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New technologies, innovations and competitiveness

Background Paper

Technology, manufactured exports and competitiveness

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Summary of Findings

- Amongst the many changes in the structure of the international economy in the recent past, two in particular are important to an understanding of the way technological factors affect competitiveness of developing countries' manufacturing sector. First, nearly all developing countries have greatly reduced levels of protection and opened their economies to international trade and investment. Second, technological change in industry has probably accelerated in the last twenty years, and under the influence of new technologies has certainly influenced many more sectors than in the past - some of them sectors which used to be regarded as technologically 'slow moving' and which play an important part in early industrialisation in developing countries.

- 9The last twenty years have seen a remarkable expansion of manufactured exports from developing countries. More than a third of the 118 countries for which we were able to establish internationally comparable data, show a significant growth trend for manufactured exports. In this group are some of the most populous countries in the world - China, India, Indonesia and Pakistan. Manufactured exports grew more rapidly in the 1970's than in the 1980's, largely because of weakening demand in the industrial countries in the latter period.

- At the same time there is a large number of countries whose entry into manufactured export trade has been limited and sporadic. All the sub-Saharan economies appear to belong to this group as do most Latin American countries.

- Countries which have had high growth rates of manufactured exports - and which we therefore defined as internationally competitive - do not necessarily owe their competitiveness to technological factors. High export growth rates are just as much associated with low productivity growth as with high. Countries with high export growth and low productivity growth - like Mauritius and Sri Lanka - have focused their export development on sectors in which they have established strong static comparative advantages. Latin American countries show similar patterns, usually associated with natural resource based industrialisation. Other countries - for example Korea and Singapore, along with China, India, Indonesia, Malaysia, Pakistan, and Thailand - may be described as being on a high productivity growth path. The contrast between these two types of export oriented growth path can be overdrawn. Obviously most countries - even the most technologically dynamic - show features of each. However, the notion of distinctive growth paths reflects an important reality. The majority of developing countries which have not experienced export growth in a significant way, show little sign of growth of productivity in manufacturing

- These different types of growth path are distinguished - although not always very clearly - by different patterns of structural change within manufacturing production. Countries with

high productivity growth have, in many cases, shown shifts in production away from the technologically simple (and generally labour intensive) sectors towards technologically more sophisticated production, in sectors like electrical machinery (including electronics), non-electrical machinery and transport equipment. Higher rates of growth of productivity have been associated with shifts in production and trade to sectors where value-added per worker is not only higher than in the less sophisticated sectors, but also tends to grow faster. The large group of economies which have not experienced a sustained expansion of manufactured exports, have not shown any clear trends towards rising productivities nor towards structural change in production.

- There is some tendency for the low productivity growth path to be associated with situations of general labour surplus in the economy, in the way economic theory would suggest. However, in most of the high productivity growth economies, the shift towards more sophisticated technologies - which is termed 'technological upgrading' - took place *well before* the full absorption of excess labour. Furthermore - either as a cause or as an outcome of this early shift in technologies - real wages started to rise in the high productivity growth economies before the full absorption of surplus labour.

- There is a relationship between the rate of growth of value-added productivity and the rate of growth of real earnings per worker. Countries which have experienced higher rates of growth of labour productivity have also - by and large - had higher rates of growth of real earnings per worker in the manufacturing sector. Consequently amongst the more successful manufactured export economies, the technologically dynamic ones have had high rates of real wage growth whilst maintaining the shares of labour and capital in value added more or less stable. It is very likely that this helps maintain the incentive to invest, which has been so marked in some of the countries in question. Countries which have stuck to more traditional, technologically less sophisticated manufactured exports have benefited much less from rising real wages. Here maintaining the incentive to invest depends importantly on withstanding too large increases in real wages in comparison to real wage rises elsewhere.

- The implications of these different growth paths for distribution of income and welfare depends in part on the rate of growth of real wages (discussed above) and in part on their effects on the growth of manufacturing employment. In practice, over the last two decades, the growth of manufacturing employment in export led economies has been determined primarily by the rate of growth of exports. High productivity growth has not been associated with slow employment growth, because of the overriding influence of expanding export demand. So, as far as the high export growth economies are concerned, 'technological unemployment' has not been a problem, whether they have followed the high productivity growth path or the low. However, this has depended on the high rates of expansion of world trade; trade offs between productivity growth and export growth might appear in a period of sluggish trade.

- The different productivity growth paths may affect income distribution and welfare differently, through their effects on the gender structure of employment. Low productivity growth paths are mainly associated with absorption of unskilled labour into the manufacturing sector at low wage rates. Both male and female workers are involved. However, there is some evidence that employment of women workers may be a way of

keeping the effective wage rate down - in part to face technological competition in international markets. Furthermore, when shifts are made to more advanced production technologies in the transition to higher productivity (and higher wage) growth, women workers seem to be displaced by men. However, women workers probably stand to gain on balance from the shift to higher productivity growth paths, because the growth of incomes which results gives an impetus to service sector development, where women's employment opportunities using new technologies are better.

- The shift to a high productivity growth path - with the attendant changes in the structure of production towards more technologically sophisticated outputs - depends importantly on prior accumulations of technological capability. It is, in this sense, 'path dependent'. The path dependencies occur at two levels. First, shifts to higher labour productivity technologies depend on the accumulation of technological capabilities in the production and service firms. This accumulation is based on processes of technological learning within firms which are increasingly (but not fully) understood. Second, the *national system of innovation* in countries has to be developed to support the shift to higher technologies. Amongst other things this involves: development of higher education and especially relevant technical education; linking of national laboratory systems to the production and service sectors; development of important ancillary technological functions like standards setting, technical information systems linked to the needs of industries; and support for international transfers of technology.

Analysis of Policy Options

- In general it is mistaken to conclude from the findings of the study, that governments may easily choose between the low and high productivity growth paths described above. These paths may only be conceived of as developmental alternatives in a limited sense. The real policy issue is not to decide between growth paths in a general way; it is to determine *when to make the shift* from a low productivity path (which is where all countries start) to a higher productivity path.

- It is easy but mistaken to overlook the importance of the low productivity (labour or resource intensive) pattern of exports. There are five reasons why the low productivity path is important. First, this growth path is based on the exploitation of sources of immediate comparative advantages (abundant labour and/or resources), and has characterised the economic history of all countries which have subsequently established strong positions in manufactured exports. Second, for the majority group of developing countries which have yet to enter international trade in manufactures in a sustained way and which are technologically weak, there is no real alternative. Third, there are important complementarities between the low and high productivity growth paths. Exports built up initially with technologically simple products, provide the foreign exchange needed to sustain investment in more sophisticated sectors. And in so far as the rate of learning and productivity increase in those sectors depends on the rate of investment in them, low technology exports must be regarded as an essential part of a strategy of learning and technology upgrading. Fourth, it is important to establish a strong basis of low technology exports as a way of hedging against the risks that may be associated with the shift to higher technology production. Fifth, and finally, low productivity exports create more employment per unit of output. In periods when international trade grows slowly (unlike the past twenty years or so), this may be an important consideration in terms of income distribution. The qualification is that low productivity production often requires that wages be held down to maintain competitiveness.

When countries have built up commercial experience in export of technologically simply manufactures, and technological capabilities in the production and service sectors, a shift to higher productivity exports may become desirable. This shift may be described as '*technology upgrading*'. The advantages of technology upgrading are as follows.

- First, to the extent that exports of technologically simple manufactures are successful, countries will sooner or later have to face the need for higher productivity technologies. It is not clear how well this shift is mediated by the market by itself.

- Second, technology upgrading allows a rising real wage, without necessarily diminishing the share of profits in value added. This helps to maintain the incentives to invest and (provided that the aggregate level of employment is maintained by a high enough growth of export demand) has positive implications for income distribution. The shift to higher productivity and higher wage production may displace women workers - but the

development of service sector employment can counterbalance this negative effect on the gender division of labour.

- Third, it enables a shift towards products which have a higher income elasticity of demand in industrialised countries' markets and so helps to maintain export demand.

- Fourth, upgrading makes it possible for a country to respond to competition from lower wage economies 'coming along behind'. Upgrading allows a country to increase its market share in technologically more sophisticated goods whilst leaving room for lower wage economies to increase their shares in the simpler manufactures. There appears to be an important aspect of collective interest in encouraging already successful exporters to upgrade.

Important Elements for Policies of Technological Upgrading

- Technological upgrading will normally require effective transfer of technologies from abroad.

  Upgrading cannot be accomplished all at once without sustained preparation. If upgrading is to be successful the 'path dependencies' discussed above must be met. This requires considerable prior investment (during the low technology phase of export development), in technical training and higher education. If women are to have a role in the new systems of production they will obviously need to have access to this training too. In addition, technological information and technology transfer systems and other key elements in the national system of innovation need to be created and there have to be efforts to link national research laboratory systems to production. These are all areas in which the role of the state is generally agreed to be important. These requirements mean that upgrading will be easier to achieve efficiently in countries which have a substantial history of scientific and technological education and research.

- Upgrading also crucially requires the encouragement of technological learning processes in firms. It is rather unclear how far market will engender this process of accumulation of technological capabilities. Provided firms have adequate information on technological matters to frame their decisions, they might be expected to undertake some technological learning investments. However, there are both practical and theoretical reasons for doubting the adequacy of unaided market forces in this field. On the practical side, it is observable that many countries which have achieved high rates of technological learning in firms, have used various forms of temporary protection or subsidy to encourage it. Against this there is as yet very little evidence about the effectiveness of learning processes under conditions where the state is neutral. On the theoretical side, it has long been accepted that technological learning processes generate important externalities, so that whilst learning may take place in response to unaided market signals, it will be suboptimal in amount.

- Technological jumps such as upgrading implies, are risky and whether the state intervenes in generating them or not, it is important to limit the risks of failure. There are two strategies which should help to do this. First, the technological 'jump' involved in upgrading should not be too large. In other words the shift should be towards fields where the initial skills required in the production sector are available. This is obviously not guaranteed by simply providing protection to the new firms or sectors. Second, countries which are currently engaged in low technology exports, should seek in the first instance to encourage learning processes in the low productivity sectors themselves. It makes sense to look for sources of 'dynamic comparative advantage' in those sectors where there is already a manifest static comparative advantage.

- Upgrading involves substantial social costs in the short run, whether it takes place under market conditions or stimulated by the state. These costs are associated with the fact that upgrading and the learning process upon which it depends, involve the allocation of resources to sectors which in the short term (until learning takes place) involve a sacrifice

of factor productivities. To reduce these costs it is important that the period of foregone output should be shortened as far as reasonably possible. Two conditions can help in this. One is that upgrading should only be undertaken when there is a sufficiently large export base (of technologically less sophisticated outputs) to sustain a high rate of capital goods import and investment in the new sector or product. The other - already mentioned - is that the technological demands posed by the new lines of production should not be too far out of line with the technological skills already accumulated in the economy.

I. Introduction[1]

This paper explores the role of technological factors in developing countries' efforts to become internationally competitive in the manufactured exports. It also explores the main effects of technological change on the distribution of welfare in countries with export-led growth. This is based on an empirical analysis of effects on real wages and income levels, on employment in general and on women's employment in particular.

The paper is structured as follows. In Part II which follows there is a brief discussion of two key conditions which have characterised the international context in the past decade. These are first, the liberalisation of most of the national economies in the developing world, which has greatly changed the terms on which economic policies for development have to be conceived. And second, the acceleration of technological change and the emergence of new families of generic technologies. This brief discussion is the background to an empirical analysis in Part III of the role of technological factors in the development of export competitiveness in the developing countries. This part suggests that it is possible to discern different technological growth paths associated with the development of manufactured exports from developing countries. High and sustained export growth is sometimes linked to a high rate of growth of factor productivities, but not always. Some countries have achieved high export performance on the basis of relatively low productivity growth. Part IV then discusses the implications of these different growth paths. It examines distributional effects arising through the growth or stagnation of real wages, aggregate employment effects, and especially the effects on women's employment.

Part V then draws the main conclusions for policy. It strongly emphasises the importance of the labour intensive relatively low productivity pattern of export growth as having characterised the early entry into international markets of all developing countries which are today amongst the main exporters of manufactures, and as being essential as the point of entry for the large number of developing countries which as yet have not entered international markets for industrial goods. It emphasises that labour intensive 'traditional' manufactured exports are an important complementary to policies of subsequent 'technological upgrading' whereby countries move up to the export of technologically more sophisticated manufactures. It is argued that the build up of traditional manufactured exports is in fact an essential preliminary to the technological upgrading. It concludes with a summary of the main policy implications of the analysis.

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[1] The author is Director of United Nations University Institute for New Technology at Maastricht, the Netherlands. He is grateful to drs. Annelies Hogenbirk for a great deal of statistical support and to Dr. Nagesh Kumar for comment and advice on Part II of the paper. The paper draws heavily on the work of various members of the UNU/INTECH research staff.

II. The International Context: Globalisation and New Patterns of Technological Change

The external situation facing developing countries has changed markedly in the past decade and a half. There are two dimensions of change which are particularly important as background to the discussion in this paper: the increasing integration of the international economy which nowadays goes by the name of globalisation; and the transformations which have attended the appearance of new technologies in production and services. In this part we shall describe each of these very briefly.

Integration of the International Economy

Increasing international integration is reflected in aggregate data on global economic indicators for the period 1975-93[2]. In that period, world economic output grew at rates between three and one percent (declining in the recessions of the 1990's). Over the same period, world merchandise trade grew at between 3.5 and 5 percent - nearly double the rate of growth of output. On the average, therefore, the outward orientation of the world's economies increased considerably. In addition, trade in services grew at a massive rate (over 20 per cent per annum in the second half of the 1980's). Flows of foreign direct investments, which at one level reflect the fact of globalisation and at another advance it, also grew at more than 20 per cent in the second part of the 1980's, slowing down markedly in the nineties, but probably not for long. A great part of multinational enterprise production is now globally integrated, partly as a result of developments in fields like information and communication technology, transportation systems and in new manufacturing systems that allow greater fragmentation of production between geographically separate sites. A large part of international trade now takes place within the multinational enterprises.

In this context of increasing internationalisation, the majority of developing countries have been through processes of liberalisation of trade and foreign investment regimes - usually accompanied by major internal reforms intended to increase the role of the market in the regulation of economic life. Liberalisation was sometimes a part of structural adjustment programmes to deal with macro-economic imbalances arising from the crisis years of the late 1970's and early 1980's.

