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Abstract

In this paper we use Singer's notion of international technological dualism to advance our understanding of the current digital divide between rich and poor countries. More specifically, the paper argues that this divide is essentially another manifestation of the same forces identified by Singer as governing not only the technological relationships between rich and poor countries but also those within the latter themselves. Although some developing countries are undertaking important initiatives to generate indigenous forms of information technology, far more research expenditure needs to be devoted to innovations that will benefit the poor in developing nations rather high income countries.

1. Introduction

More than 30 years ago, Hans Singer (1970) introduced the concept of international technological dualism to refer to the unequal developments in science and technology, between rich and poor countries. In this paper we suggest, first, that Singer's analysis remains highly relevant to our understanding of the technological relationships between these countries and we suggest, furthermore, that the so-called digital divide in the global economy is a reflection of the same basic forces that give rise to international technological dualism. It appears that in certain key areas, information technology may even strengthen these forces and thereby accentuate still further the problems described originally by Singer.

First, however, let us examine in some detail precisely what he meant by the concept. Thereafter, in Section 2, we re-appraise the main elements of the concept in the contemporary global context, including as it does, momentous innovations in information and communication technology. Section 3 addresses the question of whether it is useful to view the global digital divide from the perspective of the relationships that underlie the concept of international technological dualism. The final section summarizes the results of our analysis of these issues.

2. International Technological Dualism[1]

In essence, what Singer identified was a 'process of scientific and technological advance' that 'in all its stages – basic research, applied research and blueprinting – has been heavily concentrated in the richer countries' (1970, p. 62):

> The best estimate we can make at the present time is that measuring the distribution of advance by the distribution of inputs in the form of research and development expenditures, we find that 70 per cent of world expenditure is in the U.S., 25 per cent in Europe, and 2 per cent in the less developed countries (Singer, 1970, p. 62).

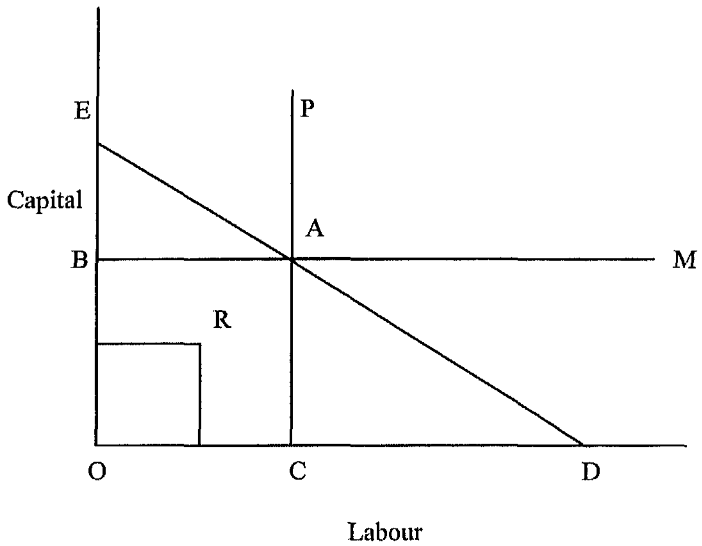
The acute inequality of global research and development (R&D) expenditures thus identified,

> ...would not matter if the direction of advance, the scientific and technological priorities and the methods of solving scientific and technological problems, *were independent of where the work is carried on.* This, however, is patently not the case. The 98 per cent of research and development expenditures in the richer countries are spent on solving the problems which concern the richer countries, according to their own priorities, and on solving these problems by the methods and approaches *appropriate to the factor endowment of the richer countries*. In both respects - selection of problems and methods of solving them – the interests of the poorer countries would be bound to point in completely different directions. Yet the two-thirds of mankind with its different problems accounts for only 2 per cent of all expenditures - a discrepancy per capita ratio of no less than 100:1 (Singer, 1970, p. 62, emphasis added).

