- iii J. Rifkin. (1995).
- iv World Bank. (1999). The World Development Report 1998/1999 on Knowledge for Development. Washington. D.C.
- v Hans-Peter Martin and Harald Schumann. (1996). P. 112.
- vi Lester Thurow (1996). Ibid., P.68.
- vii Since the mid 1980s companies such as Hewlett-Packard, Motorola and IBM began to employ new specialists from India at wages that were fractions of what they pay their nationals. Brain shopping is what they call it. When domestic governments supported their nationals complaints about moving jobs to India, many firms simply relocated major parts of their data work to India. It certainly helped that the New Delhi government laid on all the infrastructure—from air conditioned open-plan laboratories to satellite links-at almost zero cost to the multinationals in ten designated zones. Within a few years the “Electronic City” of Bangalore emerged. From a population of less than a million to one with over 4 million inhabitants, the software industry now employs over 120,000 university graduates and created \$1.3 billion in business, more than 67% of this business is derived from the export of software services.
- viii Dani Rodrik. (1997). Ibid.
- ix Daniel Feenberg and James Poterba. (1992). “Income Inequality and the Incomes of Very High Income Taxpayers”. NBER Working Paper No. 4229. P. 31.
- x Data from the US Bureau of the Census. Current population Reports. Also quoted by Lester Thurow (1996).
- xi Data from the US Bureau of the Census. Current population Reports. Also quoted by Lester Thurow (1996).
- xii Lester Thurow. (1996). P.21.
- xiii International Herald Tribune (March 6, 1996).
- xiv Paul Kennedy, *Preparing for the Twenty-First Century* (New York: Harper Collins Publishers Ltd, 1994). p. 209.
- xv From a statement distributed by the UNDP Bureau of Arab States at the Regional Symposium on Jobs and the Information Society of the 21<sup>st</sup> Century in Damascus, Syria April 26-29, 1999.
- xvi Antoine B. Zahlan, “Globalization and Science and Technology Policy”. *Forum* Vol. 4, No. 3, December, 1997-January 1998.
- xvii Antoine B. Zahlan, *ibid.*, p. 13.
- xviii Antoine B. Zahlan, *ibid.*
- xix Antoine B. Zahlan, *ibid*
- xx C. Freeman and L. Soete. (1994). *Work for All or Mass Unemployment*. London: Printer Publishers.
- xxi C. Freeman and L. Soete. (1994). *Ibid.*

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