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SIN DISCUSSION PAPER SERIES

Aspects of Marginalization

*Growth, Industry and Trade of the Least Developed Countries**

Discussion Paper No. 1

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May 2001

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*This paper has not been edited. The views expressed herein are those of the author and not necessarily those of UNIDO.

This paper submits in very concise form a certain number of insights drawn from broad research efforts carried out at UNIDO on the empirics of industrialization in developing countries. The focus, here, is on those countries considered today as the Least Developed Countries (LDCs) by the United Nations. The time span is the long run – three decades. The central topic is marginalization prodded by insufficient industrialization. The protagonist is technological change. The results presented are obtained with the tools of data envelopment analysis, total factor productivity measurement and revealed comparative advantage assessment applied to UNIDO's Industrial Database.

1. Marginalization in production – what is the role of productivity?

The last thirty years of the 20th century have witnessed an unparalleled progress in the contribution of industry to the world's standard of living[i]. What was without parallel was not only that the quantity and diversity of goods that industries delivered expanded to an extraordinary extent, but also that the relative prices of these goods, and in particular of the most innovative of them, went down faster and deeper than ever in the history of the industrial revolution. Thus, the socialization of the fruits of industry was so brisk and universal that the tools and amenities of the computer world were provided to a considerable proportion of households and working places within a lead-time that proved immensely shorter than it took the steam, chemical, electrical revolutions to disseminate the innovative goods of previous generations.

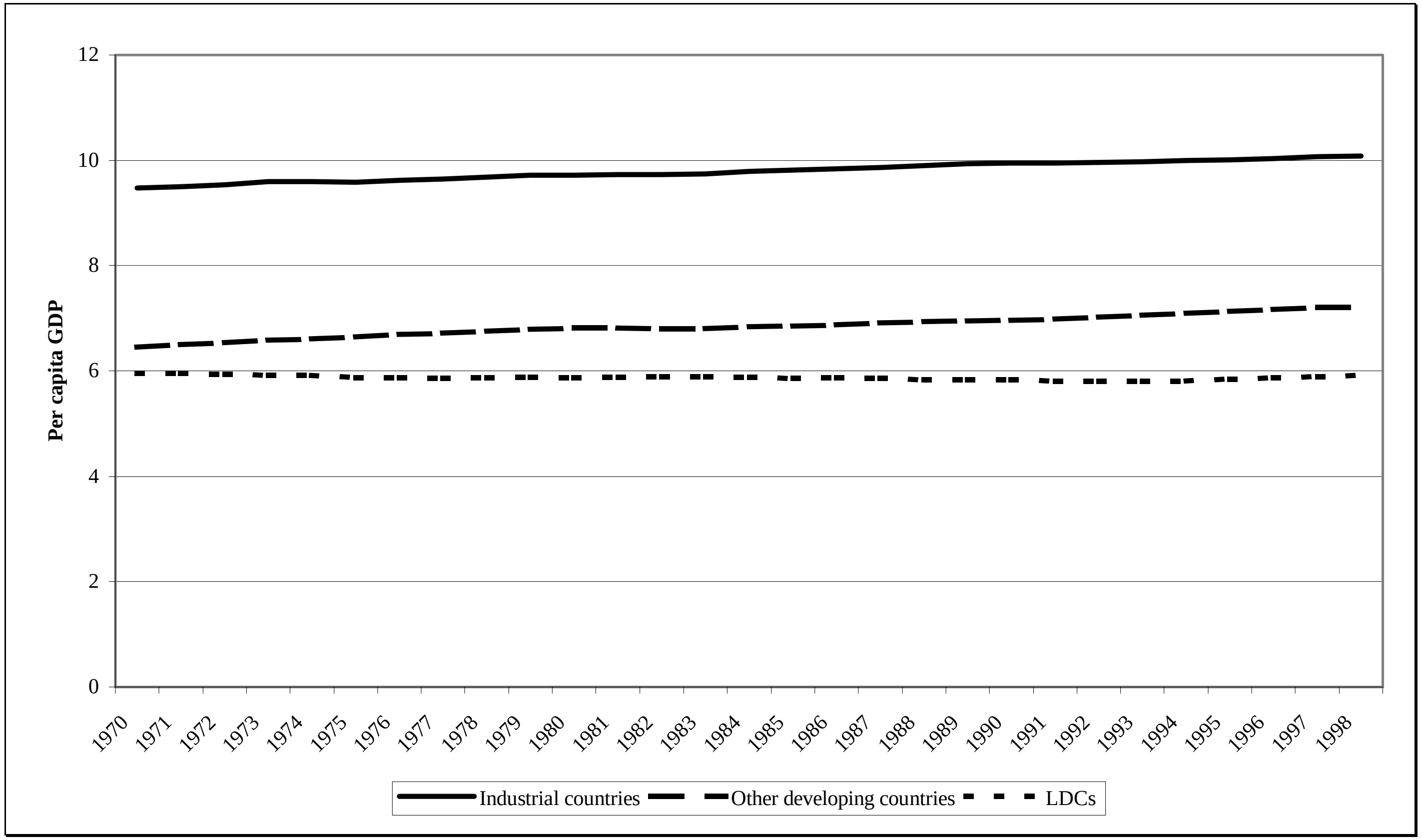
1.1 Growing gaps

Alongside the goods it makes available to the entire world, industry generates income for the factors it employs and fosters growth in the rest of the economy. Here too, the achievements of the last three decades have been without par. The industrialized countries have benefited from these economic dividends mostly through productivity gains realized as the growth of industrial output surpassed that of industrial jobs. The developing countries have benefited both through productivity gains and an expansion of industry relative to the rest of the economy. The impact of expansion combined with productivity growth considerably improved the living conditions of many developing countries. Among them, a handful of champions were pulled from poverty and technological backwardness to relative affluence and state-of-the-art technology.

But, at this point the paean must be attenuated. The tidal surge of industry in most parts of the world left stranded a group of about 50 countries, the LDC's.