Figure 1 provides a simple but useful depiction of the divergent nature of technological change that would be dictated by the factor endowments prevailing in rich countries. Point A represents a certain level of output on an arbitrarily chosen iso-cost line ED. Technological change in the diagram is represented by changes in the amounts of capital and labour that are required to

[1] Singer's analysis was considerably extended in its theoretical and empirical dimensions by Stewart (1977).

FIGURE 1: *Factor endowments and the direction of technological change*



produce the given level of output associated with point A. In the case of point R, for example, because less of both inputs are required to produce the same level of output as at A, the former combination dominates the latter in the sense that it is a more efficient technique at *all* factor price ratios. Conversely, A dominates all factor combinations within the area PAM, where *more* of both inputs are needed to produce the said level of output[2].

In Singer's analysis, the actual direction of technological change is dictated by the concentration of R&D expenditures in the developed countries, where, in general, labour is scarce relative to capital and innovations will consequently tend to take place in the area above AB and to the left of PA. Such innovations can be described as biased in the Hicksian sense in that they lead to an increase in the ratio of capital to labour. (Note that biased technological change in this sense does not require that the absolute amount of both factors be reduced per unit of output). Very few innovations, by contrast, would occur in the (capital-saving) area below AM and to the right of PC, given the paucity of R&D

[2] Stewart (*ibid.*) contains a useful historical analysis of technical change in products and processes using this type of analysis.

expenditures undertaken by the developing countries themselves, as noted above.

Even what little R&D does take place in the Third World, moreover, is not necessarily of the kind that would be dictated by the factor endowments and other conditions prevailing in those countries. For, as Singer further points out in his discussion of international technological dualism:

> The fact that the richer countries have such a virtual monopoly of research and development expenditures, as concretely expressed in terms of institutions, equipment, number of trained scientists and technologists, as well as a virtual monopoly of deciding where the existing frontiers of knowledge are, has the further consequence that the activities of the small number of institutions and people, represented by the 2 per cent of research and development expenditures in the poorer countries, is also itself largely devoted to the problems and methods determined by the richer countries. Much of the present expenditures of the poorer countries represent a hopeless attempt to compete from an inferior position in solving the same kinds of problems by the same methods (Singer, 1970, p. 62-3).

To some extent, this process may, as Reddy (1979) suggests, take the passive form of 'a virtually unexamined and unquestioned introduction of alien and inappropriate guidelines, preferences and paradigms' into the relevant institutions in the developing countries (p. 95). In part, however, the process described by Singer may also reflect a more active emulation of developed country science and technology institutions, which reflects the recognition by developing country scientists that international (and to a large degree also national) rewards accrue to those working at the research frontiers[33].Indeed, because these rewards are usually more easily won by working in the developed countries themselves, an international 'brain-drain' emerges, which constitutes the third dimension of Singer's concept of international technological dualism. As he put it, '[t]he existence of the richer countries, with their immensely superior facilities, and the glamour associated with work on their self-defined 'frontiers of knowledge' exert a powerful attraction resulting in the well-known 'brain drain'' (Singer, 1970, p. 63). In fact, even by the early 1970s the problem had assumed such importance that economists such as Bhagwati[4] were proposing to tax professional migrants in order to raise revenue for the developing countries that suffered from the consequent loss of scarce human capital.

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[3] A detailed analysis of the social and political biases in developing country research institutions is contained in A. Reddy (1979).

[4] Bhagwati and Partington (1976).

International technological dualism and divergent growth

The implications of international technological dualism for the economic growth performances of poor countries relative to rich countries were certainly not lost on Singer. Indeed, he goes so far as to claim that '[t]his international imbalance, or dualism, in the field of science and technology explains to a large extent why the growth of the under-developed countries has not been as fast as one theoretically would expect' (p. 63). That theory, associated mainly with Gerschenkron[5], is, of course, that latecomer developing countries find it increasingly easy to catch-up over time as knowledge and techniques grow in the already developed countries. 'Thus, the late-comers in development would be at an increasing advantage compared with their predecessors' (Singer, 1970, p. 63).