Liberalisation has created a quite new economic context in the developing countries, in which a great deal of earlier policy thinking, founded as it was on (often implicit and unquestioned) assumptions of closed economy, has become irrelevant. It has also created a situation in which earlier approaches to technological change have to be radically revised. In protected economies, the rate and direction of technological change in the international economy was not a matter of immediate threat - or opportunity. Developing country firms could survive with a minimum transfer of foreign technology and the domestic market could be kept closed to threatening new products and processes. This is clearly no longer the case. The impact of international patterns of technological change are now felt in an immediate way in the domestic markets of most developing countries. For firms to survive, they have not only to

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[2] The data in the following discussion is compiled from the IBRD World Statistics and from UNCTAD.

find ways of competing in export markets, but also to meet import competition from technologically sophisticated firms from industrialised countries. Indeed the problems of competing in export markets are not that distinct from the problems of competing on the domestic market. In both cases the fact of international patterns of technological change has to be faced.

Changing patterns of technological advance

It is no doubt risky to generalise about the rate and direction of technological change in the international economy. However, some of the trends which seem to be emerging are especially important - sufficiently so to justify a few generalisations, however risky they may be. The two most common generalisations about technology at present are: first that the rate of technological innovation and diffusion is accelerating; and second that there is new phenomenon of 'generic technology'.

The acceleration of innovation is hard to prove. The economic data - on factor productivities - do not show dramatic changes. However, managers and technologists themselves, have little doubt about the matter. Students of technology policy - nowadays more numerous than they have ever been - are also in little doubt, and will point to the much greater concern of governments throughout the world about technology policies, to support their arguments. It is clear also that in certain important fields of technology, like biotechnology for example, the time that elapses between scientific discovery and commercial application is shortening. This does not necessarily prove an acceleration in the overall rate of innovation but it is of some significance.

From the point of view of the developing countries the more important development is probably the appearance of the so called generic technologies. This much misused term is used to describe the fact that many of the new technologies have fields of application across many sectors. There is not much doubt that such a development is happening. The Background Papers illustrate the generic character of some types of technological advance. Background Paper No. 7 (Alcorta, 1995) shows the way in which industrial automation technologies spread across sectors; Background Paper No. 3 (UNIDO, 1995, pp. 3 ff.) demonstrates with great clarity the generic nature of new materials technology; and Background Paper No. 2 (Steinmueller and Bastos, 1995) shows the situation for information and communication technologies. In addition to the effects of technological factors, organisational innovations are affecting efficiency across many sectors. Kaplinsky (1995), in Background Paper No. 1, discusses these.

Generic, or multisectoral, technological changes have many implications for the production system, of which two are especially important from our immediate point of view: first they have a major effect on the nature of competition in many sectors; second, this effect varies from sector to sector.

Competition through innovation is distinctive and different to the type of price competition which is described in standard economics textbooks. That type of price competition - based on minimising the costs of production on a given type of technology - is a mechanism for re-establishing an equilibrium in the economy. Innovative competition, as it was first described by Schumpeter (1912), is a means whereby firms create unique advantages for themselves

through temporary sole possession of a piece of technological knowledge, and so profit from a *temporary disequilibrium*. The effect of a high rate of generic technological change in the economy is that this type of competition will prevail in many sectors of the economy. This has important implications for firms in developing countries seeking to enter international trade in manufactures, since it importantly affects the terms of entry.

Christopher Freeman (1982) has classified the competitive responses of firms in industries which are characterised by innovative competition. At the leading edge of these industries (from the technological point of view) are the innovative firms, seeking to capture a lead over the rest of the industry by establishing a unique process or product. Follower firms may pursue different strategies in response. Some will seek to innovate themselves. Others will try to exploit the advantages of being a follower, by imitating the original innovator - if necessary by licensing its technology. Still others will seek alternative more defensive strategies. For example, if the new product arising from the innovation is an imperfect substitute for the old, firms may continue to produce the older product. Or they may continue to use the old methods of production - if there is a process innovation. As Freeman points out (op. cit. pp. 169 ff.), follower firms of this kind require some compensating advantages in order to maintain themselves in competitive production. Follower firms in developing countries usually attempt to exploit low labour costs, or advantageous access to materials in response to innovative competition, though in the more industrially advanced developing countries many firms will follow imitative strategies based on the international transfer of technology.

An important aspect from the point of view of developing countries, is that the generic nature of technological change has meant that patterns of innovative competition are appearing in many of the sectors which before were considered to be technologically stagnant. Amongst these are the sectors which have long been regarded as the 'traditional' sectors for early industrialisation - like textiles and garments production for example. This poses new problems for developing countries seeking to enter international trade in manufactures.

It does not follow that firms in developing countries have to become innovators in order to compete; nor do they necessarily have to adopt new technologies at a high rate. It does mean however, that even in the older traditional industries, which are so important in early industrialisation, the pressure of innovative competition will be felt. The terms of entry will be more severe than in the past and the requirements for maintaining competitiveness will be more severe as innovative competition develops. Alcorta (1995), in Background Paper No. 7, indicates that in mechanical engineering production, which is a very important sector for 'technological upgrading' in developing countries, only a few countries (Brazil, China, Korea and Taiwan Province) account for the major proportion of automation technologies diffused to the developing countries. However, as he points out, other countries seeking to upgrade to the mechanical engineering sector will have to meet competition from innovative and imitative firms in the industrialised countries. Steinmueller and Bastos (1995), in Background Paper No. 2, include some interesting reflections on what this means in practice (p. 9, see note). They point out that whilst the working out of comparative advantage means that countries will always have some sectors in which they are competitive, the terms of trade is determined by *relative productivity of trading partners*. So '....if developed nations' productivity advances substantially outstrip those in developing nations, the consequence is slow growth or even a decline in real wages offered in developing countries....". This has important implications for the terms on which industrialisation may take place in the technologically less advanced

developing countries It is what lies behind the idea of an alternative non-innovative response to innovative competition As we shall see in subsequent parts of the paper, there are signs of defensive responses based on reductions in real wages in industry in a number of countries

Fortunately, the impact of innovative competition, even though generic in form, is uneven across sectors. It is probably a fair generalisation that all sectors in the manufacturing system have experienced accelerated generic technological change, but it remains the case that it has been more pronounced in some than in others. The traditional sectors of developing country industrialisation have been *less* exposed to innovative competition than others The route to industrialisation through initial production of technologically simple products in a comparatively labour intensive way, is still open, though it is narrower than before. In these products, there is still a high degree of conventional price competition, which developing countries are in a better position to meet.

In the following parts of the paper there is an empirical analysis of patterns of developing country competitiveness in relation to technological advance, which will echo some of these concerns.

III. Technology and Export Competitiveness Experience in the last two decades

This part of the paper is concerned with empirical evidence linking technological factors and international competitiveness in industry in developing countries. Competitiveness will be measured in terms of the long run growth of manufactured exports; the effect of technology change will be assessed by changes in value added in the manufacturing sectors. Export growth rates are one amongst a number of measures that are used to measure competitiveness. Like all others they are partial, but they are defensible as a way of measuring long run changes. The use of growth in value added per employed worker as a measure of technological change is perhaps more open to criticism. Many would prefer other measures, like the change in total factor productivity. However, more sophisticated measures demand statistical data which is hard to come by - particularly in developing countries, and most particularly on an internationally comparative basis. Value added data is the best available for our present purposes.

Basic Data

Table 1 shows the main data set on which the analysis is based. It includes export data series and value added data for 118 developing countries from the IBRD World Tables. Lack of data meant that the transitional economies of Eastern Europe could not be included. There are some other gaps, but this is the most complete set of internationally comparable export data available. Constant price export series were calculated using the IBRD data for exports in dollar values. Growth rates were calculated by regression[3], and we required that the F-statistic of the regression should be significant at the 1 percent level.

This led immediately to a distinction, which is maintained throughout the following discussion, between countries for which the regression coefficient is significant and those for which it is not. In the former case, exports show a clearly defined growth trend, which we describe as sustained growth; in the latter they do not. In Table 1, countries are grouped according to this criterion. Thirty seven countries (called Group I in the Table) have shown sustained growth of manufactured exports. The other 81 developing countries for which we have data (Group II) have shown no clear trend in manufactured exports, and have regression coefficients which are non-significant at one percent (and in most cases at five percent also). We argue that the existence of a strong export trend is a useful indicator of competitiveness in itself and on that basis we will maintain the categories Group I and Group II. Since our concern is to understand links between technological factors and competitiveness, a good deal of the following discussion will be concerned with the Group I countries.

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[3] The regression equation used was

$$\ln(E_t/E_0) = At + B$$

where E_t is the constant price dollar value of exports at time t, and t is in years measured from the base year - which is in general 1970. With t=0 in the base year, the intercept term B was constrained to be zero in the regressions. The value of A, expressed in percentage terms gives the rate of growth over the period of analysis.

TABLE 1: GROWTH OF MANUFACTURED EXPORTS AND MANUFACTURING VALUE ADDED PER WORKER

Country	Export Growth 1970-91	Export Growth 1970-80	Export Growth 1980-91	VA per Worker Growth 1970-90	Period	VA per Worker Growth 1970-80	VA per Worker Growth 1980-90
Group I: Countries with sustained growth of Manufactured Exports							
B Faso	9 92 *	14 47 *	-1 41				
Barbados	0 54 *	14 76 *	0 73	2 2 *		3 33 *	-2 02 *
Benin	7 87 *	-4 93	30 46 *				
Brazil	15 09 *	21 35 *	3 05 *	1 09 *		0 79	0 94
Brunei	6 74 *	3 01	-2 56				
Cameroon	4 3 *	3 7	8 01 *				
Chile	7 4 *	10 9 *	-0 55	1 46 *		0 71	-0 4 *
China	9 9 *	11 37 *	5 68 *	4 5 *	77-90	12 72	4 95
Fiji	9 06 *	8 5 *	12 57 *	-0 79		-0 9	-1 24
French Guyana	10 46 *	7 9	-0 53				
Grenada	3 46 *	5 6 *	-3 15				
Guadeloupe	10 9 *	12 46 *	3 63 *				
Hong Kong	7 91 *	10 34 *	2 26 *				
India	5 62 *	7 15 *	3 68 *	2 12 *	70-89	0 42	6 31
Indonesia	25 49 *	25 99 *	21 54 *	4 49 *		4 38 *	1 96
Jordan	19 48 *	25 08 *	6 72 *				
Korea	18 44 *	23 12 *	7 97 *	5 71 *		5 05 *	5 1 *
Macao	13 5 *	15 52 *	6 36 *				
Malaysia	17 54 *	20 71 *	10 61 *	1 71 *		0 19	4 43
Mauritius	25 21 *	40 82 *	5 86 *	-3 77 *		-5 44 *	-0 88
Mexico	10 46 *	9 4 *	13 78 *	2 96 *		3 2 *	2 16
Morocco	13 25 *	16 59 *	6 73 *	-1 54	80-88		
Nepal	10 03 *	7 25 *	11 27 *				
Pakistan	4 39 *	2 46 *	5 68 *	4 19 *	70-88	2 8 *	4 58
Panama	9 14 *	13 61 *	2 *	-0 9 *		-0 38	-2 25
Peru	13 49 *	20 4 *	-7 22	0 17	79-88		
Philippines	16 61 *	22 42 *	3 27 *	-0 87		-2 44 *	2 61
Singapore	16 38 *	21 *	5 71 *	2 58 *		1 34 *	4 07 *
Sri Lanka	22 42 *	27 94 *	11 01 *	-2 23	70-89	-3 35 *	0 28
Syria	12 59 *	13 78 *	9 23 *				
Thailand	21 15 *	26 36 *	11 97 *	3 09 *		2 47 *	3 53 *
Tonga	13 51 *	6 56 *	14 81 *	-3 3	83-90		
Trinidad	4 52 *	3 04 *	4 77 *	3 87 *		-2 41 *	-5 3
Tunisia	15 52 *	21 22 *	3 04				
Turkey	20 32 *	20 89 *	20 1 *	1 93 *		1 13	4 5 *
Uruguay	7 69 *	12 11 *	-1 69	3 88 *	73-89	1 82	1 29 *
Venezuela	10 21 *	8 64 *	9 02 *	-0 63		-2 12 *	1 18
Group II: Developing Countries whose Manufactured Exports have no Growth Trend							
Afghanistan	6 83	15 *	-10 81 *				
Algeria	-1 91	-10 01 *	12 17 *				
Antigua	-5 2	-18 17	-7 84				
Argentina	7 7	14 17 *	-0 78	2 34 *	70-89	1 76 *	1 62 *
Bahrain	4 54	9 4	3 26				
Bangladesh	2 94 *	3 11	1 26	-3 62	70-91		
Belize	2 34	10 48 *	-3 66				
Bermuda	-11 96	-21 05 *	2 61				
Botswana		*		2 9	71-90	10 69 *	-4 45 *
Burundi	2 2	3 72	0 65				
Cambodia	15 99	15 99		16 88 *	87-90		
Cap Verde	-5 42 *	-4 34	-6 52				
CAR	-0 25	-1 5	-0 17				
Chad	2 52	5 29	3 38				
Colombia	11 89	20 36 *	0 53	2 09		1 45 *	2 94 *
Congo	3 4	9 81	-10 67				
Congo II		*		-0 46 *	81-88		
Costa Rica	5 56	11 78 *	-6 04	-0 063	84-90		
Cote d'Ivoire	8 44	14 77 *	-1 32				
Cuba		*					
Dom. Rep	1 18	6 35	-5 41				
Dominica	6 83 *	3 67	6 38				