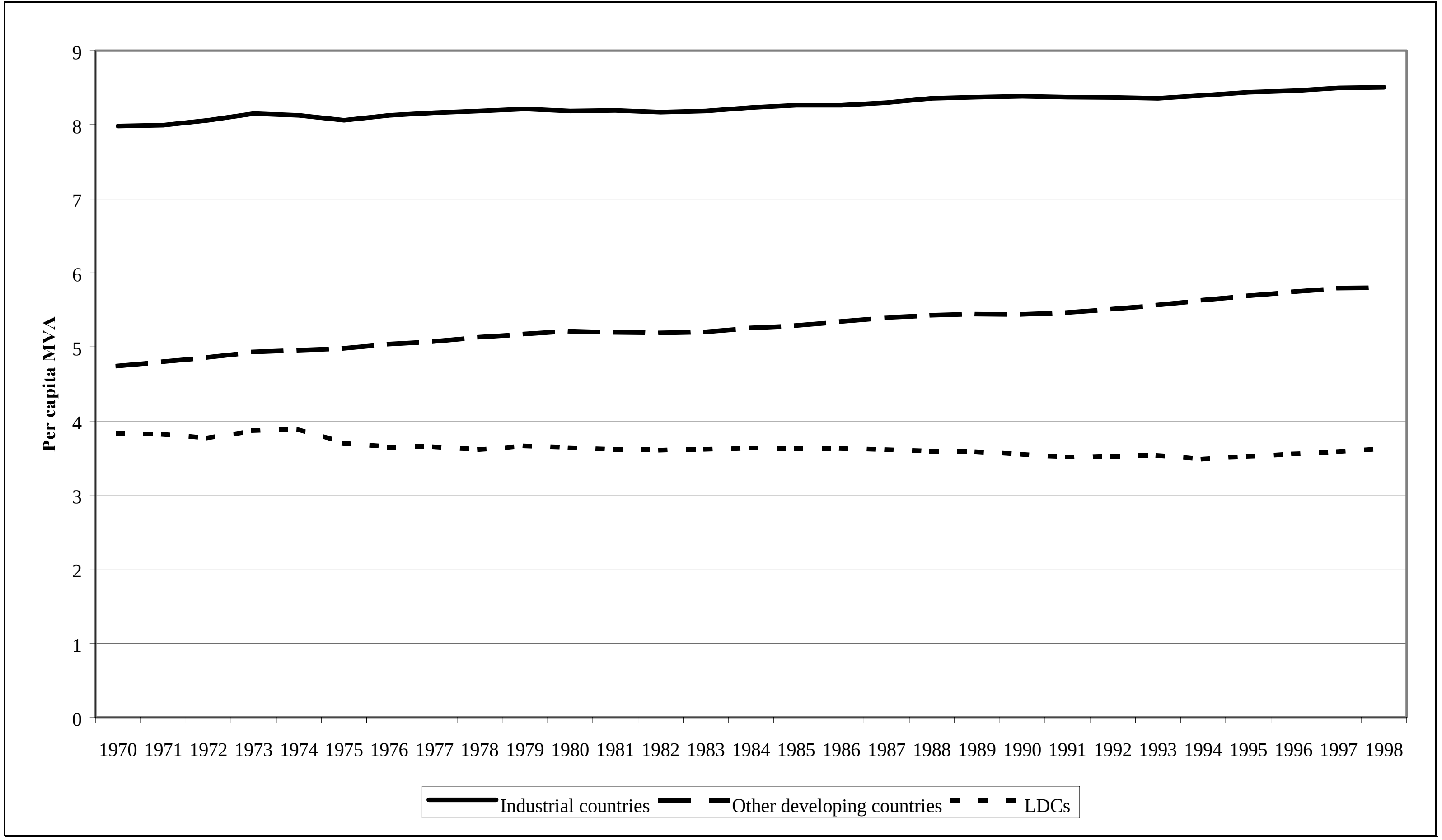
This can be seen with appalling clarity when considering Figures 1 and 2, which show, for most of those countries that in 1997 were classified as LDCs, plus two other country groups, aggregate levels of GDP per capita, on the one hand, and of per capita manufacturing value added, on the other, as they have developed over the past three decades. Over the last thirty years, the LDCs appear to have lost considerable ground with respect to the rest of the world[ii].

Figure 1 Gross domestic product (GDP) per capita, by country group, 1970 to 1998



Source: UNIDO calculations based on data from the UNIDO Statistics Database.
Note: The figure shows weighted group averages of real levels of per capita GDP with population as the weighting variable. Values are in 1990 US dollars per person and are plotted on a natural-logarithmic scale.

Figure 2 Manufacturing value added (MVA) per capita, by country group, 1970 to 1998



Source: UNIDO calculations based on data from the UNIDO Statistics Database.

Note: The figure shows weighted group averages of real levels of per capita MVA with population as the weighting variable. Values are in 1990 US dollars per person and are plotted on a natural-logarithmic scale.

As Figure 1 shows, thirty years ago, today's LDCs were not so far behind the other developing countries as far as GDP per capita is concerned: the gap was a little over one-and-a-half. Now, the other developing countries are over three-and-a-half times better off than the LDCs. While the income gap between industrial countries and the other developing countries narrowed from over 20/1 to under 18/1, that between industrial countries and LDCs widened from around 30/1 to over 60/1.

That the LDCs fared so poorly with respect to the other developing countries seems puzzling, given that both groups were at similar income levels thirty years ago. A clue to the cause of the divergence can perhaps be found in the initial conditions of manufacturing in the two groups of developing countries displayed in Figure 2. Thirty years ago, a visible difference between LDCs and other developing countries was that the former group had attained only 2/5 of the level of MVA per capita of the latter group. Given what we know of the dynamics specific to industry, it is quite plausible that the initial hiatus in the level of industrialization has geared the two groups onto divergent trajectories. Anyway, whereas the other developing countries industrialized ever faster, to the point of outpacing markedly the developed countries, the LDCs stagnated.

Of course, the divergent trajectories played like opening scissors on the respective *industrial* gaps between the two groups and industrialized countries.

Thirty years ago, the LDCs were at two-fifths of the level of MVA per capita of the other developing countries. Now, the other developing countries are nearly nine times more productive in the manufacturing field than the LDCS. Over the last thirty years, the other developing countries have been converging towards the industrial countries' per capita levels of manufacturing output. The 'industrial gap' - measured by the ratio of per capita MVA - narrowed from over 25/1 in the beginning to around 15/1 today.

In sharp contrast, divergence between the industrial countries and the LDCs led to an increase in the per capita MVA-ratio from over 60/1 to over 130/1 during the past three decades. Some marginalization indeed, and not an accidental one at that for the statistical evidence is clear: the marginalization is not an artefact resulting from the choice of the beginning and end-years of the period. Figures 1 and 2 show that what is at play is long-term trends[iii].

1.2 What has technology to do with the opening scissors?

If the LDCs as a group were marginalized because they failed to industrialize, it must be asked why industrialization failed. This failure may perhaps appear to verify the prediction- based on the new findings of economic geography- that industry would not expand uniformly on the map of the world. Instead, it would agglomerate in places offering external economies capable of fuelling industrial growth. As economic geography would have it, places endowed with this kind of external economies are places where industries and the factors connected to it are already present. According to this theory, industrial growth would pick up easily, for instance, in Korea - because of the legacy of pre-WWII experience -, in South Africa- because of the experience acquired when the wars isolated the colony from the metropolis- or in Brazil – because of domestic-based incipient industrialization. But, countries from where industry is radically absent, even in the form of traces of a past industrialization, would be at quite a disadvantage to attract industries[iv].

If industry goes where industry is, then the fact that LDCs were at 2/5 of the level of industrialization of other developing countries means that the former group had less chances to attract further industries.

Until a certain point that is. Industry is attracted not only by the external economies of agglomeration but also by low labour costs. In places where there is no industry to remunerate labour, the labour costs are low. Hence, one would expect that with time, the income gap between regions *with* industries and regions *without* industries would grow so wide that, notwithstanding the centripetal force of agglomeration, some industries would move into the non-industrial regions to take advantage of the low factor compensation rates there.

That did happen to some extent in LDCs. For instance, the low salaries of Bangladesh, which is the industrial champion of LDCs, attracted industries that could no longer export from other South-Asian countries that had exhausted their export quotas. As the quotas were filled, the centripetal forces of agglomeration petered out in the neighbour exporting countries, thereby allowing the attraction of low salaries to play fully in the hands of Bangladesh.

But, that is about the only case out of 48 LDCs. At group level it makes hardly a difference with the result that, as seen in the previous section, the share of LDCs in world MVA remains stale over the whole last third of the century and seems doomed to remain there indefinitely.