The problem with the received theory, according to Singer, is not that the volume of accumulated knowledge has failed to increase over time. It has rather to do with the differential relevance of that body of knowledge to developed as opposed to developing nations. In particular, the latter have increasingly found themselves exposed to the types of technological advances that bear little or no relevance to their own particular problems[6].

> ...[And] this in turn is due to international dualism, the fact that knowledge is accumulated by the richer countries, and in respect of the problems of the richer countries. These are not the problems or methods of primary concern to the developing countries. The richer countries are mainly interested in sophisticated products, large markets, sophisticated production methods requiring large inputs of capital and high levels of skill and management while saving labour and raw materials. The poor countries by contrast are much more interested in simple products, simple designs, saving of capital and particularly land, reduction in skill requirements, and production for smaller markets. The potential impact of the increasing stock of knowledge – no doubt still very important and on balance useful to developing countries – has been largely offset by *a tendency for each unit of this knowledge to become less and less useful to developing countries* (Singer, 1970, p. 64, emphasis added).

It is true that the technology thus emanating from the developed countries may still have some relevance for the more modern sectors of developing countries, but the resulting situation of growing *internal* technological dualism would then hardly be conducive to growth and development, as Singer himself recognized

[5] Gerschenkron's analysis spawned a huge literature on 'catch-up' by means of technological borrowing. See, for example, Abramovitz (1989).

[6] Such technology is thus aptly described as 'inappropriate' by Stewart (1977), as opposed to innovations that would be 'appropriate' to the needs of poor countries.

and others, such as Johnston and Kilby (1975) and Stewart (1977) have confirmed[7].

3. International Technological Dualism in Contemporary Global Context

We shall argue in this section that the main elements of international technological dualism sketched above have continued to retain their general relevance. We shall also show that the concept has now effectively been formalized into a new model of economic growth, the predictions of which run counter to the conventional view of differences in growth rates between rich and poor countries. On the other hand, it is also important to recognize that some important exceptions to this general portrayal have emerged, mainly, but not only in East Asia[8].

The composition and direction of global R&D

While noting the rapid rise of R&D expenditures in South Korea, Taiwan and Singapore over the past decades (and more modest increases in some other developing countries), Freeman and Hagedoorn (1995) conclude that global R&D expenditures are nevertheless 'highly concentrated in the rich OECD countries' (p. 37). At the other extreme, 'the Third World, on the most generous estimates, accounts for only about 6 per cent, and without China probably less than 4 per cent of global R&D' (p. 37). If, therefore, the composition of global R&D has not changed markedly since the time when Singer originally discussed the problem, is there any indication that this type of investment has become any more relevant to the problems of poor countries?

Perhaps the best answer to this question is provided in the recent (2001) *Human Development Report*, which, after noting that 'research on and development of technologies for poor people's needs have long been under funded', goes on to suggest that 'despite the possibilities of technological transformations, this continues to be the case' (UNDP, 2001, p. 109). Although there are few precise estimates of spending on developmental needs (itself 'a sign of the lack of attention paid to this problem'), the pharmaceutical industry is more revealing than most. For example:

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[7] Partly because of the limited degree of positive interactions and feedbacks between the formal and informal sectors of developing countries. Partly because of unemployment and inequality.

[8] From a technological point of view, one of the best accounts of the East Asian experience is by Bell and Pavitt (1997).

> In 1992 less than 10% of global spending on health research addressed 90% of the global disease burden. Just 0.2%, for example, was dedicated to research on pneumonia and diarrhoea – 11% of the global disease burden. This funding gap creates research and medicine gaps. In 1995 more than 95,000 therapy-relevant scientific articles were published but only 182 – 0.2% of the total- addressed tropical diseases. And of 1,223 new drugs marketed worldwide between 1975 and 1996, only 13 were developed to treat tropical diseases – and only 4 were the direct result of pharmaceutical industry research. Reallocating just 1% of global spending on health research would provide an additional US$700 million for priority research on poor people's maladies (UNDP, 2001, p. 109-10).