Country	Export Growth 1970-91	Export Growth 1970-80	Export Growth 1980-91	VA per Worker Growth 1970-90	Period	VA per Worker Growth 1970-80	VA per Worker Growth 1980-90
Ecuador	10 74	22 66 *	-9 44	1 04 *		0 62 *	1 6
Egypt	0 25	1 8	4 43				
El Salvador	-4 07	7 04 *	-10 34				
Ethiopia	0 19	-3 22 *	15 78	-0 22	-9 62		0 3
Faeroe Isl	6 97	12 49	-4 17				
French Polynes	0 68	-2 71	7 55 *				
Gabon	3 99	*					
Gambia	15 95	30 61 *	-1 07				
Ghana	2 48	13 51	-4 73				
Guatemala	1 49	5 65 *	-7 49	1 37	71-88	1 62 *	0 24
Guinea-Bissau	-9 95	-17 33	0 18				
Guyana	5 46	16 31 *	-14 28				
Haiti	6 4	13 18 *	-7 02 *	-2 94 *	70-88		
Honduras	1 83	8 75	-14 24	-0 58	71-90	0 21	0 15
Honduras II		*					
Iran	3 69	10 65	-4 89	-0 56			
Jamaica	0 79	3 54	-6 93	-1 1 *		-0 88	-0 39
Kenya	4 88	11 31 *	-4 78	2 46 *		3 09	1 42 *
Kiribati	-1 37	4 57	5 3				
Kuwait	14 04	23 63 *	-4 66	-0 78	77-88	1 71	-0 26
Lebanon	3 63	12 25	6 95				
Liberia	-4 85 *	1 2	-19 16				
Libya	-54 14	*					
Madagascar	-0 32	3 16	-3 42 *				
Malawi	5 81	11 4 *	-8 78				
Martinique	10 69	14 55 *	1 49				
Mauritania	13 37	23 29	4 33				
New Caledonia	-1 48	0 37	-4 24				
Nicaragua	-4 14	6 22	-12 15				
Niger I	4 16	14 28	-14 31				
Nigeria	7 23	15 82 *	-11 78				
Oman		*		5 07	85-90		
Paraguay	5 99	12 91 *	-1 96				
PNG	10 02	12 19	6 88	-1 05	80-87		
Puerto Rico		*		6 17 *		5 68 *	4 86
Qatar	12 64	22 6 *	-7 37				
Reunion	5 88	10 94	0 53				
Saoedi Arabia	26 22	44 89 *	-12 04				
Senegal	1 35	1 24	2 46				
Seychelles	-4 96	-2 74	-15 33				
Sierra Leone	-7 96	-5 68 *	-10 5				
Solomon Isl	7 01	13 59	5 57				
Somalia	-7 47	-10 29	0 46				
South Africa				1 21	72-90		
St Kitts	3 68	5 6	2 14				
St Lucia	13 68	17 37 *	1 26				
Sudan	10 39	16 9 *	1 [illegible] *				
Suriname		*		0 18	75-90	4 98	-3 72
Swaziland		*		2 58	76-89	-1 47	6 08 *
Tanzania	1 36	1 36		-4 02	80-88		
Togo	5 39	11 4 *	-10 72				
UAE	28 77	49 05 *	-0 0601				
Uganda	-6 34	-6 36	-6 94				
Vanatua	-17 93	*					
W Samoa	-6 33	-3 87	-7 15				
Zaire	-5 06	-2 55	-10 25				
Zambia	3 49	10 99 *	-8 15	0 5		-0 31	2 58 *
Zimbabwe	1 61	5 77	-3 61	3 64 *		3 07	1 13 *

Notes

(1) Asterisks indicate that the growth coefficient is significant at the one per cent level

(2) Source for data IBRD World Tables

The underlying series of value added per worker from which the growth rates were estimated was also calculated from the IBRD World Tables. The series on value added and the index series for manufacturing employment were used to establish a constant price index of value added per worker. This was then used to evaluate the rate of growth of value added per worker over the period 1970-90. The data set is unavoidably incomplete, and is especially lacking in the case of the Group II countries. Once again we required the F-statistic for the constrained regression on time to be significant at one percent.

One of the obvious limitations of the following analysis is that in analysing relationships between export growth and productivity growth, we are restricted by the data to the use of aggregate productivity measures for the whole manufacturing sector. In the future it will be necessary to supplement these aggregate value added data with analysis at the sectoral level, and to establish more detailed data on the sectoral composition of exports.

It is important to note that statistically significant coefficients in Table 1, and elsewhere in the paper, are marked with an asterisk; unmarked coefficients are thus not significant at the one percent level.

Growth of Manufactured Exports and Value Added Productivity in Manufacturing

In the first place, it is notable that a large number of countries have successfully entered the international market for manufactures in the past twenty years, as the large group of developing countries with sustained export growth over the period 1970-90 indicates. Group I includes the NICs of course, as well as the so-called 'second tier' NICs (countries like China, Indonesia, Malaysia, and Thailand). It also includes smaller economies with very high export growth, like Mauritius and Sri Lanka.

Export growth has of course varied over the period. As Table 1 indicates, growth rates were generally higher over 1970-80 than over 1980-90. Only a few countries escaped the generally sharp export slow down. Cameroon, Fiji, Mexico, Nepal, Pakistan, Tonga, and Venezuela achieved an actual acceleration in export growth. Some very rapid export growers of the first period slowed down somewhat in the second, but nevertheless managed high rates. China, Indonesia, Malaysia, Mauritius, Sri Lanka, and Thailand are in this group. The second tier NICs seem to have been more successful at maintaining export growth than the older NICs. Generally developing countries experienced two major changes between the 70's and the 80's. On the one hand, many of the more protected economies were opened up to world trade from the late 1970's onwards. One might expect this policy shift to have accelerated export growth rates. However, the 1980's were also recessional in the world economy - in part as a result of the high priority attached to control of inflation in the industrialised countries of the OECD. The main reason for deceleration of export growth must lie in this slow down in the growth of demand.

Table 1 also shows how the productivity growth rates changed between the two periods. For many countries productivity growth accelerated between the 1970's and the 1980's. For a

number this was most probably an outcome of efficiency gains arising from policy reforms. Countries like India, Malaysia, Pakistan, Brazil and the Philippines fall into this group. In others, like Korea and Singapore, the acceleration of productivity growth mainly reflects changes in industrial structures resulting from the export led development policies they had followed throughout. Productivity growth slowed down in Indonesia and China - though in both cases from very high levels. The reasons for this are not clear, and may reflect statistical eccentricities rather than realities. The low productivity growth economies, Mauritius and Sri Lanka, more or less remained in the same pattern between the two decades.

It is clear that the Group II countries in Table 1 are in a different category both from the point of view of export growth and from the point of view of productivity growth. For many of them, manufactured exports were a small part of trade and an even smaller part of production. In some of these countries, especially in sub-Saharan Africa, manufactured exports actually declined steadily over both decades. In parts of Sub-Saharan Africa, the industrial sector is inefficient in terms of static measures of comparative advantage, so that policy reforms which led to a rapid opening up of the economies, have had negative effects on the role of the manufacturing sector. There is of course considerable debate about whether this is leading to a de-industrialisation of the African economies - which we do not intend to pursue here.

From our point of view, it is very striking that no clear relationship emerges between *export growth* and the *growth of value added productivity*. Figure 1 is a scatter plot of export growth rates (1970-90) against productivity growth rates, for all those Group I countries for which the data set is complete. There is no statistically significant relationship to be seen. We may tentatively conclude that though technological change - through introduction of new processes and products - has an important role in international competition[4], countries may attain high levels of competitiveness and growth of manufactured exports, without high rates of technological change. Evidently, competitiveness can be established on other bases.

However, despite the lack of a statistical relationship in Figure 1, it shows some interesting patterns which are worth further discussion. The Figure suggest strongly that competitiveness may be associated with different growth paths. The situation might be characterised in a rough and ready way as follows. Countries may be thought of as falling into two groups. We have made an arbitrary distinction by drawing a dividing line at the level of a value added per worker growth rate of 2 per cent in Figure 1. Though this is arbitrary, it is not unreasonable to suggest that countries with data points lying below the line - that is countries with relatively low value added per worker growth - essentially base their competitiveness on conventional sources of static comparative advantage. Later we shall show that this assertion is borne out by other evidence. Countries above the line - the NIC's and the second tier countries by and large - have pursued sources of dynamic comparative advantage. Both of these paths can - and do - produce high rates of growth of exports.

[4] There is a large economics literature which formalises a great deal of a previously empirical approach to technology and trade. This is well reviewed in Grossman and Helpman (1995)

Figure 1: Growth in Exports v. Growth in Productivity

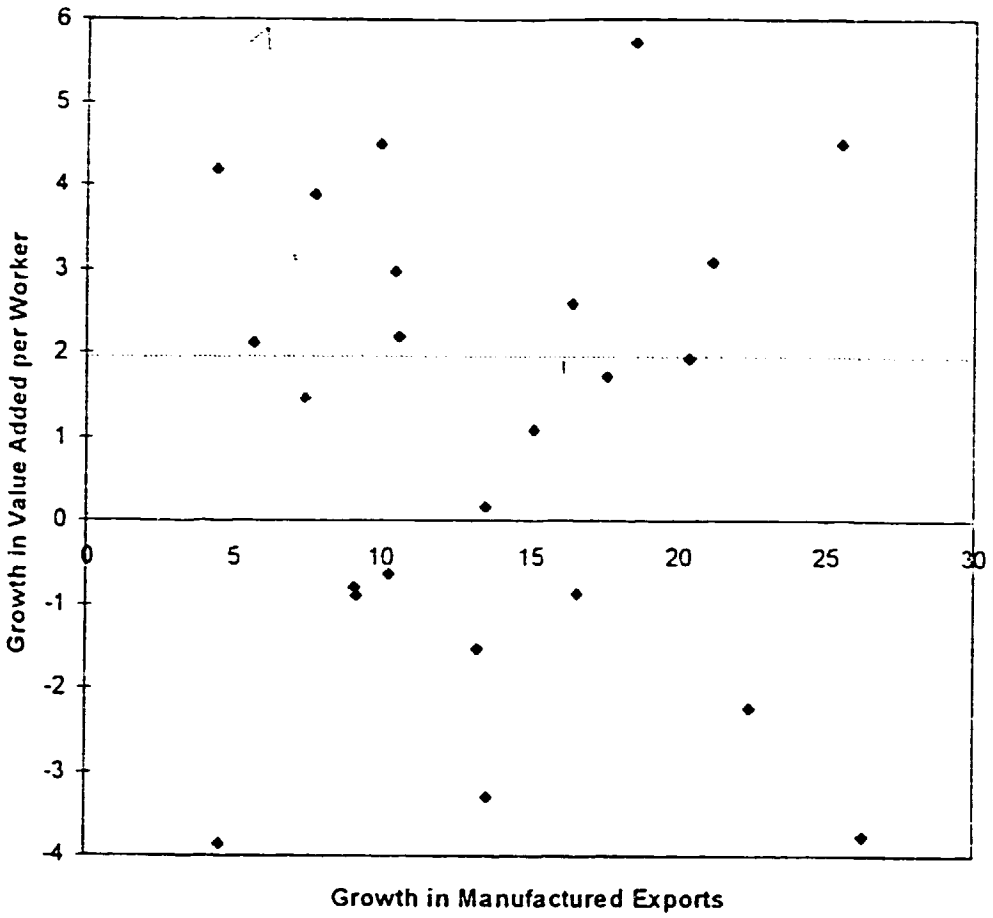


Table 2, which follows, shows the situation. It includes all the Group I countries for which data is available on both export growth and the growth of value-added per worker. These are the countries whose data points are shown in Figure 1. The Group I is subdivided in Table 2 into sub group IA, which is made up of countries where the rate of growth of value-added per worker was more than 2 percent per year, and sub-group IB with growth of value-added per worker at less than 2 percent. The countries which are excluded from the table for lack of data, would probably mainly fall into the Group IB category.

TABLE 2: GROUP I COUNTRIES: GROWTH OF MANUFACTURED EXPORTS AND VALUE ADDED PER WORKER 1970-90

Country	Export Growth 1970-91	VA per Worker Growth 1970-90	Period
IA Countries with high value added growth per worker			
Korea	18.44 *	5.71 *	
China	9.9 *	4.5 *	77-90
Indonesia	25.49 *	4.49 *	
Pakistan	4.39 *	4.19 *	70-88
Uraguay	7.69 *	3.38 *	73-89
Thailand	21.15 *	3.09 *	
Mexico	10.46 *	2.96 *	
Singapore	16.38 *	2.58 *	
Barbados	10.54 *	2.2 *	
India	5.62 *	2.12 *	70-89
AVERAGES	13.09	3.572	
IB. Countries with low value added growth per worker			
Turkey	20.32 *	1.93 *	
Malaysia	17.54 *	1.71 *	
Chile	7.4 *	1.46 *	
Brazil	15.09 *	1.09 *	
Peru	13.49 *	0.17	79-88
Venezuela	10.21 *	-0.63	
Fiji	9.06 *	-0.79	
Philippines	16.61 *	-0.87	
Panama	9.14 *	-0.9 *	
Morocco	13.25 *	-1.54	80-88
Sri Lanka	22.42 *	-2.23	70-89
Tonga	13.51 *	-3.3	85-90
Mauritius	26.21 *	-3.77 *	
Trinidad and To	4.52 *	-3.87 *	
AVERAGES	14.19	-0.82	

Notes and sources as in Appendix Table 1.

The table includes a simple (unweighted) average rate of export growth for each sub-group. This is not significantly different between the two groups. The average export growth rate for the high productivity growth Group IA is 13.09 per cent; it is, in fact, slightly higher at 14.19 per cent, for Group IB. The unweighted, simple average of growth rates of value added per worker is obviously different between the sub-groups: Group IA had productivity growth of about 3.5 per cent; Group IB effectively had zero productivity growth on the average.

Group II countries include a large majority of developing countries. In terms of the definitions we are using here, they are countries whose exports of manufactures in constant prices show no growth trend. This does not preclude of course that there were periods of time in which exports did grow. It means though that growth was not sustained over the period 1970-1990 - nor for that matter over the sub-periods 1970-80 and 1980-90 (see Table 1). Similarly, these Group II countries show no significant trend rate of growth of value added per worker and a number show actual declines in labour productivity.

Sectoral shifts and productivity growth

If indeed the differences in patterns of competitiveness described above are associated with different degrees of dynamism in the pursuit of comparative advantages, one might expect this to be reflected in sectoral compositions of output. Prima facie, if countries adhere closely to patterns of static comparative advantage, it is reasonable to expect that the sectoral patterns of trade and output will remain more or less stable. The pursuit of dynamic comparative advantages through technological learning, on the other hand, may have other implications for sectoral patterns. In so far as technological learning takes place within established trading sectors it need not lead to changes in the sectoral pattern of trade and output. However, we also know that learning rates, as reflected for example in Verdoorn elasticities of productivity growth with respect to output growth, differ considerably between sectors. It would not be surprising therefore to find that high rates of growth of productivity are associated with shifts from technologically slow moving ('traditional') sectors, towards sectors of greater technological sophistication, higher value added per worker, and higher levels of learning elasticity. As a step towards understanding the differences in productivity growth performances noted in Table 2, we shall examine the issue of sectoral composition of output.