What is it then that makes the staying power of marginalization in LDCs?

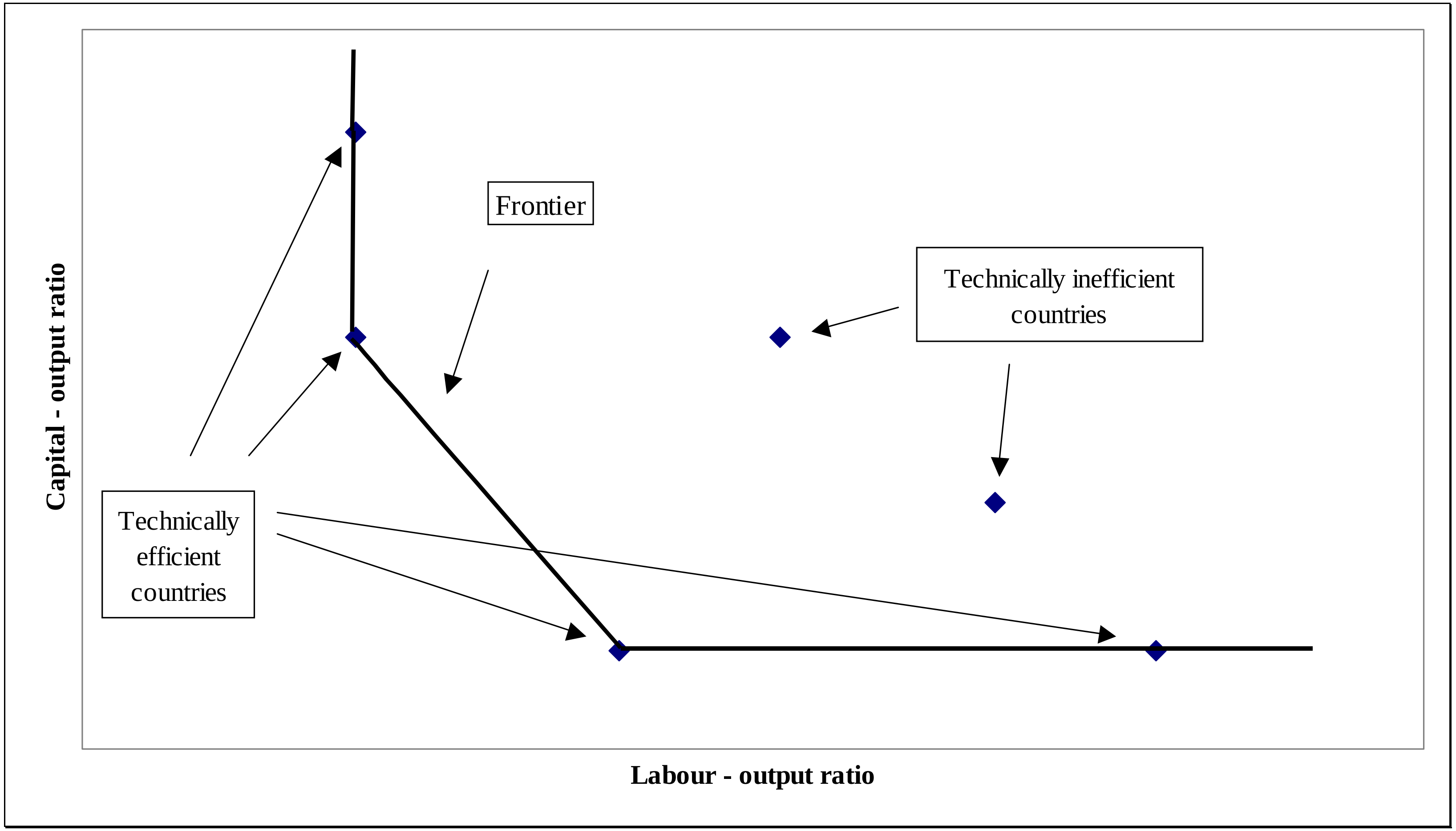
The statistical evidence on LDCs is scant to a point excluding a confident and complete answer to a question that is surely multidimensional. Yet, based on the available evidence, it can be submitted that LDCs remain marginalized because they are losing a technological race affecting productivity.

UNIDO arrived at this rather startling view by using the recently developed data envelopment analysis (DEA) to benchmark the technology frontier of LDCs. As DEA is a fairly new tool, it deserves a word of introduction. The concept of technology in use in economics refers to the set of techniques that are available for use in productive activities. As economists are concerned with the allocation of resources among competitive uses, the techniques themselves are not defined as engineering techniques but as combinations of resources. For instance, to an economist a technique A would consist in producing one unit of output with x units of, say, labour and y units of, say, capital. Efficient techniques are then those that allow a minimization of the production cost once the remuneration of the factors are taken into account (a technique could not be deemed efficient if it required a little more of one factor and no less of the other factors than some other available technique).

The set of efficient techniques available to given countries forms a sort of technology frontier for those countries. An illustration of this frontier for imaginary countries is given in Figure 3. Countries on the frontier have efficient techniques. Inefficient techniques are those that are at some distance from the frontier defined by the efficient techniques.

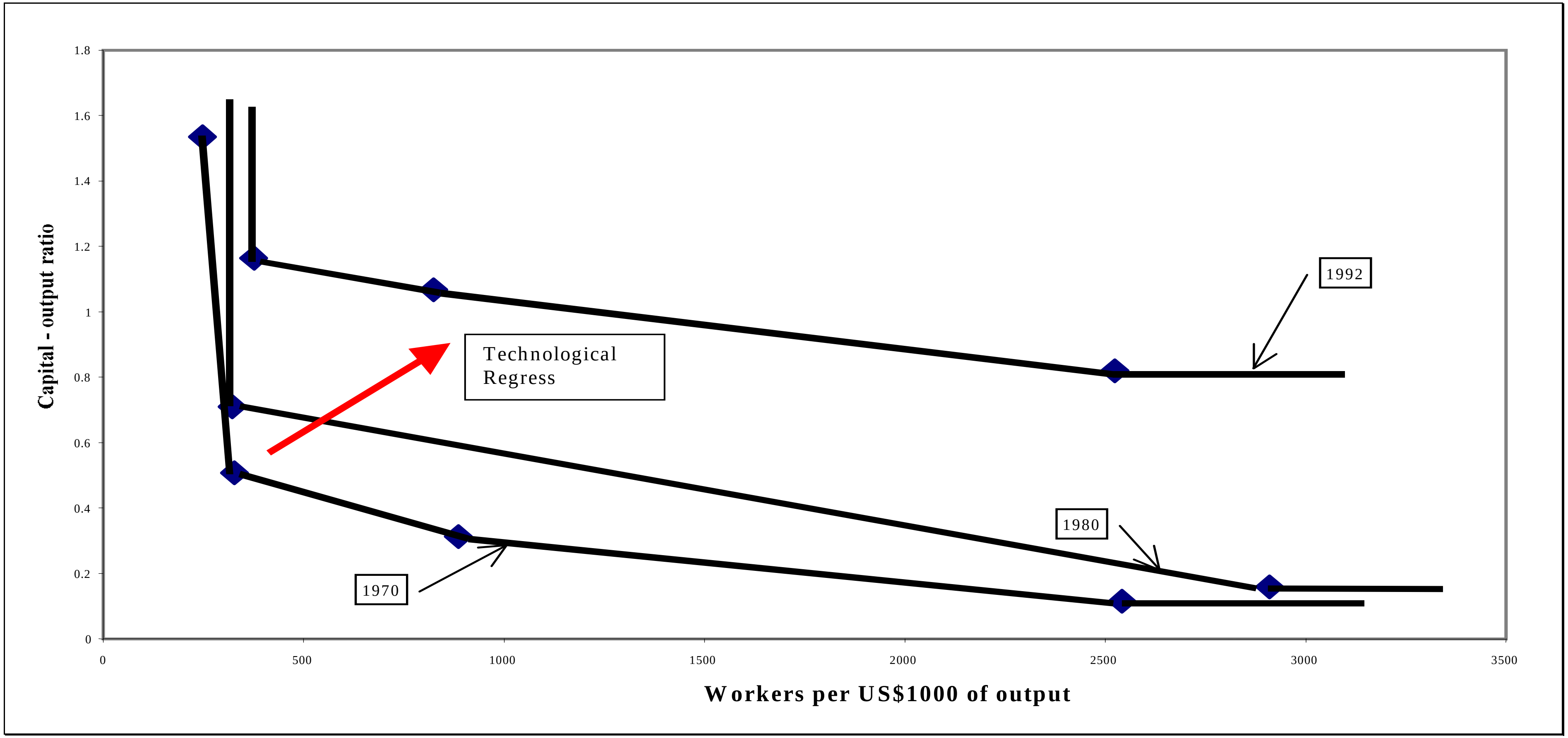
Using UNIDO's statistical database, the technology frontier of the actual LDCs has been calculated for several years[v]. These estimations – depicted in Figure 4 for 1970,1980 and 1992 - bring out one rather striking feature: Over the years, the frontier has moved North-Eastwards, indicating that the technology available to the LDCs – in particular, to those using the relatively best production techniques - has become more demanding in terms of both the factors considered. In other words, as time passes, it takes more capital and more labour to make one unit of output in LDCs. The technological shift in question has a Sisyphean quality that makes catching up ever more difficult as industrial marginalization widens the gap that is to be closed.