By symmetrical reasoning, what one also needs to ask in the present context is whether the increased amounts of research spending in developing countries have become any more oriented to their own needs and problems than they seemed to be in the past (as discussed above). As in the case of developed country R&D, however, it is difficult, if not impossible to provide a specific answer to this question, given the same lack of empirical material[9].

Again, as in the case of the developed countries, it is easy enough to cite cases where R&D investments have generated innovations that are relevant to local low-income needs, such as small-scale tractors in India or low-cost computers in Brazil. Basing her view on a number of country case studies, Stewart, however, argues that such examples as these:

> ...represent only a minority of cases...within the innovations of the R&D institutions in developing countries...there is tremendous potential for improving the productivity of traditional methods in Indian agriculture; this potential has not been realised partly because of deficient R&D. The study of technical change in Latin America indicated that *no efforts* had been made to channel innovations towards appropriate technology (Stewart, 1987, p. 293).

If this particular problem has not been reduced to any significant degree over the past three decades, it is in all likelihood because of the biases noted above, which link local R&D and other related institutions so strongly to the developed countries. Only recently, for example, a prominent Brazilian scientist took critical note of how universities and research centers in developing countries 'have become isolated from the rest of the country in an ivory tower, more connected to research centers in Europe or the United States than to the obvious needs of industry, agriculture and education in their own countries. ...Heavy government bureaucracies wind up cultivating whatever science and technology is fashionable in the developed countries' (Goldemberg, 1998). Such an

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[9] There is of course also a problem of deciding quite where the border should be drawn in dividing developed as opposed to developing country-oriented innovations. The extreme cases in each category are clear enough but there is also a fairly large 'grey area'.

atmosphere, needless to say, only serves to increase the attraction of working in the developed countries themselves; an attraction that continues to erode the supply of crucial research capabilities in much of the Third World. Some of the most acute losses have occurred in small African, Caribbean and Central American countries, which have lost no less than 30 per cent of individuals with a tertiary education. (Carrington and Detragiache, 1999). The same data source also records 'a sizable brain drain from Iran, Korea, the Philippines, and Taiwan Province of China. These numbers suggest that in several developing countries the outflow of highly educated individuals is a phenomenon that policymakers cannot ignore' (*Ibid*).

International technological dualism and patterns of economic growth between rich and poor countries

There has long been a yawning gulf between the literature on technology and development and the literature on the theory of economic growth. Not the least of the reasons for this lack of overlap is that whereas the former has tended to focus on detailed micro case studies, the latter tends to be formal in structure and only very weakly grounded in technological detail[10]. Partly as a result of this mutual seclusion, little or no attention is paid in growth models to the *actual* (empirically observed) nature of the technological innovations from which developing countries (for reasons given above) are required to choose. And this weakness in the formal models, in turn, is largely responsible, as I see it, for their failure to explain the recently observed patterns of growth between rich and poor countries.

Whereas much conventional theory predicts a convergence in the distribution of incomes across countries[11], the empirical evidence sharply contradicts any such tendency. In a paper entitled 'Divergence Big Time', Pritchett (1995), for example, has argued that 'divergence in output per person across countries is perhaps *the* dominant feature of modern economic history. The ratio of per capita income in the richest versus the poorest country has increased by a factor of 6 and the standard deviation of (natural) log GDP per capita has increased between 60 per cent and 100 per cent' (Pritchett, 1995, p. 2-3). According to a more recent empirical test of the convergence hypothesis, the 'results indicate that disparities among rich and poor countries have not shown a tendency to diminish during the last three decades, not even among the eight high-performing countries' (Pazos, 2000, p. 54).

[10] See, for example, the Solow-type neoclassical growth models.
[11] A point made among many others by Zeira (1998).