Two limitations arise immediately, because of the lack of internationally comparable data. First, instead of studying the sectoral composition of trade, we shall be limited to examining the sectoral composition of output. This need not be too much of a problem given that in the export led economies with which we shall be mainly concerned here (i.e. the Group I countries of Table 1), trade is a significant part of total manufacturing output and changes in its sectoral composition should show up as changes in the sectoral composition of output.

Second, it would be ideal to establish Verdoorn type learning elasticities for various sectors, so as to show the differences in potential productivity growth. Unfortunately the data series available in most countries do not permit us to do this. The task of 'cleaning' available data so as to provide this kind of analysis is extremely large and has not been done. Consequently, we shall have to rely on rather more descriptive forms of analysis, which are less rigorous statistically, but nevertheless permit some tentative conclusions to be drawn.

To start with Table 3 summarises some descriptive data on changes in sectoral structure. It lists the three largest ISIC group in the manufacturing output structure of each country for 1970 and 1990. Countries are ranked in descending order of the growth rate of value added

TABLE3
CHANGES IN OUTPUT
STRUCTURES

Country	Year	ISICs	Value Added Growth Rates 1970-1990	Value Added Growth Rates 1980-90
Korea	1970	11,14,21	5.71	6.1
	1990	82,83,84	5.71	6.1
India	1970	11,21,71	2.12	6
	1990	21,71,84	2.12	6
Pakistan	1970	11,21,53	4.19	4.58
	1989	11,14,21	4.19	4.58
Malaysia	1970	11,31,55	1.71	4.43
	1990	11,51,83	1.71	4.43
Singapore	1970	53,83,84	2.58	4.07
	1990	53,83,84	2.58	4.07
Philippines	1970	11,13,52	-0.87	4.07
	1990	11,13,52	-0.87	4.07
Thailand	1970	14,21,52	3.09	3.53
	1990	13,21,69	3.09	3.53
Mexico	1970	12,21,71	2.96	2.16
	1990	13,51,84	2.96	2.16
Turkey	1970	11,21,53	1.93	2
	1990	11,21,53	1.93	2
Indonesia	1970	11,14,21	4.49	1.96
	1990	11,14,21	4.49	1.96
Uruguay	1970	11,13,21	3.88	1.29
	1990	11,21,53	3.88	1.29
Venezuela	1970	11,13,53	-0.63	1.18
	1990	11,53,72	-0.63	1.18
Brazil	1970	11,21,84	1.09	0.94
	1990	11,82,83	1.09	0.94
Sri Lanka	1970	14,21,52	-2.23	0.1
	1990	11,14,22	-2.23	0.1
Chile	1970	11,21,72	1.46	-0.4
	1990	11,52,72	1.46	-0.4
Mauritius	1970	11,13,14	-3.77	-0.88
	1990	11,21,22	-3.77	-0.88
Barbados	1970	11,13,22	2.2	-2.02
	1990	11,13,81	2.2	-2.02
Panama	1970	11,13,53	-0.9	-2.25
	1990	11,13,90	-0.9	-2.25

Reference Table of 3-digit ISIC Groups

ISIC Number	Product Group	ISIC Number	Product Group
300	All Manufacturing	353	Refineries
311	Food products	354	Misc. petroleum
313	Beverages	355	Rubber Products
314	Tobacco	356	Plastic Products
321	Textiles	361	Pottery etc.
322	Wearing Apparel	362	Glass products
323	Leather products	369	Non-metallic
324	Footwear ex. plastic	371	Iron and Steel
331	Wood ex. furniture	381	Non-ferrous metals
332	Furniture,ex.metal	382	Machinery non-elec.
341	Paper and products	383	Machinery elec
342	Printing	384	Transport equipment
351	Industrial chemicals	385	Scientific equipment
352	Other chemicals	390	Other manufactures

per worker in the period 1980-90, and the data on the growth rates of value added per worker for the period 1970-90 are also shown. The data are not very conclusive, but they do indicate some patterns of interest. First, note that in the higher productivity growth economies - i.e. with value added per worker growth rates above 2 per cent, there are a number which plainly show considerable changes in output structure. Korea, with a big shift away from simple manufactures (ISIC 1 is food and beverages, 2 is textiles and garments), and towards the production of electrical and non-electrical equipment (ISIC 8) is the most obvious case. India also showed a shift towards machinery production, as did Malaysia and Mexico. Singapore showed little change in structure but was committed throughout to the machinery sectors - where it is a fair assumption that productivity growth is more elastic (see Pilat, 1995 on Korea). Other high productivity growth economies were less clearly experiencing structural change: Pakistan, Philippines, and Thailand were committed to the same sectors in 1990 as in 1970, though it is probable that there were considerable changes in the product base within these broad ISIC groups.

Second, amongst the slower productivity growth economies in the lower part of the Table 3, there are some which clearly show the types of sectoral pattern associated with a long run commitment to sectors of static comparative advantage. Sri Lanka, Chile, Mauritius and Panama are in this group. It is worth noting that commitment to these types of ('static comparative advantage') growth paths, does not preclude shifts in the sectoral patterns of output and trade. In both Mauritius and Sri Lanka, for example, there were changes in sectoral patterns. However they were changes within the group of low productivity growth sectors. In the case of Mauritius, for example, the decisive shift was from ISIC 1, which is mainly food beverages and tobacco, to ISIC 2, which is textiles and garments. Indonesia is a curious case. Although productivity growth was low in the period 1980-90 and structures of production did not change much, nevertheless the economy had a very high productivity growth rate over the whole period 1970-90, and is indeed classed in the group IA in Table 2 above.

It is difficult to find a single statistic to measure structural change, where shifts may take place between many sectors. We have used a very rough measure in an effort to give some statistical basis to the argument. For each country, we calculated the proportion of manufacturing value added which was derived from the first three ISIC two digit levels[5] in 1970 and 1990 - and took the ratio of the two proportions. Thus a value of this structural statistic above unity indicates a 'regression' of the structure of production towards an increasing commitment to technologically simpler sectors. Lower values indicate a shift away from the simpler sectors. We then regressed this statistic (called S) on the rate of growth of value added per worker for the 18 economies of Table 3. The regression and the results were as follows:

$$G = -4.08 * S + 5.28$$
$$(-2.5) \quad (3.6)$$
$$\text{Adjusted R squared} = 0.2380; \quad F = 6.61$$

The regression coefficient is significant at the 2 per cent level, though with there are very few degrees of freedom and one should not place to much reliance on the result. It is however consistent with the descriptive pattern in Table 3 and suggests a weak relationship between rates of growth of labour productivity and structural change in production. This relationship has of course been shown to hold in a number of studies of individual economies (see again Pilat, 1995, op cit. for an excellent analysis of productivity growth in Korea)

[5] These comprise food, beverages, tobacco, textiles, garments, footwear and leather products, and wood and furniture.

IV. Implications of Different Technological Growth Paths

Export growth, value added per worker growth and changes in real earnings per worker

One clear implication of the low productivity growth path is that countries on it need to find other ways of maintaining competitiveness than by technological improvements. In a world of generic technological change affecting most sectors, that implies one of two conditions: either these countries must have special access to low cost materials, or there must be a commitment to relatively low growth of real wages. It is clearly of interest, therefore, to explore the implications of the patterns discussed above for the development of real earnings per worker. Table 4 which follows brings together the data available in the IBRD World Tables.

The data show patterns which are becoming familiar. It is notable that the cases where there is a significant trend rate of growth of real earnings per worker are nearly all to be found in the Group I group of countries in the top half of the Table. Group II countries are characterised primarily (in our definitions) by the absence of a long run growth trend for manufacturing exports, but the group of countries so defined is also characterised - in the main - by the absence of significant growth in manufacturing value added per worker, or in real earnings per industrial worker. Once again it is worth recalling that this does not mean that these magnitudes have not grown at all in the Group II countries, but rather that there has been no sustained growth in them. And in some cases there has indeed been secular decline. It is true of course that some Group I countries have also not experienced much productivity growth (or real earnings per worker growth); that of course was the basis for our earlier distinction between Groups IA and IB. They are however different from the Group II countries, which have no export growth trend either.

TABLE 4: GROWTH OF VALUE ADDED PER WORKER AND OF REAL EARNINGS PER WORKER 1970-90

Country	Export Growth 1970-91	VA per Worker Growth 1970-90	Period	Growth of Real Earnings per Worker	Period
Group I: Countries with sustained growth of Manufactured Exports					
B. Faso	9.92 *				
Barbados	10.54 *	2.2 *		0.88 *	70-90
Benin	7.87 *				
Brazil	15.09 *	1.09 *		4.26 *	70-90
Brunei	6.74 *				
Cameroon	4.3 *				
Chile	7.4 *	1.46 *		5.86 *	70-90
China	9.9 *	4.5 *	77-90	3.66 *	77-87
Fiji	9.06 *	-0.79		0.53	70-90
French Guyana	10.46 *				
Grenada	3.46 *				
Guadeloupe	10.9 *				
Hong Kong	7.91 *			3.47 *	73-90
India	5.62 *	2.12 *	70-89	1.41 *	70-89
Indonesia	25.49 *	4.49 *		5.91 *	70-90
Jordan	19.48 *				74-90
Korea	18.44 *	5.71 *		6.91 *	70-90
Macao	13.5 *				
Malaysia	17.54 *	1.71 *		2.08 *	70-90
Mauritius	26.21 *	-3.77 *		-0.13	70-90
Mexico	10.46 *	2.96 *		-0.84 *	70-90
Morocco	13.25 *	-1.54	80-88	-1.19 *	76-87
Nepal	10.03 *				
Pakistan	4.39 *	4.19 *	70-88	4.22 *	70-88
Panama	9.14 *	-0.9 *		0.6 *	70-90
Peru	13.49 *	0.17	79-88	-1.63	79-88
Philippines	16.61 *	-0.87		-1.37	70-90
Singapore	16.38 *	2.58 *		3.74 *	70-90
Sri Lanka	22.42 *	-2.23	70-89	-0.33	80-89
Syria	12.49 *			0.39	70-90
Thailand	21.15 *	3.09 *		1.75 *	70-90
Tonga	13.51 *	-3.3	83-90	-3.76	79-81
Trinidad	4.52 *	-3.87 *		2.06	74-78
Tunisia	15.52 *				
Turkey	20.52 *	1.93 *		2.17 *	70-90
Uruguay	7.69 *	3.88 *	73-89	0.88	76-89
Venezuela	10.21 *	-0.63		1.87	70-90
Group II: Developing Countries whose Manufactured Exports have no Growth Trend					
Afghanistan	6.83			2.46	79-88
Algeria	-1.91				
Antigua	-5.2				
Argentina	7.7	2.54 *	70-89	-0.12	70-89
Bahrain	4.54				
Bangladesh	2.94 *	-3.62	70-91	-2.25	70-90
Belize	2.34				
Bermuda	-11.96				
Botswana		2.9	71-90	-0.48	74-88
Burundi	2.2				
Cambodja	15.99	16.88 *	87-90		
Cap Verde	-5.42 *				
CAR	-0.25				
Chad	2.52				
Colombia	11.89	2.09		0.41	70-90
Congo I	3.4			5.86	70-75
Congo II		-0.46 *	81-88	-0.38	81-88
Costa Rica	5.56 *	-0.063	84-90	-0.5	84-90
Cote d'Ivoire	8.44				
Cuba					
Dom. Rep	1.18				
Dominica	6.83 *				

Country	Export Growth 1970-91	VA per Worker Growth 1970-90	Period	Growth of Real Earnings per Worker	Period
Ecuador	10.74	1.04 *		2.81 *	70-90
Egypt	0.25			3 *	70-89
El Salvador	-0.07				
Ethiopia	0.19	-0.22	-0.62	-2.2 *	70-90
Faeroe Isl	6.97				
French Polynesia	0.68				
Gabon	3.99				
Gambia	15.95				
Ghana	2.48				
Guatemala	1.49	1.37	71-88	-1.32 *	71-90
Guinea-Bissau	-9.95				
Guyana	5.46				
Haiti	6.4	-2.94 *	70-88	-1.59	70-88
Honduras	1.83	-0.58	71-90	0.25	71-75
Honduras II				1.26	83-90
Iran	3.69	-0.86		5.22 *	70-77
Jamaica	0.79	-1.1 *		-0.17	70-88
Kenya	4.88	2.46 *		-1.83 *	70-90
Kiribati	-1.37				
Kuwait	14.04	-0.78	77-88	5.21 *	72-89
Lebanon	3.63				
Liberia	-4.83 *				
Libya	-54.14				
Madagascar	-0.32			-1.59	70-88
Malawi	5.81				
Martinique	10.69				
Mauritania	13.38				
New Caledonia	-1.48				
Nicaragua	-4.14				
Niger I	4.16			5.85	77-80
Nigeria	7.23				
Oman		5.07	85-90		
Paraguay	5.99				
PNG	10.02	-1.05	80-87	0.61	71-87
Puerto Rico		6.17 *			
Qatar	12.64				
Reunion	5.88				
Saoedi Arabia	26.22				
Senegal	1.35				
Seychelles	-4.96				
Sierra Leone	-7.96				
Solomon Isl	7.01				
Somalia	-7.47				
South Africa		1.21	72-90	1.93	72-90
St Kitts	3.68				
St Lucia	13.68				
Sudan	10.39				
Suriname		0.18	75-90	2.02	74-87
Swaziland		2.58	76-89	6.12 *	70-73
Tanzania	1.36	-4.02	80-88	-0.51	70-74
Togo	5.39				
UAE	28.77				
Uganda	-6.34				
Vanatua	-17.93				
W. Samoa	-6.33				
Zaire	-5.06				
Zambia	3.49	0.5		-0.64	70-90
Zimbabwe	1.61	0.64 *		1.59 *	70-90

Notes

(1) Asterisks indicate that the growth coefficient is significant at the one per cent level

(2) Source for data: IBRD World Tables

Table 5 is extracted from Table 4, and shows the situation for those Group I countries for which both productivity data and growth of real earnings data are available