Figure 3 The technology frontier in theory



Note: The present 'input-orientated' representation of production builds on the assumption of constant returns to scale. The technology frontier is traced out by the most technically efficient countries. Countries to the north-east of the frontier are technically inefficient, i.e., they could reduce at least one of the inputs needed to produce one unit of output.

Figure 4 The technology frontier in reality: 32 LDCs, 1970–1980–1992



Source: UNIDO estimates based on data from the UNIDO Statistics Database.

Note: Each one of the technology frontiers shown here is not only typical for a given year, but also characteristic of 'best-practice' methods of production within the country sample under purview. (The 32 countries of the present sample are listed in endnote v.) Here too, constant returns to scale are assumed.

Figure 5 fills the background to the previous two figures with real-life data that are representative of LDCs and of industrial countries in 1992. The striking impression here is that a gulf separates LDC techniques from those used by the industrial countries. Capital intensity is the ratio of capital to labour (not of capital to output). A glance at Figure 5 suffices to realize that all industrial-country production is vastly more capital-intensive than all LDC production. A techniques-gap of this size puts industrial-country methods of production almost out of sight for the LDCs. The figure suggests that the two country groups use different technologies, represented by two different frontier curves. As LDCs have no own technology creation, change can only come from industrial countries and it will be necessarily a change in direction of more capital intensity since this is the exclusive formula in use in industrial countries.

1.3 How is productivity reacting to the technological shift?

As the technological shift involves the use of more capital and more labour per unit of output, one can be sure that productivity is on the decline. To find out the extent of this decline an additional bit of investigation is needed.

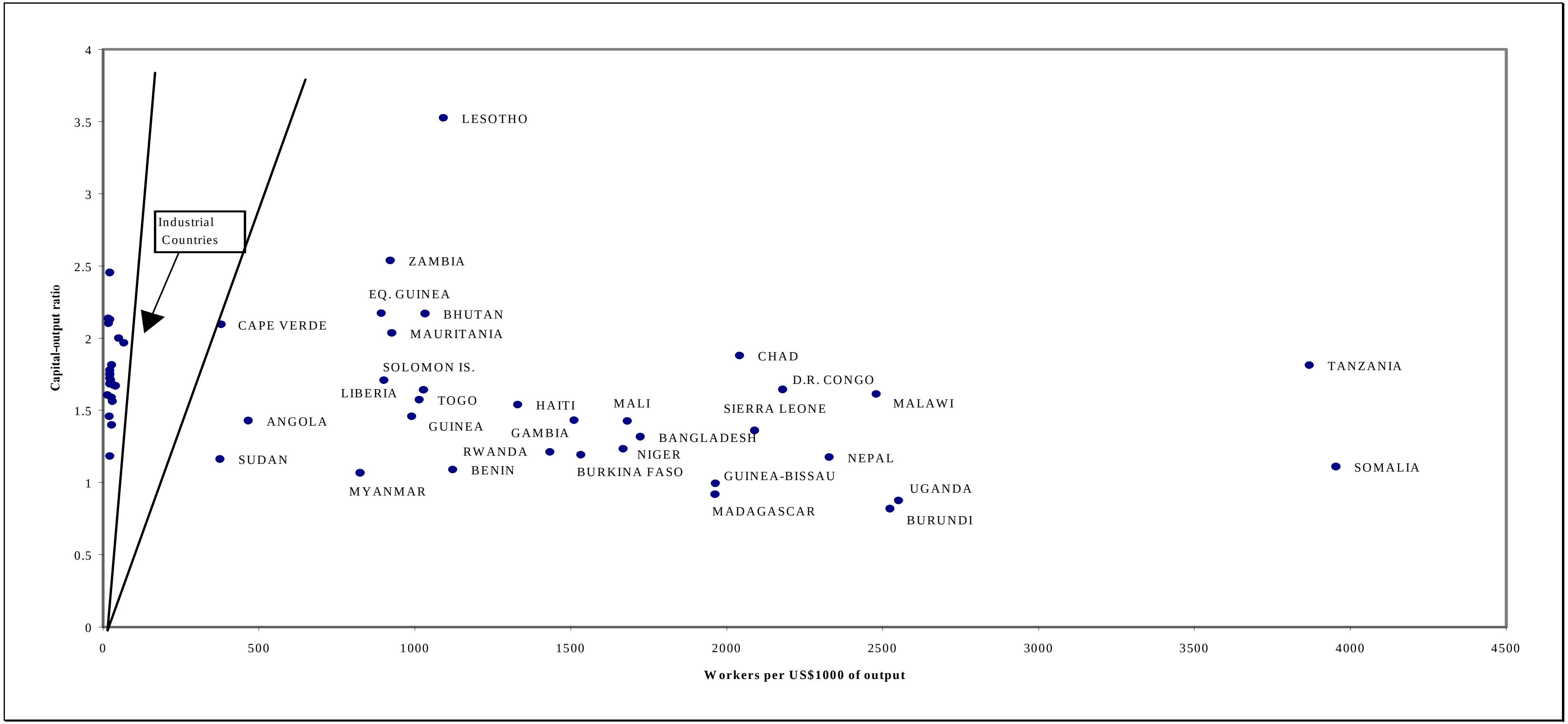
The productivity method used in this paper allows for a comprehensive appraisal of the factor-technology-output relationship based on the broad measure of productivity called total factor productivity (TFP).