One recent formal growth model (Zeira, 1998), however, has gone some way towards making more realistic assumptions about the pattern and nature of global research expenditures and technical innovations (assumptions that very close in some respects to the concept of international technological dualism). As a result, the predictions of the model about inter-country growth rates are correspondingly far more accurate than most of the other literature in this area. More specifically, the model predicts that technological innovations will be adopted only in countries with high productivity (and hence, presumably those that are relatively affluent), since it is assumed that innovations save on labour but require more capital. Innovations, that is to say, are consistent with the factor endowments prevailing in rich rather than poor countries. (In terms of Figure 1, above, innovations will lie in the 'labour-saving zone' above AB and to the left of PA). Thus, 'Some countries adopt fewer technologies than others because they have lower wages. Therefore, technology adoption, which saves labor but requires more capital, is not profitable. These countries have lower wages because their productivity is lower' (Zeira, 1998, p. 1103). With biased technological kind, the model is thus able to explain the large (and growing) international differences in per capita output referred to above.

4. The Digital Divide as International Technological Dualism

Information technology is in many respects a reflection of the same pattern of international technological dualism that has helped to produce the pronounced gap in incomes between rich and poor countries. Primarily, this is because it developed almost entirely for the conditions prevailing in the developed countries (such as skilled labour, capital abundance, advanced infrastructure and high incomes). From this point of view, the digital divide (defined as the unequal distribution of computers, Internet connections, fax machines and so on between countries)[12] is merely another technological gap that emanates from and reflects the highly skewed distribution of global research expenditures between the North and the South. (Consider, for example, the direction in which developed country research expenditures have transformed the characteristics of the once basic personal computer. Not only has this product become vastly more powerful and faster over time but (in the form, for instance of the Pentium 4 variety), it has also acquired a host of such high-income characteristics as DVD and CD-RW drives, a Trinitron monitor and highly sophisticated sound equipment)[13].

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[12] The *Human Development Report*, 2001 provides data on the adoption rates of computers, Internet connections, telephones etc. by country.

[13] Kanellos and Wilcox (2000).

Compared to the period when the concept of international technological dualism was introduced, however, the emergence of information and communication technologies has raised several new issues with regard to the *internationalization* of R&D and the possible implications thereof for scientific and technological forms of dualism between rich and poor countries:

> Prior to the mid-1970s one the reasons stated by TNCs for not internationalizing R&D was the difficulties involved with the supervision and control...[b]ut the introduction of new information and communication technologies (ICT) has significantly increased the scope for global sourcing of technologies. By the mid-1970s, the telecommunications, and computer industries were leaders in adopting the new methods of control for *worldwide organization of R&D.*
>
> In recent years, the R&D functions, especially in the high-tech industries such as...microelectronics...have become more science based and research intensive...basic scientific knowledge is playing an increasingly crucial role in major technological advance; and many recent major innovations have occurred through cross-fertilization of different scientific disciplines. These ongoing paradigmatic changes in science and technology (S&T) are increasing the pressure on firms. These pressures can be met partly by increasing the in-house R&D, both at home and abroad, or by the establishment with other firms of joint venture R&D or research cooperation with universities.
>
> Since the 1980s, inter organizational technology cooperation has also become a widespread practice (P. Reddy, 1997, p. 1823, emphasis added).

If advances in communications technologies have thus made it feasible for multinational operations to internationalize (or globalize) their research operations, conditions in the labour market for R&D personnel are necessitating such operations. Indeed, one observer has gone so far as to argue that 'The key driving force for globalization of R&D in the 1990s has been the increasing demand for skilled scientists' (Reddy, 1997, p. 1823). According to this view, an international market for science and technology personnel has arisen which extends beyond the OECD countries, to include 'uncommon countries...for international corporate R&D' such as Israel, Brazil and India (*Ibid*).

As examples of this emerging trend, one can cite the case of Texas Instruments in India, which performs geographically dispersed, but globally integrated R&D activities as a result of new information and communications technologies that allow the firm to 'send and receive the latest support information, design technology and applications information for its products and services' (UNCTAD, 1995, p. 153). In another example, Motorola has a paging device plant in Singapore employing 75 local engineers in its R&D centre. Indeed, the 'Scriptor' pager was developed by local scientists at this centre, while yet another major American firm in the industry, Hewlett-Packard, uses its plant in Singapore as the 'global R&D and production centre for the company's portable ink-jet printers' (UNCTAD, 1995, p. 153).