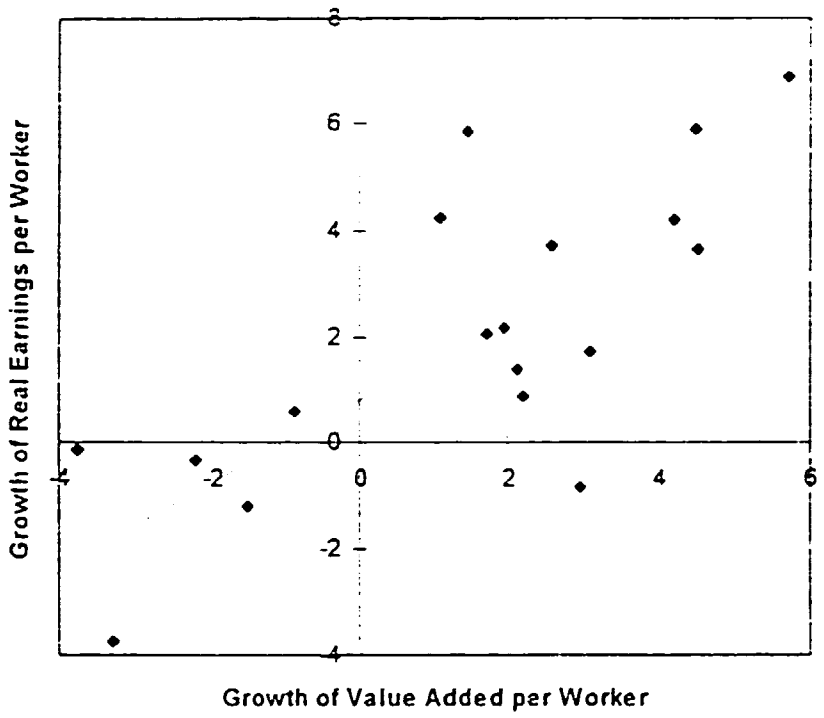
TABLE 5: GROUP I COUNTRIES - GROWTH OF VALUE ADDED PER WORKER AND OF REAL EARNINGS

Country	VA per Worker Growth 1970-90	Period	Growth of Real Earnings per Worker	Period
Group IA. Countries with high value added per worker growth				
Korea	5.71 *		6.91 *	70-90
China	4.5 *	77-90	3.66 *	77-87
Indonesia	4.49 *		5.91 *	70-90
Pakistan	4.19 *	70-88	4.22 *	70-88
Uruguay	3.88 *	73-89	0.88	76-89
Thailand	3.09 *		1.75 *	70-90
Mexico	2.96 *		-0.84 *	70-90
Singapore	2.58 *		3.74 *	70-90
Barbados	2.2 *		0.88 *	70-90
India	2.12 *	70-89	1.41 *	70-89
Group IB: Countries with low value added per worker growth				
Turkey	1.93 *		2.17 *	70-90
Malaysia	1.71 *		2.08 *	70-90
Chile	1.46 *		5.86 *	70-90
Brazil	1.09 *		4.26 *	70-90
Peru	0.17	79-88	-1.63	79-88
Venezuela	-0.63		1.87	70-90
Fiji	-0.79		0.53	70-90
Philippines	-0.87		-1.37	70-90
Panama	-0.9 *		0.6 *	70-90
Morocco	-1.54	80-88	-1.19 *	76-87
Sri Lanka	-2.23	70-89	-0.33	80-89
Tonga	-3.3	83-90	-3.76	79-81
Mauritius	-3.77 *		-0.13	70-90
Trinidad	-3.87 *		2.06	74-78

A quick inspection of the Table suggest immediately that the rates of growth of real earnings per worker in the Group IA countries (which are the high productivity growth countries) are greater on the average than for the low productivity growth Group IB countries. In fact, the simple average of real earnings per worker growth for the upper group is about 2.9 per cent. For the lower group it is less than 1 per cent. However, these are unreliable data since the Table contains a number of data points of low levels of statistical significance

Although the data are few and hardly justify detailed econometric analysis, it is worthwhile to explore them a little further. Figure 2 below plots out the rates of growth of real earnings per worker (y-axis) as a function of the rates of growth of productivity (x-axis) It includes only data points for which the growth rate regressions were significant at least at 5 per cent. This means that all the points marked with asterisks in Table 5 are included as well as the points for Mauritius and Sri Lanka.

Figure 2: Growth of Value Added per Worker v. Growth of Real Earnings per Worker



A linear regression of real earnings growth (W) on productivity growth (G) gives the following result.

$$W = 0.949 + 0.765 * G$$

(1.8) (4.53)

Df = 17; Adjusted Rsquare = 0.534; F = 20.48

The regression coefficient on G is significant at well below the one percent level and the relationship is - as one might well expect - a strong one, although there are regrettably few degrees of freedom The dotted line in Figure 2 shows the regression line. The intercept term in the equation is not significantly different from zero, and the coefficient on G is not

significantly different from unity in a statistical sense. So the regression suggests that the real earnings per worker in this group of countries have grown at more or less the same rate as labour productivity. This means that factor shares in value added have remained - on the average for these countries - more or less constant. We return to this point later.

It is interesting to ask whether this relationship is stronger for the Group IA countries than for the whole of Group I, or to put the matter more directly, whether there is a closer link between the growth of value added per worker and that of real earnings per worker in countries with a higher rate of growth of productivity. Indeed, it turns out that if the regression is rerun for the group of 8 Group IA countries alone, there is a strong relationship. The adjusted R-squared rises to 0.601, and the F-value of the regression is 13.06 (a little lower than for the overall regression). However, one should not place too much reliance on an analysis based on so few data points, and we will not take the matter further with the existing data.

A Synopsis of the Analysis to date

Before discussing some of the underlying economic aspects of the relations between technology factors and competitiveness implicit in the analysis, it will be helpful to summarise the main findings. The following is a summary:

(1) First, the 1980's have seen a considerable expansion of manufactured exports from developing countries. More than a third of the 118 countries for which we were able to establish internationally comparable data, have experienced a significant growth trend of manufactured exports. In this group of countries are some of the most populous in the world - especially China, India, Indonesia and Pakistan. At the same time there is a large number of countries whose entry into manufactured export trade has been limited and somewhat sporadic. All the sub-Saharan economies appear to belong to this latter group of countries whose manufactured exports have failed to show sustained growth

(2) Countries which have had high growth rates of manufactured exports - and which we therefore defined as internationally competitive - do not necessarily owe their competitiveness to technological factors. High export growth rates are just as much associated with low productivity growth as with high. Some countries - like Mauritius and Sri Lanka - have focused their export development on sectors in which they have established strong static comparative advantages, and have stayed in that pattern over nearly two decades. Some Latin American countries show similar patterns, usually associated with natural resource based industrialisation. Others - Korea, Singapore and increasingly China, India, Indonesia, Malaysia, Pakistan, and Thailand (amongst those covered by the data set) - have experienced considerable increases in value added per worker, and may be described as being on a high productivity growth path. The contrast between these two types of export oriented growth path can be overdrawn. Obviously most countries - even the most technologically dynamic - show features of each. However, the notion of distinctive growth paths helps to fix ideas.

(3) These different types of growth path are distinguished - although not always very clearly - by different patterns of structural change within manufacturing production and export trade. Countries like Korea - especially - have experienced marked shifts in production away from

the technologically simple (and generally labour intensive) sectors towards technologically more sophisticated lines of production, in particular in sectors like electrical machinery (including electronics), non-electrical machinery and transport equipment. India, Indonesia, Malaysia and Thailand show rather similar shifts. Singapore's production was strongly concentrated in the more sophisticated sectors throughout. Plainly higher growth of productivity has been associated with some advances in the more traditional sectors (probably associated with product changes within traditional lines of production) and with shifts in the pattern of production - and trade - to sectors where value-added per worker is not only higher than in the less sophisticated sectors, but also tends to grow faster. Learning elasticities, in the Arrow or Verdoorn sense, are higher there. Sectoral shifts of this kind are sometimes referred to as 'technological upgrading' (see Background Paper No. 4, Cooper and Turner, 1995,). The low productivity growth economies have shown much less change in sectoral composition and such changes as have happened tend to be from one labour intensive sector to another.

The large group of economies which have not experienced a sustained expansion of manufactured exports, have not shown any clear trends towards rising productivities nor towards structural change in production.

(4) There is a relationship between the rate of growth of value-added productivity and the rate of growth of real earnings per worker. As might be expected countries which have experienced higher rates of growth of labour productivity have also - by and large - had higher rates of growth of real earnings per worker in the manufacturing sector. Consequently amongst the more successful manufactured export economies, the technologically dynamic ones (Group IA in our terminology) have had high rates of real wage growth whilst maintaining the relative shares of labour and capital in value added more or less stable. It is very likely that this helps maintain the incentive to invest, which has been so marked in some of the countries in question. Countries which have stuck to more traditional, technologically less sophisticated manufactured exports have benefited much less from rising real wages. Here maintaining the incentive to invest depends importantly on withstanding too large increases in real wages in comparison to real wage rises elsewhere and to technological changes in the traditional sectors. The evidence available to us suggests that this has necessitated a fall in real wages over the past decade (or more) in the countries in this category of competitiveness.

In the larger group of countries which do not show sustained export growth, neither value added per worker, nor real earnings per worker in manufacturing have shown any growth trends. If anything real wages in manufacturing have tended to fall.

Explanations of the Patterns of Competitiveness

It is natural to try to relate these patterns to the larger body of analysis on the economics of underdevelopment. A natural place to start is with the concept of the dual or labour surplus economy. This is too well known to need detailed discussion in the present paper. We merely sketch some of the main features of the dual economy idea which has played such an influential part in development thinking since it was first formulated by W. Arthur Lewis (1954), and then focus on the central question whether the pattern of competitiveness described above can be related to the dynamics normally associated with this type of economic structure. Our argument will be that dual economy ideas help to explain some aspects of the

patterns of competitiveness and trade which we have explored, but only tell a part of the story. The other part relates to the demands of international competition in a technologically dynamic world economy[6].

The Lewis 'unlimited supplies' model deals with the processes of capital accumulation in a labour surplus economy, leading to the emergence of a modern sector in the context of a large subsistence oriented rural sector. There is a labour surplus in the rural sector in the sense that the migration of workers to the modern sector will not cause a fall in output. It is assumed that arrangements in the subsistence sector are such that all persons working there enjoy access to the average product of labour in the sector - and this average product of labour is what determines the minimum real wage in the modern industrial sector. This is one of the more debatable and debated assumptions of the model, but we will not enter into that. The level of output in industry is determined by the prevailing modern sector technology and the minimum real wage. Production is expanded to the point where the marginal product of labour is equal to the real wage. At this point the surplus value-added in production above the wage bill accrues as profit to the owners of capital. It is this surplus, properly reinvested, which provides for reinvestment and expansion, and which therefore drives the economy. Reinvestment of surplus and the accumulation of capital stock will expand the modern sector so that eventually surplus labour will be fully absorbed.

The Lewis formulation dealt essentially with a closed economy. Twenty years later, Fei and Ranis considered the implications of the Lewis type of accumulation in an open economy and applied their framework to the (early) development of Korea and Taiwan (Fei and Ranis, 1974). More recently Ranis (1988) has given a useful reformulation of the original ideas of the earlier paper. The centre piece in the Fei and Ranis (1974) analysis as also in the Ranis (1988), is the onset of a phase of "export substitution" starting at the point where traditional exports are replaced by exports of labour intensive manufactured goods. This is a key turning point, because thereafter the absorption of surplus labour is greatly accelerated. So much so, claimed Ranis and Fei, that debates on trade off between growth and employment, which were characteristic of the seventies, became largely irrelevant. Once the economy had got into the export substitution phase it was expected to move rapidly to the next turning point, called by Ranis and Fei, the 'commercialisation point'. At the commercialisation point, surplus labour is fully absorbed, the real wage is no longer 'institutionally' determined, but becomes equated to the marginal product of labour in the rural sector.

Expectations about changes in technology follow directly from this formulation. After the process of export substitution has started and up till the commercialisation point the idea is that the institutionally determined low real wage will rule. Once labour is fully absorbed, i.e. the commercialisation point is past, the real wage will naturally rise. In the first, 'pre-commercialisation' phase, "..the existence of relatively constant (and low)..real wages...should induce labour-intensive technology choices and, more importantly, labour-using technology change....in the dual economy.." (Ranis, 1988, op. cit. p. 82). Then, after the commercialisation point and full absorption of surplus labour, "...increase in real wages...is expected to be accompanied by a shift towards more capital and skill intensive technology and output mix...(Fei and Ranis, 1974, op. cit.). In short, labour productivity and real wages will remain low and stagnant, after the initial shift to what Fei and Ranis call 'export substitution'.

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[6] The following discussion is dealt with in more detail in the Background Paper No. 5 (Cooper, 1995).

whilst manufactured exports will rise rapidly. Thereafter, when surplus labour is absorbed, wages and labour productivity will rise more rapidly

There are some obvious similarities between the Fei and Ranis expectations and the course of events in the economies we are examining. There has indeed been a shift away from primary product exports in the Group I economies which have successfully entered trade in manufactured exports. Also, just as Fei and Ranis predicted, basing themselves on the experience of Korea and Taiwan, the rate of growth of exports and employment was accelerated strongly by the shift. And finally, it is clear that in all cases, the initial shifts in the pattern of trade and output in manufacturing were towards the simpler types of manufactures in the first two or three ISIC 2-digit groups.

In addition, some of the countries in Group I, especially those in Group IB where comparative advantage is closely linked to labour intensity and low wages, correspond to the Fei-Ranis expectations in a more detailed way. Countries like Mauritius and Sri Lanka for example, have had precisely the low and more or less constant real wages, and the low productivity growth, which was predicted for the period of continued surplus labour. And the sectoral shift in Mauritius - from food products to textiles and garments - probably accounts for the decline in labour productivity which we have observed, and may be just that type of labour using technological change which Fei and Ranis thought would (or should) happen in the labour surplus phase. Furthermore, as Table 1 shows, the historical pattern followed by Malaysia, also seems similar to the conventional anticipation. Over the whole period, 1970-90, Malaysia had a low growth of productivity (1.71 per cent), and a slightly higher growth of real earnings (2.8 percent). Manufacturing employment grew rapidly (at 7.47 per cent)[7], and by the mid eighties, labour shortages were beginning to be felt, and an import of unskilled labour started from neighbouring countries. At the same time, as the labour surplus phase came to an end, a technological shift took place. Labour productivity growth accelerated to more than 4 percent per annum in the second period (1980-90). Evidence on movements of the real wage in manufacturing in this period is not available. This Malaysian pattern is very close to the expectation that technology will be predominantly labour intensive in the first period of manufactured exports, whilst there is labour surplus, and will then shift to higher capital intensity and higher labour productivities as full employment levels are reached.

It is also notable that the Group II countries (which show no significant growth trend in the pattern of manufactured exports), have not - in the main - shown any significant trend in value added per worker. To this extent, they conform to the Fei-Ranis prediction[8].