Table 1 presents the results as an account of growth in LDCs between 1970 and 1992 in terms of productivity itself and of two of its major components: technological change and change in (technical) efficiency[vi].

On the whole, average productivity growth in those 32 LDCs for which data were available was negative, and this was the case also for each one of four sub-periods. Similar estimations for the industrial countries (not shown here) reveal an opposite trend for that group. Thus, it becomes clear that the divergence in per-capita GDP levels between the two groups that was reported in Figure 1 is rooted in divergence of overall productivity.

Undoubtedly, the most vital component in productivity change is that of technological change. As can be seen in Table 1, technological change over the past three decades appears to have brought about technological *regress* rather than *progress.* This is indeed a striking observation, one that demands careful interpretation[vii].

Figure 5 The technical divide: LDCs versus industrial countries, 1992



Source: UNIDO estimates and calculations based on data from the UNIDO Statistics Database.

Note: Each point in the plot represents a GDP-production technique, which is characteristic of a particular country. All value data involved in the calculations are in constant US dollars at 1990 prices. Country samples are as described in endnote v. The two straight lines drawn into the scatter plot delimit a factor-proportions cone that separates LDC from industrial-country production techniques.

Table 1 - Productivity, technology and technical efficiency of the LDCs:

Average annual change, 1970-1992

Period	Productivity	Technology	Technical efficiency
1970-75	0.983	0.967	1.016
1975-80	0.976	0.968	1.008
1980-85	0.977	0.949	1.030
1985-92	0.990	0.972	1.019
1970-92	***0.982***	***0.965***	***1.018***

Source: UNIDO estimates based on data from the UNIDO Statistics Database.

Note: All numbers in the table are index numbers. An index value larger (smaller) than unity indicates a positive (negative) change, whereas an index value of 1 indicates no change. Productivity is measured by the Malmquist index, which is decomposed into two components: one of them reflects the contribution of technological change and the other one that of change in technical efficiency. Calculations were carried out on a year-to-year-change basis, and all averaging over years was in terms of geometric means of index values. The LDC sample used here covers those 32 countries (listed in endnote v) for which data were available consistently for the time period studied here.

UNIDO has no evidence on why the technology frontier shifts to the northeast in the presentation of facts by the DEA method, or why the contribution of technological change to productivity was negative in the TFP presentation. In the former case the conjecture was made that it had to do with embodiment of technological change in techniques emanating from an industrial world where the technology is immensely more capital-intensive than in the recipient LDCs. This view comes from the evidence of the sharp contrast between the two technological worlds.

However, for good measure, additional speculations may be lined up. One that comes to mind first has to do with the availability of complementary factors. The more capital-intensive techniques become, the more their use will rely on skilled labour[viii] and supporting infrastructure. Exogenous causes, like AIDS and civil wars are taking their toll in precisely these two vital domains. No wonder that technology regresses and that productivity declines.

One thing that seems clear, though, is that negative productivity growth is not to be ascribed to some sort of sloppiness on the part of LDCs. On the contrary, LDC developments in *technical efficiency* (as shown in Table 1) leave a quite positive impression. Unlike productivity and technological change, the index of technical efficiency shows values greater than one – indicative of positive change- and this for each of the periods considered. There has been progress in technical efficiency and this LDC performance squares well, for example, with the intentions and also with part of the achievements of structural adjustment programmes. Reforms, such as trade liberalisation or price deregulation, were deemed to enforce adjustments at micro level. It is likely that the companies that survived were those that managed to become more efficient. Inversely, those less apt to increase efficiency are likely to have perished. As a result of less efficient firms exiting the market and more and increasingly efficient ones staying in business, it is logical that a rise of technical efficiency is observable in the aggregate.

2. Marginalization in trade – what are the prospects?

In the context of globalization, the industrialization of latecomers works as a process whereby un-sophisticated industrial goods made at home are exported to pay for the costs of learning to do state-of-the-art industrial goods and of acquiring the tools and inputs that will allow manufacturing these state-of-the-art goods. Now that globalization is going full steam, the role of exports as a key to modernity is quite universal, but it may be expected to be even more vital in the case of LDCs because of their modest economic size.

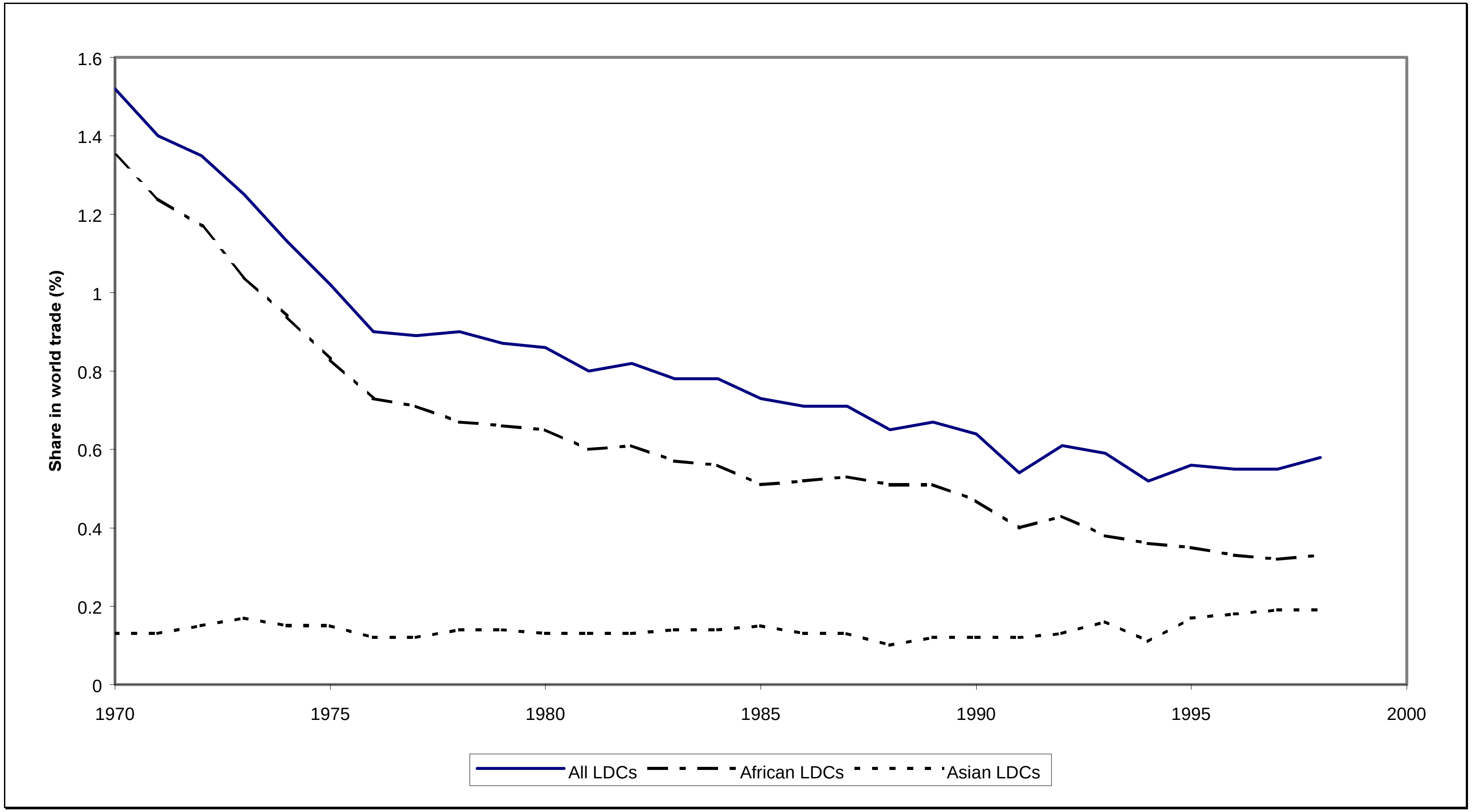
However, if that process is to be the destiny of LDCs, the preceding findings are surely a cause to worry. The technology to make state-of-the-art goods seems very far from the reach of LDCs. To get there will require a powerful stream of imports and a corresponding export drive. Yet there is hardly an LDC industry to feed its products to export markets.