From one point of view, this emerging propensity for R&D activities to spread themselves more widely across the developing countries (or, at least a small group of them), clearly undermines the notion that developed countries undertake research activities only in the rich parts of the global economy. On the other hand, one also needs to consider the *content* of research expenditures thus dispersed to parts of the Third World. For, as noted earlier, one cannot necessarily assume that research expenditures in developing countries are directed solely to local needs and problems[14].

The content of research expenditures dispersed by foreign investment to developing countries

Reddy's (1997) study of multinational firms in India contains the most comprehensive information about the direction of R&D activities in India and what is especially useful about his results is a comparison of 'new technologies' firms with firms in 'conventional' industries. In particular, whereas the latter conventionally perform some degree of adaptive R&D (i.e. adaptations of products and processes to the local environment), the former conduct considerably less of this type of R&D behaviour. Specifically, all the efforts to develop new products and processes for major world markets and to generate 'basic technology of a long term or exploratory nature for use by the corporate parent' (Reddy, 1997, p. 1828) took place in the new technologies firms, only 25 per cent of which undertake any adaptive type of R&D.

> This suggests that in new technologies there is less need for product or process adaptation to the local market. Similarly, the development of products exclusively for the local market...by new technologies firms is also less, except in the case of biotechnology companies developing new plant varieties based on the local soil and weather conditions. On the other hand, an overwhelming majority of new technologies firms are involved in developing products for *the global markets*, e.g., computers, communications equipment, etc. (Reddy, 1997, p. 1828).

Therefore, while globalization may be inducing some degree of dispersion of research activities outside the OECD area, the above evidence suggests that the direction of the resulting innovations, such as 'global' products, may be even less relevant to developing countries than the more adaptive type of research that was undertaken when subsidiaries were less closely integrated into global

[14] Indeed, if anything, the converse proposition might be closer to reality.

research and production networks[15]. That research was intended to make products and technologies somewhat more relevant to developing country conditions (eg. to the climate, environmental conditions).

Conversely, however, there is encouraging evidence from countries such as Brazil and India that local scientific personnel have developed innovations designed specifically for the income levels and other conditions prevailing in those countries. Both countries, for example have developed extremely low cost computers and Indian scientists have come up with a low cost form of wireless local loop technology[16]. And even in the developed countries themselves, there is a certain amount of research now being conducted on ways of bridging the digital divide by means of low cost information technologies (such as some of the research programmes at the Media Lab of the Massachusetts Institute of Technology).

Global strategic alliances and the direction of research outcomes

Changes in the worldwide organization of R&D are not just confined to intra-firm locational behaviour (as just described) but also include various types of cooperative ventures between independent firms[17] It has been suggested that '[t]hese new coordination mechanisms', moreover, 'have opened windows of opportunity for developing countries, enabling them to establish a foothold in the actual generation of new technologies' (Vonortas and Dodder, 2000). With respect to foreign investment we have already argued that new forms of R&D locational behaviour tend to alter the nature of innovations in developing countries from being somewhat adaptive and local in character, to being more global and standardized. With regard to strategic alliances we also doubt whether any such arrangements entered into by developing country firms are likely to address poor country concerns and needs in the area of information and communications technologies. For while there are numerous developing countries that participated in such alliances between 1984-1994 (such as China, Korea and Mexico)[18], and while such participation may have enabled the firms concerned to gain access to knowledge that would otherwise have been inaccessible, there are again doubts about whether the resulting innovations have much, if anything, to do with the problems of poor people (though again there is very little evidence to make an assessment one way or the other).