But this correspondence between labour market conditions, export development and technology is not present in other cases - especially those in Group IA. A number of countries have plainly experienced considerable technological advance and rising labour productivity, *whilst still having large amounts of surplus labour.* This is certainly true of China, India, Indonesia, and Pakistan and probably also Thailand. In addition to this, historic evidence on Korea suggest rather strongly, that there too there was a vigorous growth of labour

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[7] The growth of manufacturing employment is discussed in detail in a later section.

[8] Although for these countries, the matter is somewhat different since - as their export data indicates - they have not really entered the 'export substitution' phase.

productivity well before the point of full absorption of labour was reached. The evidence on this point is discussed in detail in Background Paper No. 5. (Cooper, 1995).

So we are left with the problem of explaining the apparently anomalous behaviour of the economies which have followed the high productivity growth path. The main question is: why did these economies follow high productivity growth paths while they were still in the labour surplus phase of economic development ? A number of reasons can be suggested.

Firstly, the Fei-Ranis expectation that a commitment to labour intensive technology would be sustained until surplus labour is fully absorbed, is linked to strong assumptions about the working of the labour market and in particular to the idea that, during this period, the real wage will be more or less constant - or "slow growing" (Ranis,1988). In practice, this assumption has not been borne out in many countries. In most countries there has been a strong upward shift in industrial real wages. A cursory examination of Table 5 and Figure 2 bears this out. Amongst the high value added growth countries there are a number which, throughout the period 1970-1990, had excess supplies of labour in the Lewis sense. China, India, Indonesia, Pakistan and Thailand were certainly in this category. Despite this the average rate of growth of real earnings per worker for these countries was 3.5 percent per annum over the period. In addition, although surplus labour has been absorbed in Korea, the evidence shows that, in the early part of the period, before this had been accomplished, Korean real wages were already rising. So it could be argued that the reason why productivity increases in the Group IA economies took place so early (in the sense that there was still a labour surplus when they occurred) may be found in the 'untimely' increase in real wages. It might be argued that the only way to maintain competitiveness in the face of rising real wages was through a higher rate of technological change. There are, however, some problems with this argument. In the first place, it assumes that real wage rises took place *independently* of changes in technology. In fact, real wage increases could just as easily have been a result of the incorporation of technology which raised factor productivities as a cause[9]. On the other hand, this argument shifts the burden of explanation from one area to another. Differences in real wage growth between economies may have been the cause of differences in the rate of growth of labour productivity, but then what causes the differences in real wage growth between economies in the first place?

A second possibility is that the acceleration of technological change during the labour surplus phase may have resulted from pressures generated by technological change in the international economy. In order to remain competitive, firms in the domestic economy must reduce costs, either through technological change, or through some other means of cost reduction. So some countries - those in Group IB for example - deal with the competitive threat by holding down real wages, or even reducing them, whilst others respond by technological advances. This may be a more plausible explanation than the first, but it still leaves unanswered questions. For example, who decides between a low wage and a high wage trajectory, and how is the decision implemented? Or - to put the question more generally - what objective circumstances might result in a commitment of national economies to one or other of these trajectories?

Thirdly, it may be that the early onset of high productivity production in the Group IA countries is due to important supply side differences - in particular the fact that some countries

[9] The data available are too weak to support tests of causality

might have a better endowment of factors of production that make it possible to adopt new technologies. So if the technologies becoming available internationally require proportionately large demands for particular factors - like skilled labour - they may become profitable in countries where there is a supply of relatively low waged skilled labour - even though there is a large excess supply of unskilled labour. It is possible that the Group IA countries, some of which have long and substantial traditions in scientific and technical education, and substantial science and engineering capabilities, are differentiated from the Group IB countries in this way. Evidence on the supply of scientific and technically trained people would support this idea in the case of countries like China, India, Thailand and Singapore - perhaps also for the other Group IA countries. But puzzles remain since the large Latin American countries listed in Group IB also have long traditions of technical education and a comparatively highly educated workforce, and have nevertheless shown very limited increases in labour productivity.

In short there is no single explanation which can easily encompass the comparisons between all the countries in the analysis. This is not necessarily a major problem, since contingent conditions may vary widely between countries, and there may therefore be more than one explanation for the various differences. It is not surpassing that such a complex set of phenomena cannot easily be reduced to a single simple pattern.

Finally, it is of some interest that recent developments in trade theory have provided a number of insights which seem relevant to the present discussion. These developments are mainly derived from 'new growth theory' in which technological change is treated as an intrinsic part of economic activity. Their implications for trade theory rest on differences in factor productivities arising from differential learning or from differences in the production functions facing different economies. A recent review, already mentioned, is Grossman and Helpman (1995). Barros (1993) is an interesting attempt to draw conclusions from the new growth/new trade theory approaches, for developing countries. For present purposes, there are two points of interest arising from the literature, both are drawn from the work of Krugman, in particular Krugman (1987).

The first point is that where learning effects are important in determining the relative productivities as between trading countries, there will be a tendency for the existing trading pattern to get 'locked in'. Essentially countries get relatively more productive in those branches in which they are specialised, and the short run pattern of comparative advantage is reinforced by this; to quote Krugman "...once a pattern of specialisation is established, it remains unchanged, with changes in relative productivity acting to further lock the pattern in.."(op cit. p.46). This kind of behaviour may well be at work in the case of (at least some) Group IB countries. In some Latin American countries for example, the relative efficiency of production or resource based industries is probably reinforced by the exporting from them. In principle this presents advantages of course, but it also means that it is increasingly difficult as time goes by to make changes in the trading pattern. Furthermore, if the learning elasticities in such sectors are lower than in the sectors where advanced country trading partners have comparative advantage, the Latin American economies could be committed in a long term sense to a low productivity growth trajectory[10]. Precisely similar points would apply, of

[10] This is what Barros seems to have in mind when he writes of specialisation having a "negative effect on productivity increase" (op.cit. p.545), but his discussion is vague and unconvincing.

course, to economies like Mauritius and Sri Lanka with their heavy commitment to 'low' technology, labour intensive lines of production[11]

This line of analysis could have special importance to the 'low productivity exporters' as they reach the point where labour is fully employed. If at that time they are locked in to a pattern of relative productivities inherited from the past, they could experience serious difficulties in shifting to new lines of production with higher labour productivity (in the way the Fei-Ranis approach suggests is necessary)[12]. We will discuss this problem briefly in the next section.

The second point to emerge from the Krugman's analytics, is that there is clearly a way out of the 'lock-in' - along lines which he identifies with Japanese industrial policy, and which is nowadays more commonly associated with the policies of selective protection followed by Korea. The idea is that governments may use 'temporary protection to permanently shift comparative advantage'. The protection will be directed to goods which are just outside the present pattern of national comparative advantage, and applied for just so long as is necessary to raise relative productivities in their production to the point where a new area of comparative advantage is established. Krugman refers to this as the policy of a 'narrow moving band' of protection (Op. cit. p.48-49). It is an interesting reflection of the notion of "technological upgrading", and has considerable empirical foundation in the history of industrial policies in some of the Group IA countries in our analysis[13]. For a short review of evidence on Korean policy see Background Paper No.4 (Cooper and Turner, 1995).

Path Dependencies and the role of National Systems of Innovation

The idea that trade patterns may get 'locked in' as described in the preceding section, is derived from the learning process. Once firms are committed to a particular line of production, the learning processes this sets in train - whether 'automatic' in the Arrow tradition (Arrow, 1962), or the result of conscious managerial decision and resource allocation[14] - reinforces the inter-industry pattern of comparative advantages and, since the same thing is happening in trading partner countries, it becomes increasingly difficult to change the pattern. This is an example of 'path dependence - which might briefly be described as a recognition that 'history matters'. Learning processes[15] will, obviously, produce many situations of path dependence. From the present point of view, path dependence is important because it will influence the

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[11] The analysis is based on the assumption that whilst there may be international spill overs of technological capability *within* industries, there are no spill overs *between* industries. The lock in effect would be much less severe if there were inter-industry spillovers. It might be argued that one of the implications of generic technological change is that such interindustry spill overs will be important.

[12] Krugman's analysis has not been extended to the case of labour surplus economies operating with a constant institutionally determined wage rate, but that does not change the validity of the present line of argument.

[13] It is certainly relevant to Korea and Singapore. In somewhat different ways it probably applies to the case of China. Matters are less clear for India and Indonesia.

[14] The recognition that learning processes involve important resources has a substantial history. As far as work on developing countries is concerne, Katz's work in Latin America provided the essential empirical basis (Katz,1974) and was the point of departure for a substantial literature. Much later the point became embodied in theories of endogenous technological change.

[15] On the kinds of technological learning which are important in firms in developing countries see Dahlmann, Ross-Larsen and Westphal (1982).

possibilities of shifting between the types of growth path (i.e. high versus low productivity growth paths) which differentiate developing countries. There are two levels at which relevant kinds of path dependency may get set up.

First, the technological learning processes within firms are path dependent. David (1975) recognised this:

" ..Because technological learning depends on the accumulation of actual production experience, short sighted choices about what to produce and especially about how to produce it using presently known methods, also in effect govern what subsequently comes to be learnt" (David, 1975, p.4).

Dosi (1988) describes the cumulative learning processes which underly the accumulation of technological capability in enterprises[16]. There are three distinctive features of these learning processes. First, they tend to have important firm specific features. Although there may be spill overs of technological know how between firms, a good deal of the learning process in a firm differentiates it from its competitors. Secondly, learning processes create a good deal of 'tacit' knowledge - that is knowledge specific to the application of particular processes inside the firm, and which is neither codified, not easy to codify. This is the type of technological capability that can only be acquired by 'doing'. Thirdly, whilst some knowledge may accumulate 'spontaneously' through the experience of production, for the most part the accumulation of technological capabilities depends on the allocation of time and effort by the personnel of the firm, and depends on explicit management decisions.

But though accumulation of technological capabilities takes place in the first instance *within* production units (and increasingly in service enterprises too), the broader institutional environment within which firms operate is also important. In recent times this environment has become called the 'national system of innovation' and important attempts have been made to describe it systematically (see Nelson, 1992). The national system of innovation is the second level at which there are important path dependencies. It has a number of components other than enterprises. These differ in form from country to country, but are present in most. In the first place there is the education system - especially those parts concerned with scientific and technical education. The early creation of a highly skilled and educated workforce is generally agreed to have been a key element in the success of the first generation of NICs. On its importance in Korea see Pack and Westphal (1986). Second, there are the various institutions engaged in scientific and technological research (outside of enterprises). These normally include the universities, as well as various national laboratory organisations. Sometimes - especially in developing countries - a large part of the scientific and technical capability of a country is 'tied up' in these institutions and a major policy problem is how to relate this capability to national development objectives. Sometimes also - as in the United States for example - these institutions grew out of major national programmes - like the space programme or defence programmes. Third, there are a set of important ancillary institutions - survey systems, technical information systems, standards systems, technology transfer organisations and so on.

In most countries the institutions making up the national system of innovation play an important part in technological development within enterprises, whether through creating a supply of skilled persons, or through facilitating the acquisition of technology from abroad, or

[16] This and other basic material on accumulation of technological capability is surveyed in Cooper (1993)

through provision of technological information, or through the support of university or other research activities on which enterprises can draw. It is important not only that the institutional structure of the national system of innovation should be present, but that it should be *functionally related* to the requirements of the enterprises which are at the sharp end of the process of acquisition of technological capability. The long term development of these institutions and their organic relations to the enterprise sector have played a large part in the process of technological development in many of the Group IA, high productivity growth countries.

How, then are high and low productivity growth economies distinguished from one another as far as the technological capabilities are concerned. We can give an impressionistic, but probably reasonably accurate response along the following lines. First we expect that in the high productivity growth economies we will find production and service enterprises - especially in the export sectors - in which there are considerable concentrations of technically skilled persons, and where - more importantly - there is a vigorous process of technical learning happening within firms. Second, we would expect that there will be close links between production and the rest of the national system of innovation. In the low productivity growth economies we would expect to find firms which are solely concerned with repetitive production tasks, in which there is no concern with learning or change. Very little research has been done on these differences, but there is a good deal of impressionistic evidence to support the picture we have drawn This hypothetical description will make clear also that the shift from low productivity to high productivity paths is not as easy as may appear. It will depend on generating learning processes within firms on the one hand, and on linking the key elements of the national system of innovation to services and production on the other.

Technology, Distribution and Employment

Technological change may affect the distribution of welfare in various ways For example, as we have seen in the case of the Group I economies, through its effects on the productivity of labour it may produce increases in the real wage. It is also argued that technological change influences the distribution of welfare through it effects on the level of employment. So if the growth of output is restricted by limits on demand, high productivity growth, perhaps occasioned by high real wage growth, will limit the rate of growth of employment. Such positive distributional effects as may arise from rising real wages for those in employment could be offset by high levels of unemployment overall, with a large part of the potential workforce thereby committed to very low income levels. And the argument is encountered that the general requirements for increasing labour productivity posed by the need for international competitiveness, is likely to exacerbate the problem. The argument is somewhat questionable on empirical grounds since it is not obvious - as the analysis has shown - that rising labour productivity is a necessary condition for international competitiveness. Nevertheless, it is plainly of interest to examine the employment implications of the patterns of international competitiveness discussed above.

Table 6 sets out the data available on the growth of employment in manufacturing industry in the 118 countries on which the analysis is based. It is clear immediately that the incidence of significant trend rates of growth is much higher in the Group I countries (which also show sustained growth of manufacturing exports). On the average, the Group I countries show a rate of growth of manufacturing employment of just over 4 per cent per annum. The average (unweighted) for those Group II countries for which employment growth rates are available, is about 1.5 per cent per annum. The employment growth rate in Group I is - on average - well above population growth rate. The rate for the Group II countries is well below most developing country population growth rates. There is, however, a considerable variation between countries in Group II.

There remains the question of employment growth patterns within the Group I countries. Group I includes those countries with the highest growth rates of labour productivity in the developing world, so if indeed technological unemployment is an important issue in the developing countries, it is here that one might expect to find it.