As time passes, the situation deteriorates. Moves of the technology frontier such as could be performed over three decades seem like blocking industrialization without bringing any significant bridge between the polar technology worlds. Whereas industrialization fails to pick up, it becomes ever more necessary to find exportables because the technological shifts accelerate the turnover of capital and orient it towards capital goods embodying ever more capital intensive techniques. Productivity, the mother of competitiveness, is pushed in a direction adverse to exports. With dwindling productivity, whatever goods are there to be exported find it increasingly difficult to defend their market shares.

2.1 Plummeting world trade shares

The result, as it were, of losing the technological race in the competitiveness contest can be seen in Figure 6 depicting the participation of LDCs in world trade (the sum of world exports and imports of commodities)[ix]. From a mere one-and-a-half per cent participation in world trade in 1970, the LDCs as a group sink into an abysmal one-half per cent in the late 1990s. Asian LDCs do better than African ones. This is due principally to the export-oriented incipient industrialization of Bangladesh.

Figure 6 Participation of the LDCs in world trade, 1970 to 1998



Source: UNIDO calculations based on UN Commodity Trade Statistics
Note: 'Trade' is the sum of exports and imports of all commodities.

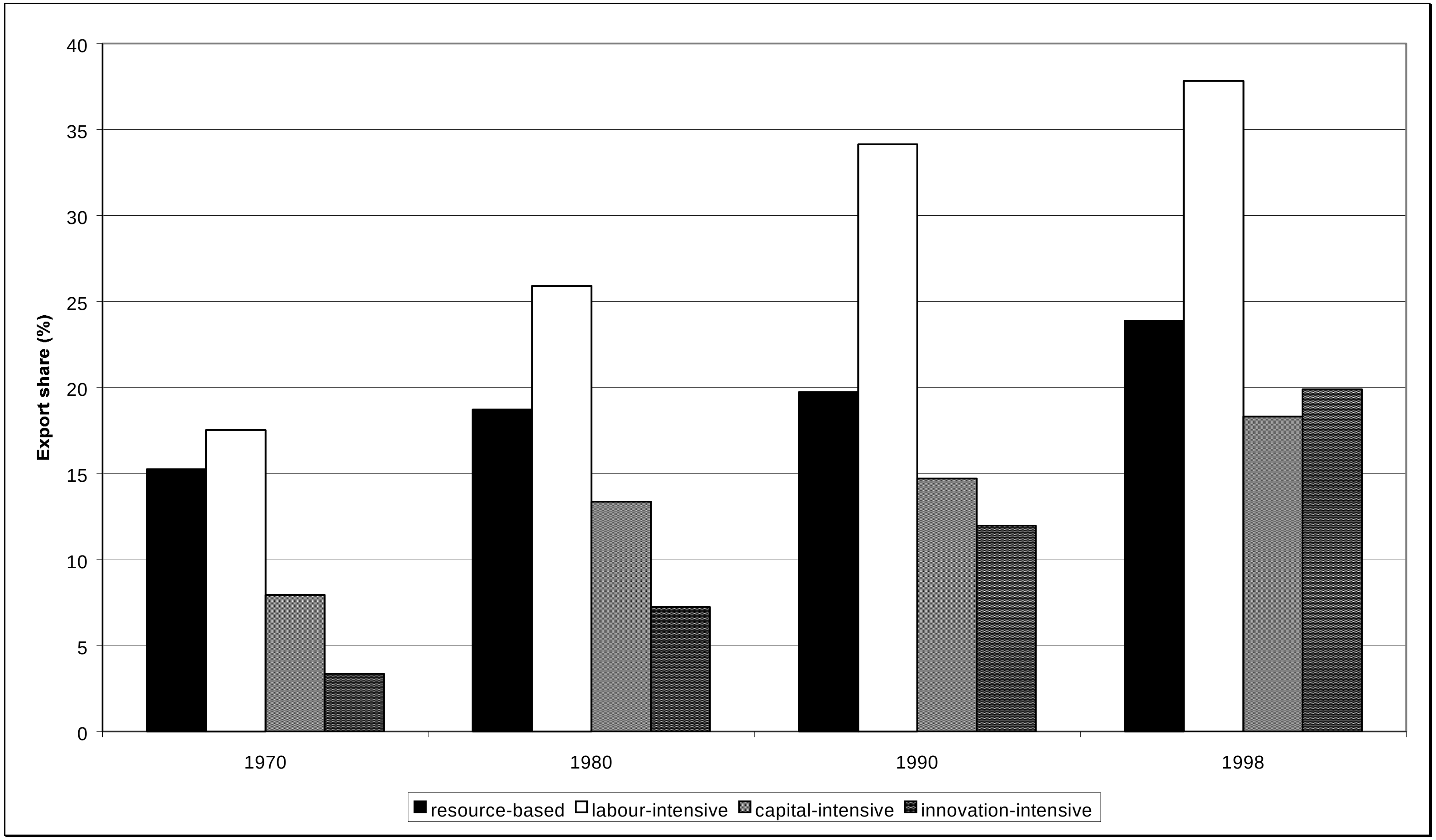
The cause of this rout is in the jammed industrialization of LDCs. Whereas the other developing countries make their way to globalization thanks to a breakthrough in manufacturing exports, which itself is the most dynamic sector of world merchandise trade, the LDCs are trapped at bottom level. The most glaring illustration of this contrast appears from comparing Figures 7 and 8 where the comparative advantages that the two groups of countries have in several areas of manufacturing are depicted. In all areas the comparative advantages of the other developing countries (Figure 7) are on a monotonic increase throughout the 1970-1998 period. In LDCs (Figure 8), on the contrary, there is a struggle to maintain the minuscule ground held in manufactures based on labour, capital and innovation and there is a spectacular withdrawal in resource-based manufactures that 30 years ago were a relative forte[x].

2.2 Dwindling imports of capital goods

Capital goods are vital for growth, of course, and, in conditions of swift technological change, capital goods imported from where technological change is concocted, are particularly vital. Without exports, though, access to imported capital goods cannot occur. Figure 9 provides an overview of what has happened to absorption of imported capital goods by LDCs between 1970 and today. By the late 1990s the LDC share in world imports of such goods had dropped to one-fourth of its 1970 level.