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[15] Reuber (1973) is a useful reference in this regard, containing as it does, a survey of product and technology adaptations made by 'stand-alone' type affiliates of multinational firms.
[16] See James (2001) and (2002).
[17] For a review of the various alternatives and their implications for the globalization of technology, see Freeman and Hagedoorn (1995).
[18] Complete list of participating developing countries is contained in Vonortas and Safioleas (1997).

Information technology and the brain drain

With regard to our previous discussion of the concept of international technological dualism, one last point warrants emphasis in the context of information technology and the digital divide. This form of new technology is giving rise to shortages of skilled personnel in the OECD countries, which, in turn are seeking to recruit such personnel from some of the developing countries. Software is most often cited in this regard and particularly with respect to India, where, according to one report, '[t]he more trained and experienced talent find what is more 'attractive dollar paid jobs' abroad and leave. On an average most young programmers after twelve to eighteen months of working in India leave' (Bajpal and Shastri, 1998).

Just how big the extent of this problem actually is cannot be quantified with any degree of certainty. However, recent estimates from the *Human Development Report* indicate the orders of magnitude that are involved. The Report invites the reader to:

> Consider the drain of software professionals from India to the United States. Under new legislation introduced in October 2000, the United States will issue about 200,000 H-1 B visas a year over the next three years. These visas are issued to import specific skills, primarily in the computer industry. Almost half are expected to be issued to Indian software professionals (UNDP, 2001, p. 92).

It is true, as the Report points out, that this brain drain has indirect effects that may help to offset the direct costs to India (and by extension to other developing countries confronting the same problem). For example, it is possible that as a result of the outflow of skilled professionals, a so-called 'brain diaspora' may develop, as contacts emerge between Silicon Valley and Bangalore. But whereas we have fairly reliable estimates of the direct costs of the brain drain in software, we can only guess at this stage how powerful the countervailing indirect effects will be.

5. Conclusions

Centered around vast inequalities in research expenditures, human capital and technological capabilities, Singer advanced the concept of international technological dualism more than thirty years ago. As he then saw it, the technological relationships between rich and poor countries were such that, for a variety of different reasons, only a relatively minor amount of resources was actually spent on the problems afflicting the majority of those living in the Third World. As a result, so his argument ran, technological innovations designed for developing countries would lag behind those designed for developed countries and to this extent the growth of the former would be sorely impeded relative to the growth of the latter as time goes by.

Following a brief discussion of each of the main elements of the concept, we then, in subsequent sections, went on to examine whether and to what extent, these elements have retained their relevance in the contemporary global context, including the changes that are now being wrought by information and communication technologies. Stated briefly, what we find is that the problems described by Singer may have somewhat lessened (especially in a few exceptional country cases) partly in response to the opportunities afforded by the globalization of research, yet for much of the developing world, international technological dualism remains an important policy problem. Above all, a much greater percentage of global research expenditures needs, we feel, to be devoted, in one way or another to the particular problems faced by the vast majority of those living in the regions that are currently most neglected by the world's research community[19].

In two recent papers, James (2001, 2002) has argued that research designed to bridge the digital divide between rich and poor countries, should focus on bringing down the costs of information technologies to levels where they are affordable by the majority of the population in the latter countries. He cites, for example, low-cost indigenous wireless local loop communications technologies, computers that cost less than US$200 and e-mail services offered by the Indian Postal Service, among other appropriate technologies.

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[19] The following remarks by Kenny et al (2000) are worth quoting as a basis for justifying policy towards bridging the digital divide. For, on the one hand,

> ...[t]he mere existence of a gap in levels of ICT services between rich and poor across and within countries does not imply that ICTs are a priority; after all, poor countries also have fewer factories, fewer cars, fewer doctors and nurses, and lower calorie intakes per capita than wealthy countries. That said [there are] a number of reasons why a *growing gap* in the provision of advanced ICTs *should* be of concern:
> The gap in provision is already large, much larger than income disparities.
> Threshold effects are at work.
> Within country gaps in service provision worsen existing inequities.
> (Kenny et al, 2000, p. 15, emphasis in original).

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