TABLE 6: GROWTH OF EXPORTS, VA PER WORKER AND EMPLOYMENT IN MANUFACTURING

Country	Export Growth 1970-91	VA per Worker Growth 1970-90	Period	Growth of Manufacturing Employment 1970-90	Period
Group I: Countries with sustained growth of Manufactured Exports					
B. Faso	9.92 *				
Barbados	10.54 *	2.2 *		1.31	70-90
Benin	7.87 *				
Brazil	15.09 *	1.09 *		4.62 *	70-90
Brunei	6.74 *				
Cameroon	4.3 *				
Chile	7.4 *	1.46 *		-0.75 *	70-90
China	9.9 *	4.5 *	77-90	2.88 *	77-90
Fiji	9.06 *	-0.79		3.33 *	70-90
French Guyana	10.46 *				
Grenada	3.46 *				
Guadeloupe	10.9 *				
Hong Kong	7.91 *			5.16 *	70-90
India	5.62 *	2.12 *	70-89	2.45 *	70-89
Indonesia	25.49 *	4.29 *		7 *	70-90
Jordan	19.48 *			7.53 *	74-90
Korea	18.44 *	5.71 *		7.14 *	70-90
Macao	13.5 *			5.61 *	78-90
Malaysia	17.54 *	1.71 *		7.47 *	70-90
Mauritius	26.21 *	-3.77 *		10.61 *	70-90
Mexico	10.46 *	2.96 *		1.69 **	70-90
Morocco	13.25 *	-1.54	80-88	4.9 *	76-88
Nepal	10.03 *				
Pakistan	4.39 *	4.19 *	70-88	1.02 *	70-88
Panama	9.14 *	-0.9 *		2.84 *	70-90
Peru	13.49 *	0.17	79-88	0.29	70-73
Philippines	16.61 *	-0.87		4.57 *	70-90
Singapore	16.38 *	2.58 *		5.48 *	70-90
Sri Lanka	22.42 *	-2.23	70-87	4.99 *	70-89
Syria	12.49 *			2.87	70-90
Thailand	21.15 *	3.05 *		5.18 *	70-90
Tonga	13.51 *	-3.5	83-90	9.69 *	75-81
Trinidad	4.52 *	-3.87 *		1.33	70-88
Tunisia	15.52 *				
Turkey	20.32 *	1.93 *			
Uruguay	7.69 *	3.88 *	73-89	-1.8 *	72-89
Venezuela	10.21 *	-0.63		4.48 *	70-90
Group II: Developing Countries whose Manufactured Exports have no Growth Trend					
Afghanistan	6.83			3.65	73-88
Algeria	-1.91				
Antigua	-5.2				
Argentina	7.7	2.34 *	70-89		
Bahrain	4.54				
Bangladesh	2.94 *	-3.62	70-91	5.16 *	70-90
Belize	2.34				
Bermuda	-11.96				
Botswana		2.9	71-90	10.62 *	71-90
Burundi	2.2				
Cambodja	15.99	16.88 *	87-90	-1.57	85-90
Cap Verde	-5.42 *				
CAR	-0.25			-8.02	73-78
Chad	2.52				
Colombia	11.89	2.09		2.27	70-90
Congo I	3.4			-1.2	70-73
Congo II		-0.46 *	81-88	7.66	81-88
Costa Rica	5.56	-0.063	84-90	3.84 *	84-90
Cote d'Ivoire	8.44				
Cuba				2.8 *	76-89
Dom. Rep	1.18				
Dominica	6.85 *				

Country	Export Growth 1970-91	VA per Worker Growth 1970-90	Period	Growth of Manufacturing Employment 1970-90	Period
Egypt	0.25			2.91 *	70-90
El Salvador	-0.07				
Ethiopia	0.19	-0.22	-0.62	3.59 *	70-90
Faeroe Isl	6.97				
French Polynesia	0.68				
Gabon	3.99				
Gambia	15.95				
Ghana	2.48				
Guatemala	1.49	1.37	71-88	2.12 *	71-90
Guinea-Bissau	-9.93				
Guyana	5.46				
Haiti	6.4	-2.94 *	70-88	7.59 *	70-88
Honduras	1.83	-0.58	71-90	5.17 *	71-90
Honduras II					
Iran	3.69	-0.86		7.99 *	70-77
Jamaica	0.79	-1.1 *		0.68	70-90
Kenya	4.88	2.46 *		6.03 *	70-90
Kiribati	-1.37				
Kuwait	14.04	-0.78	77-88	8.33 *	70-89
Lebanon	3.63				
Liberia	-4.83 *				
Libya	-52.14				
Madagascar	-0.32			1.69	70-88
Malawi	5.81				
Martinique	10.69				
Mauritania	13.38				
New Caledonia	-1.48				
Nicaragua	-4.14				
Niger I	4.16			6.92	77-80
Nigeria	7.23				
Oman		5.07	85-90	-3.39	85-90
Paraguay	5.99				
PNG	10.02	-1.05	80-87	0.0289 *	70-87
Puerto Rico		6.17 *		0.7	70-90
Qatar	12.64				
Reunion	5.88				
Saoedi Arabia	26.22				
Senegal	1.35				
Seychelles	-4.96				
Sierra Leone	-7.96				
Solomon Isl	7.01				
Somalia	-7.47				
South Africa		1.21	72-90	1.73 *	72-90
St Kitts	3.68				
St Lucia	13.68				
Sudan	10.39				
Surname		0.16	75-90	-1.76 *	74-90
Swaziland		2.58	76-89	3.42	70-73
Tanzania	1.36	-4.02	80-88	7.11 *	70-74
Togo	5.39				
UAE	28.77				
Uganda	-6.34				
Vanatua	-17.93				
W. Samoa	-6.33				
Zaire	-5.06				
Zambia	3.49	0.5		2.6 *	70-90
Zimbabwe	1.61	0.64 *		3 *	70-90

Notes

(1) Asterisks indicate that the growth coefficient is significant at the one per cent level

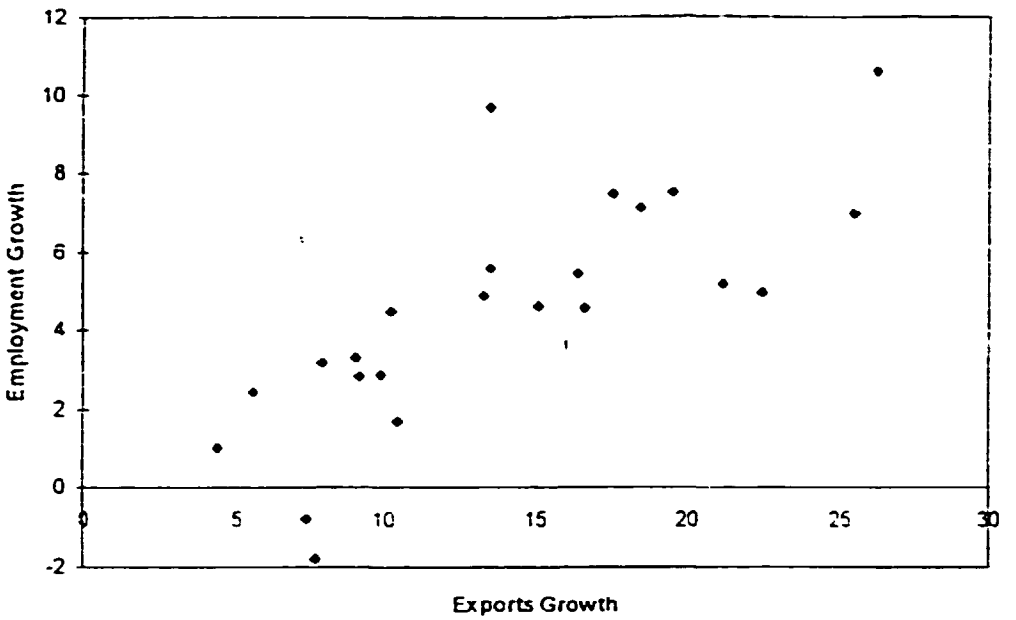
(2) Source for data: IBRD World Tables

Figure 1, given earlier, gives a first suggestion that technological unemployment has not in fact been an issue in these countries Earlier we used Figure 1 to argue that there is no clear relationship between the rate of growth of manufactured exports and the rate of growth of value added per worker. This was a point of departure for the argument that competitiveness can be achieved by different technological growth paths. But Figure 1 shows something more than this. It shows that in these developing countries which have achieved international competitiveness, the rate of growth of exports has in general, outstripped the rate of growth of value added per worker, whether in the high productivity growth sub-group (Group (IA), or in the low productivity growth Group IB. The diagonal arrow drawn from the origin of the Figure, traces the line along which the rate of growth of exports is equal to the rate of growth of value added per worker. Countries lying along this line would not experience any growth of employment resulting from export expansion. Countries lying to the right of the line - where all the countries in the sample are in fact found - have had rates of growth of exports well in excess of the rate of growth of value-added per worker. On some conventional assumptions about the multiplier effects of export growth on the macro economy, it is reasonable to suppose that this means that the aggregate impact of growth in exports was to expand total output in more or less the same percentage.[17] It also follows that employment will have expanded at this rate. If these conditions are met, it is reasonable to conclude that the countries in this group have on the average, experienced considerable growth of employment as a result of export expansion, even if their labour productivity has grown rapidly.

The same conclusion, regarding the Group I countries, is obtained more directly from an analysis of the data in Table 6. Figure 3 shows the scatter plot of growth rates of manufacturing employment (on the y-axis) against the growth rates of manufactured exports. There is evidently a strong relationship between the two.

[17] This depends on the assumption that the multiplier is a constant, viz that marginal propensities to save and to import are constant over the relevant range of incomes.

Figure 3: Growth of Manufacturing Employment vs Growth of Exports



This is further explored in Table 7 which follows and which gives the results of some simple regressions. Two sets of equations are tested in Table 7: one set is based on the full data set for Group I countries in Table 6 (with 19 degrees of freedom); the other is based on the same data set, but only uses values which are statistically significant (with 14 degrees of freedom). Neither set is satisfactory since there are too few degrees of freedom, but it is unlikely that the regressions are spurious. The rate of growth of manufacturing employment is the dependent variable in all cases. The rates of growth of exports (X), and of value-added per worker (G), are the explanatory variables. Equations (1) and (4) are multiple regressions of both explanatory variables on the rate of growth of employment. In each case they show relationships which are strongly significant at the one percent level. The intercept term is effectively zero. The coefficient on export growth (X) is highly significant, whilst that on G, the growth of value added per worker is not significant (at 5 per cent), although it has the correct sign. In equations (2) and (4), employment growth is regressed on export growth alone. In the case of (2) there is a small (non-significant) reduction in explanatory power (compared to (1)). In the case of (4), explanatory power actually increases when the value-added growth term (G), is dropped. Equation (2), in fact determines the regression line for Figure 3.

This leads to some straightforward conclusions. First the analysis shows, as Figure 1 suggested, that for the Group I economies, the rate of growth of exports has been the dominant determinant of employment growth. It is the successful expansion of export demand and the multiplier effects flowing from it which have generated growing output and employment. The regressions show that there is no systematic tendency for Group I countries

Table 7: Regressions of Rate of Growth of Employment on Rate of Growth of Exports (X), and Rate of Growth of Productivity (G).

Eqn.	Constant	t-stat	X	t-stat	G	t-stat	F-stat	DW	adj R-sq	df
(1)	-0.05	-0.05	0.344	4.83*	-0.310	-1.89	15.64*	1.79	0.6065	19
(2)	-0.76	-0.67	0.368	4.92*	-	-	24.22*	1.58	0.5501	19
(3)	4.93	6.87*	-	-	-0.45	-1.84	3.5	1.52	0.1182	19
(4)	-1.38	-1.06	0.385	5.414*	-0.071	-0.37	17.0*	1.37	0.6958	14
(5)	-1.64	-1.56	0.393	6.026*	-	-	36.31*	1.36	0.7161	14
(6)	4.80	3.99*	-	-	-0.403	-1.22	1.48	1.42	0.3333	14

exports based on a high growth of value added per worker, to have a less good employment growth performance than the low productivity growth economies. At least as far as these countries are concerned, technological unemployment has not been a problem. This is interestingly in line with the comments of Fei and Ranis on Korea and Taiwan in the 1960's and 70's, that the shift to 'export substitution' (i.e. the development of manufactured exports to replace primary exports) is a critical turning point, after which the 'trade off between growth and employment' is no longer an issue.

This needs some qualification, however. First the result is based on a propitious period in the development of the international economy, during which there was generally a high rate of growth of trade. It is not clear whether it would hold so strongly for the later 1980's for example, when trade was lagging, whilst value added productivity was nevertheless increasing in economies which were increasingly open to international competition and the pressures of technological change elsewhere in the world economy Second, whilst we found no significant relationship between the rate of growth of value added productivity and employment growth, it remains the case that the sign on the value added coefficient (i.e. the coefficient on G), is negative, and it is possible that a more complete data set would show a stronger negative relationship. The fact remains, however, that in the conditions of openness to trade, developing countries which have attained competitiveness - whether through high productivity growth or low - have commonly achieved very high growth of manufacturing employment, because of export expansion. They have not had problems of technological unemployment. Nor is it clear that technological factors can in any aggregative sense be held responsible for unemployment in the other developing countries in Group II, because as far as this group is concerned, the growth of value added per worker has not been significant - at least on the average.

Overall, as far as income distribution is concerned, the evidence available suggests that both high and low technology growth paths have resulted in positive effects, through the rapid expansion of employment (narrowing gaps between the employed and the formally unemployed). In addition, in the high technology countries, with high rates of growth of productivity, the closely linked rise in real wages (see Figure 2), has also made a significant contribution to a more equal distribution - essentially through its effects on the functional distribution of income.

Technology, Distribution of Welfare and the Gender Division of Labour in Society[18]

Distributional impacts of technological change are not confined to its effects on the functional distribution of income and its aggregate impact on employment. In addition there are important distributional consequences resulting from the effects on the *structure* of employment. The effects of technological change on the demands for skilled and unskilled workers is a widely discussed structural change. Much less discussed, but important in determining the welfare implications of technological change, is its effects on the relative demands for male and female labour, in other words on the gender division of labour.

There are few studies which deal with the effect of technological change on women's employment. The following discussion and the Background Paper No. 6 (Mitter,1994) and on the preliminary results of a joint study between UNU/INTECH and UNIFEM on Technological Change and Women's Employment.

It is helpful to relate impacts on women's employment to more general conditions in the labour market and in the economy. In particular, there seem to be contrasts between situations in which there is a general labour surplus and situations (such as arise in some of the Group IA economies) which are approaching the point at which surplus labour is fully absorbed.

Usually in the labour surplus economies the central employment problem is the absorption of large numbers of unskilled and inexperienced workers into labour intensive industries. Of course, women workers as well as men are involved in this process. However, women workers face some particular problems which are relevant from the point of view of distribution.