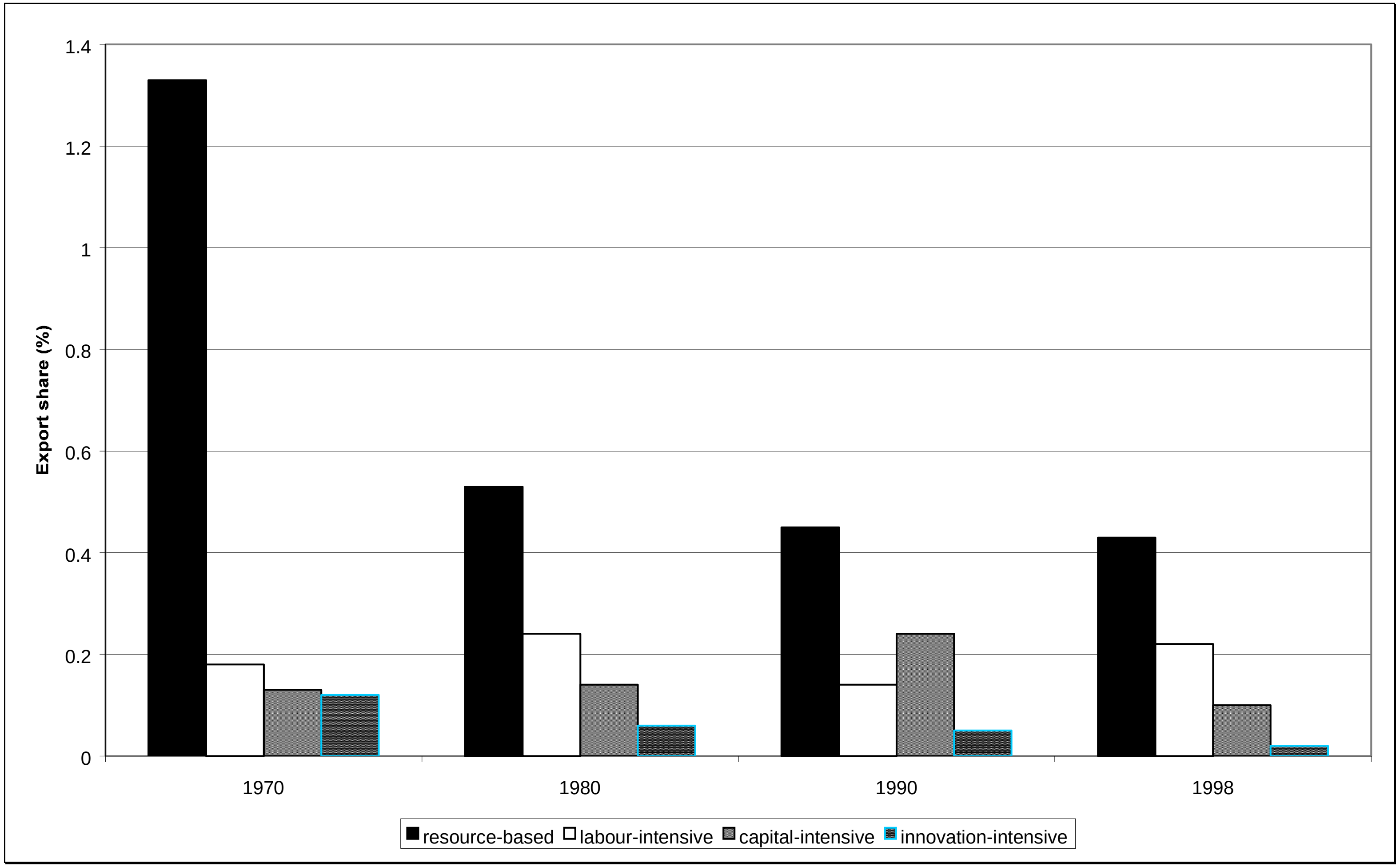
At individual country level the drying up of capital goods imports over the past three decades has been alarming in many cases. For the ten worst-off countries in terms of access to capital goods from abroad (including Somalia, the Democratic Republic of Congo, Zambia, Sierra Leone and Mozambique) the corresponding import share has been reduced by factors of between one-fortieth to one-sixth. And for two-thirds of the members of the LDC group this import share was more than halved between 1970 and 1998. At the ‘upper’ end of the distribution by relative levels of capital-goods imports there are only five countries for which absorption of such imports has increased. Most of these countries progress because of a low departure level like the Maldives, starting from virtually zero around 1970 to reach over 100 million dollars imports of capital goods per year in the late 1990s, or like Bhutan, which achieved a five-fold increase in its share of capital-goods imports.

Figure 7 Participation of other developing countries in world manufactured exports, by product category, 1970 to 1998



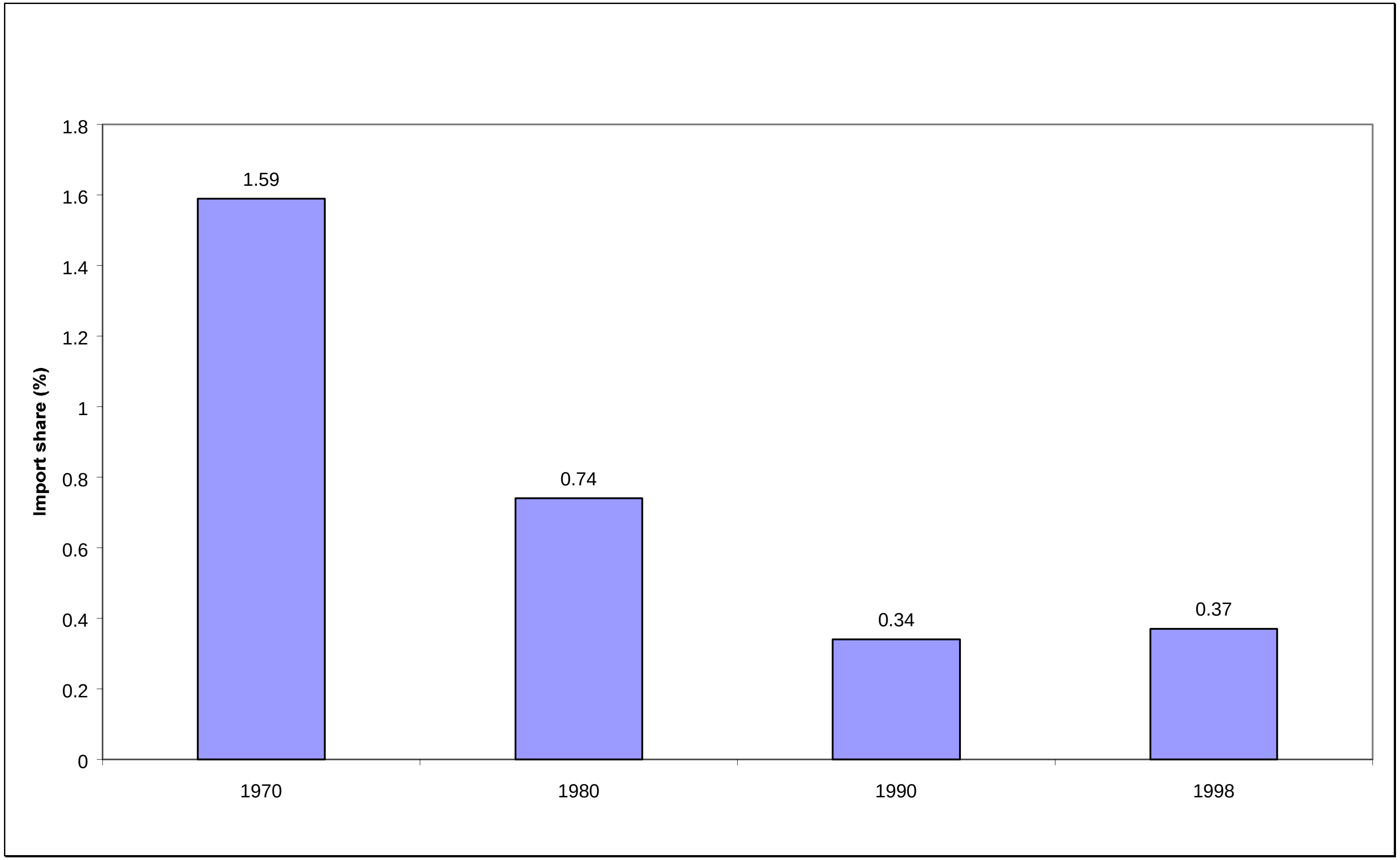
Source: UNIDO calculations based on UN Commodity Trade Statistics.

Figure 8 Participation of the LDCs in world manufactured exports, by product category, 1970 to 1998



Source: UNIDO calculations based on UN Commodity Trade Statistics.

Figure 9 The share of the LDCs in world imports of capital goods, 1970 to 1998



Source: UNIDO calculations based on UN Commodity Trade Statistics.

Exceptionally, the case of Bangladesh, tripling its share in world capital goods imports, indicates a positive spiral of exports of manufactures leading to imports of manufactures.

3. Conclusions

The LDCs are in trouble because they do not get industrialized. If everything goes on as in the past, misery is ineluctable. Poverty alleviation transfers on ever larger scales will have to be provided willy-nilly.

Things will not get better by themselves. The findings in Section 1 point to a shift in the technology frontier that makes catching up more difficult as the industrial gap widens. It is not only that the difficulty increases; it is also that the means to tackle it are dwindling. No matter the efforts on the efficiency side, the technological shift curtails productivity to the point of jeopardizing competitiveness. This may be a globalizing world, but, without an industrial base, LDC exports are not with it. Yet, without exports, there is no way to pay for the capital goods that could pave the way for industry, exports and, eventually, growth.

The way ahead consists in building an industrial base from where a modernization spiral will be launched. The markets won't do it because the market way to industrialization is through agglomeration, meaning that an industrial void is an obstacle rather than an incentive to industrialization. The industrial base to erect in LDCs must be thought of as a public good. From its cost must be discounted the poverty alleviation transfers that will increasingly be needed if the radical poverty reduction way is ignored.

The first step towards the industrial base might seem to be a crash Trade Facilitation programme: to do what it takes to set up a first line of industrial plants capable of churning out exportables.

Endnotes

[i] All empirical results presented here are extracts from ongoing research in UNIDO out of which two papers will grow, namely, UNIDO (2001) and Forstner, Isaksson and Ng (2001).

[ii] The term LDCs, as it is used in the present paper, applies to the following 48 countries that the United Nations defined as 'least developed' in 1997: Afghanistan(*), Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati(*), Lao PDR(*), Lesotho, Liberia, Madagascar, Malawi, Maldives(*), Mali, Mauritania, Mozambique(*), Myanmar, Nepal, Niger, Rwanda, Samoa, Sao Tome and Principe, Sierra Leone, Solomon Islands, Somalia, Sudan, Tanzania, Togo, Tuvalu(*), Uganda, Vanuatu, Yemen, Rep.(*), Zambia. Countries marked with an asterisk could not be included in the group aggregates shown in Figures 1 and 2, due to gaps in their data. The two 'reference groups' of countries used here to analyze LDC developments are 93 developing countries other than LDCs ('Other developing countries') and 22 'Industrial countries', namely, Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States. Per capita values of GDP and of MVA for a whole group are weighted averages where population is used as the weight. In other words, a country group – in particular, that of LDCs – is viewed as the aggregate of its members, a view which is appropriate in the present case where the overall situation of LDCs is to be assessed. The figures show the respective per capita levels in logarithmic form, which allows for direct measurement of changes in gaps, in other words, of divergence or convergence.

[iii] Divergence of LDC per capita levels of GDP and MVA from those of the other two groups is, of course, accentuated by the choice of a stable composition of this group over the whole period. Tracing back in history the 1997-version of the LDC group brings into our purview the decline of some countries that had not started out as LDCs 30 years ago, but today are members of this group.

[iv] A brief discussion of the issue of agglomeration in industrial development is found in Robyn (2000).

[v] In order to estimate the technology frontier of aggregate production in LDCs, data are required on GDP, capital stock and labour force. While time series on GDP (in 1990 US dollars) and labour force were readily available from the UNIDO Statistics Database, capital stock (also in 1990 US dollars) had to be estimated on the basis of data on gross fixed capital formation and by use of the perpetual inventory method. Here the approach outlined in Easterly and Levine (2000) was followed by and large, with an assumed depreciation rate of 10 percent and estimation of initial capital stocks based on a steady-state assumption (King and Levine, 1994). In this way, time series from 1970 to 1992 on the above three variables were obtained for the following 32 LDCs for which the required data were available: Angola, Bangladesh, Benin, Bhutan, Burkina-Faso, Burundi, Cape Verde, Chad, Democratic

Republic of Congo, Equatorial Guinea, The Gambia, Guinea, Guinea-Bissau, Haiti, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Myanmar, Nepal, Niger, Rwanda, Sierra Leone, Solomon Islands, Somalia, Sudan, Tanzania, Togo, Uganda, Zambia. Finally, in the estimation of the frontier the input version of data envelopment analysis (DEA) was applied, assuming constant returns to scale (Coelli, Prasada Rao and Battese, 1998).

[vi] The measure of total factor productivity used here is the Malmquist index. This index measures a change in productivity with reference to a (best-practice) technology frontier which itself shifts over time. Due to this frontier relation, the method allows for a decomposition of a change in (total factor) productivity into two components or contributions: that of technological change on the one hand and that of a change in technical efficiency on the other (Faere, Grosskopf, Norris and Zhang, 1994). In the present case productivity change and its two components were first measured on a year-to-year basis and then averaged over the whole period as well as over several sub-periods.

[vii] Throughout the paper a distinction is maintained between the terms 'technical' and 'technological' that is based on terminology normally used in production theory. Thus, everything relating to the production frontier is termed 'technological' for obvious reasons: In particular, a shift of this frontier is associated with 'technological' (rather than 'technical') change, irrespective of the sources of such change.

[viii] Some basic information on skill-biased technological change and its relevance to developing country industrialization can be found in Machin (2000).

[ix] The source of trade data is the United Nations Commodity Trade Statistics. In order to obtain maximum coverage of LDCs, gaps in reported data were filled through imputation from partner country information, i.e., a missing export figure was filled in from the aggregate imports of all trading partners and similarly for imports.

[x] The shares shown in Figures 7 and 8 can be read as measures of revealed comparative advantage as they are discussed, e.g., in UNIDO (1986). The definition of product categories is taken from UNIDO (1986) and UNIDO (2000).

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