In labour surplus economies which follow a path of labour intensive (low productivity growth) exports, competitiveness in the face of international technological change often requires cost cutting by methods other than improved technological efficiency. This usually depends on one of two conditions: either a reduction in the costs of materials inputs through access to new sources of intermediates (or technological advance in the materials sector), or a fall in real wages. In labour intensive lines of production where the share of labour costs in unit costs is high, reductions in real wages are especially effective. This probably underlies the falls in real earnings per worker in some of the Group IB countries. (See Table 5). It appears that the employment of women workers may be used as a way of achieving such reductions in the real wage. This is noticeable in particular sectors - like garments - where cost cutting can take the form of substituting less well organised female labour for male labour. This poses special distributional problems

Further problems arise in the transition out of the low productivity pattern. Technological upgrading to higher levels of labour productivity - which as we have seen may happen in the context of labour surplus (see earlier and also Mitter, op.cit. p. 10), and in the course of changes in the structure of labour demand, women workers may be replaced by men. The gender distribution of income is then affected For example, Mitter (Op. cit. p. 11) quotes

[18] This section is based on Background Paper No. 6 (Mitter, 1994).

Narayan and Rajah (1990) as showing that technological upgrading in the electronics industry in Malaysia resulted in a fall in the proportion of women in the workforce from 80 per cent in the low technology phase, to 67 per cent after production had been computerised. She also notes deterioration in conditions and nature of women's work.

With more complete transitions to a higher productivity growth path in the industrial sector, other factors become important in determining the scale and nature of women's employment. First, the higher productivity technologies may open up the prospect of more skilled employment. It therefore underlines the importance of prior training - a point to which we will return. Second, as Mitter shows (Ibid. pp. 15 ff.) the transition is usually accompanied by an accelerated growth of the service sector. This has opened up new opportunities for women's employment. Provided that the 'need for aggressive training programmes' (Ibid p15), this could have a major effect in equalising job opportunities for women.

V. Implications for Policy

Should developing countries pursue technological upgrading ?

Perhaps the most striking outcome of the discussion has been that although a number of highly successful (and by definition highly competitive) developing country exporters of manufactures have exploited the opportunities offered by technological advance, a number of countries - equally successful in international markets, at least as far as export growth is concerned - have not done so. On the face of things, it has been possible for countries to become competitive in international markets for manufactures, without being much concerned about technological change. This leaves an obvious question: is there any need for concern about technology policies in relation to trade and competitiveness? In this concluding part of the study we will explore the question in more detail. A convenient way to do this is by putting the question: should developing countries pursue "technological upgrading"?

Why "technological upgrading"? The reason is straightforward. Return to Table 1 and the ensuing discussion. This is where the distinction between was first made between two sub-groups of internationally competitive economies - Group IA which had rapidly growing factor productivity, or to be more precise, labour productivity, and Group IB which had hardly any growth in productivity and in some cases (of very successful export development) an actual fall. The path followed by the high productivity growth countries of Group IA may legitimately be described as one of technological upgrading. It involves a shift of production and export trade from lower value added products and industrial branches to higher. In many cases, (Korea, Singapore and Indonesia are examples, but not the only ones) this shift was an outcome of government policies, similar in kind to the policy of the 'narrow moving band' which Krugman suggests characterised the history of Japanese industrialisation. So the question (what should be the role of technological policy in the development of trade in manufactures?) can, in light of the facts of recent industrial and trade history, legitimately be posed in terms of technological upgrading.

In the following there is an exploration of whether the path of technological upgrading is possible and desirable for other developing countries. The discussion will proceed as follows. First, there is a section which emphasises that for many countries the low productivity growth path is extremely important and that it would be a serious mistake if concern for technological dynamism were to obscure the point. Second there is a discussion of the reasons why governments might legitimately be concerned to pursue policies of technological upgrading. This is essentially an analysis of the advantages it represents as a policy. Then a third and final section discussed the constraints which such policies have to face and the social and economic costs of technological upgrading. These are considerable and make it quite clear that 'technology' doesn't offer easy ways out of development problems, even though it is a centrally important factor.

The importance of the low productivity growth path. Labour intensive manufactured exports

Before even considering the issue of technological upgrading it is important to place matters in perspective - and in particular to relate 'upgrading' to the role of low technology exports. In essence we return to a discussion of the early 'export substitution' phase, where countries - usually still in a state of labour surplus - switch from primary exports to manufactured exports. It will be obvious to start with that this shift is a matter of great importance to a large number of developing countries, whose manufactured exports are small and which have yet to establish a position in international markets for manufactures. This includes all those countries in Group II in our earlier analysis, which have as yet shown no sign of sustained exports of manufactured goods - though they may from time to time have made successful forays into the international market. For these countries there is really no choice about the matter. If they are to enter trade in manufactures they will have to start with labour intensive lines of production and export. And since these are, in all cases, labour abundant economies with a weak basis in technological skills, this means in effect that they will have to follow well known lines of relative price policy which will allow them to realise their immediate sources of comparative advantage. There are two points to make about this situation.

First, this initial exploitation of immediate sources of comparative advantage has characterised the economic history of all developing countries which have subsequently established strong positions in manufactured exports. Sometimes, as we note earlier, there was a rather early shift away from the low productivity labour intensive sectors[19], but whether the shift was early (as in Korea or China), or much later (as in Malaysia), the first period of manufactured exports was in all cases focused on relatively low productivity labour intensive productions or, in Latin America in particular, on natural resource intensive lines of production. Given the underlying economic logic of this line of development, it is surely a pattern which new entrants to markets for manufactured goods will have to follow.

Second, the development of low productivity lines of production is not an *alternative* to technological upgrading but a *complement* to it. This point is explored in Background Paper No. 4 (Cooper and Turner, 1995). The argument is as follows. Characteristically the small open developing economies depend on imported capital goods to realise investments. This means that expansion in these economies is usually faced with a foreign exchange constraint and in particular the rate of investment -particularly in the industrial sector where imported foreign capital goods are especially important - depends on the availability of foreign exchange and so, ultimately, on exports. Now, technological upgrading depends on learning process within sectors and, on the development of new sectors, both of which require large investments (and concomitant importation of equipment[20]). It follows that in so far as the development of low technology manufactured exports has been an important way of financing capital goods exports for the rest of the industrial sector, it is actually an intrinsic part of the process of technological upgrading Cooper and Turner (1995) show that, in most circumstances, it is optimal from a welfare point of view that policies of technological

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[19] We have argued that for the Group IA countries the shift to higher labour productivity took place earlier than might have been expected on grounds of labour market conditions, ie. whilst there was still a good deal of surplus labour.

[20] See Pack and Westphal, 1986, on the importance of imported capital goods in the upgrading of Korean industrial sectors.

upgrading should be preceded by periods during which traditional manufactured exports are given priority and built up This ultimately permits an acceleration of learning and productivity growth when the shift is made and therefore reduces the social costs which are associated with it (and which are discussed below).

Third, low productivity growth exports are, in an important sense, a hedge against the risks that attend the process of technological upgrading. These risks are clear. Techological upgrading can go wrong - both for firms and for governments - and then the fact that there are well established markets for simple manufactures helps to limit the damage which such failures might cause to trading positions[21].

Fourth, low productivity exports are potentially very important for the rate of growth of employment and the eventual absorption of excess labour. It is true that the earlier analysis suggests that in export led economies, the rate of growth of employment has been so dominated by the effects of expanding export demand, that there has not been much reason to worry about the decelerating effects of increases in labour productivity However, for much of the period analysed, world demand was generally expanding fast and the trade off with employment growth was much softened by the very high rates of growth of exports. It is not clear that such high export growth rates will always be maintained. If they are not, labour absorption may come to depend to a greater extent, on the use of labour intensive technologies. And it is certainly clear that in the Group II countries which have not yet entered manufactured export production, employment effects can be enhanced in the early period of export development by a focus on relatively low labour productivity outputs, as happened initially in all the economies which today are experiencing a high growth of value added per worker.

There are however some important trade offs in relation to the distributional effects of low productivity employment. In aggregate, high labour intensity should open employment opportunities for more people in aggregate than capital intensive production, but it could have some other less favourable distribution effects, particularly for women's employment. Of course women will benefit from the general expansion of employment opportunities, but as we have seen earlier, they are particularly vulnerable in situations where it is necessary to hold down real wages in general. That, of course, is a requirement in labour intensive, low labour productivity production - where the displacement of higher waged male labourers by female ones who are less well organised has been a way for some countries to reduce the effective real wage. This is a matter of employment policy and regulation.

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[21] Something of this kind seems to have happened in Korea. The switch to 'heavy industries' in the 1970's was an initial attempt at upgrading, which - it is widely agreed - was a failure. Yet Korea's export performance remained strong throughout.

What are the advantages of technological upgrading and why might countries pursue it?

An important implication of the last section is that the high and low productivity growth paths which distinguish Group IA and IB countries are not to looked upon as alternatives. The policy issue, for the vast majority of countries and particularly the countries in Group II which have not yet established a position in world markets for manufactures, is not whether to follow one path or another. The issue is rather to determine, once properly established in international market for simple (low productivity) manufactured exports, when it is possible and desirable to make a switch to a higher productivity growth path The focus of policy must be on this question - not on choices which do not exist.

Why is such a switch potentially desirable? There are some fairly straightforward reasons.

First, the shift to higher value-added per worker lines of production, means that the relative full employment real wage (compared to trading partners) will rise at equilibrium (Krugman, 1987, op. cit. pp. 48-49) - and in so far as real wages in most trading countries in the higher value added lines of manufactured production probably rise faster than in the lower value added lines, there will also be a potential for a more sustained increase in real wages. This pattern is to be seen in the case of countries like Korea, and the new 'generation' of NIC's. It has, in general, positive income distributional implications as between capital and labour. The functional distribution of income is improved without posing a threat to the incentive for capitalists to invest. This - it would seem - is a major source of strength in those economies where value added per worker has grown rapidly.

It is not clear how far these distributional advantages are shared between male and female workers. Earlier we discussed two possible effects. On the one hand, the rise in real wages associated with upgrading will lead to the disappearance of low productivity sectors and lines of production in which women found important, if low paid, sources of employment. There is a risk therefore that the women's employment position may in aggregate be weakened by upgrading. Technological upgrading may displace female workers by male ones. There are of course case studies which demonstrate this kind of outcome. At the same time, technological upgrading is associated with the appearance quite new job opportunities - quite often in service sectors which become important ancillaries to classical manufacturing production as incomes rise - and women workers may be well placed in these fields.

Second, to the extent that efforts to expand exports of simple manufactures meet with success, the point will come sooner or later, where labour surplus turns into labour shortage, and real wages will tend to rise under the normal pressures in the labour market[22]. In this situation some change in the technologies of production becomes inevitable if countries are to remain competitive. In the Fei-Ranis scheme of things, this shift in technologies to more capital intensive 'upgraded' technologies and products will come as a natural response to market forces. The earlier discussion on 'path dependencies suggests that this response to the market might not be all that automatic or natural - since the capacity to respond will depend to some

[22] Some countries, Malaysia for example, seek to delay this shift by import of unskilled labour from neighboring labour surplus economies.

considerable extent on the prior build up of technological capabilities. The point is discussed further in a later section

Third, upgrading not only makes possible a rising real wage, but also means that countries are better able to meet low wage competition in international markets for simple manufactures, from new entrant countries 'further down the line'. So upgrading can be thought of as making room for new entrant countries. It increases a country's share of world trade in higher value added goods, and leaves space for other countries to increase their share of trade in low wage and low productivity goods. There is in this sense a collective interest amongst developing countries - in Group II as well as Group I - in succesful upgrading by other exporting countries. Progressive upward shift by Southern economies in this way ultimately puts pressure on the trade shares of industrialised North, which can only be met by accelerated technological innovation in those countries.[23] At the same time upgrading will help developing countries to maintain competitiveness in the face of technological advance in the industrialised countries whilst resisting a downward pressure on real wages. The process of upgrading conceived in this way is, of course, strongly dependent on the international transfer of technology

Finally, aside from maintaining shares of world trade, upgrading probably allows countries to shift towards the exports of goods which have higher income elasticities of demand in international markets and especially in developed countries. This may help to maintain the growth of exports. Although the cross-sectional evidence from export led countries does not show a relationship between rates of growth of exports and the rates of growth of value added per worker (which can be regarded as an approximate measure of upgrading), it is nevertheless possible that individual economies in the high productivity growth group were able to maintain high rates of export growth along with considerable rises in real wages precisely because of such shifts towards products with a high income elasticity of demand

Constraints, Costs and Policies

Two conditions have to be met in order for a country to accomplish a shift in manufacturing production and exports towards goods of higher value added per worker. First, there usually has to be a transfer of production technology from abroad. (The implications of international transfers of technology are discussed fully in Main Paper No. 2 (Kumar, 1995)). Transfers of technology take place in various ways, which have been widely discussed and which differ considerably between countries. Korea, for example, depended heavily in the early stages on imported capital equipment, and licensed technology. Later, there was a shift towards increased reliance on joint ventures and foreign direct investment. In other countries - notably Singapore and Malaysia - there has been a much larger and more sustained reliance on foreign direct investment as a means of technology transfer.

Second, the preconditions of skill supply, management, and intrafirm technological capability have to be met. This means in effect that the 'path dependent' conditions discussed earlier

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[23] This type of argument, nowadays widely accepted, was first developed by Vernon (1966) in his concept of the product cycle. Krugman (1976) gave an influential formalisation of Vernon's arguments, which are also discussed in Grossman and Helpman (1991, pp.310 ff.)

have to exist if the transition from one path to another is to be successful. Firms must be able to absorb the higher productivity technologies and to initiate and manage learning processes[24]. And various elements of the national system of innovation must be in place and properly integrated to the system of production[25].Amongst other things this means that training is a central concern in the building up the basis for the switch to higher growth of productivities. So is the encouragement of technological learning processes in firms. And in so far as women's employment is a matter of special concern from a distributional point of view, training and intrafirm learning processes will need to be focused on women workers.

But even if these rather demanding prior requirements are met so that technological upgrading is possible, it always involves costs. Upgrading involves a switch of resources from lines of production in which a country has comparative advantage ones in which it does not - but where learning processes promise to create a new source of comparative advantage in the near future. (See Krugman, 1987; Cooper and Turner, 1995). Until these learning processes take effect, there will be foregone output and profit. It is possible that private firms operating under free markets will be willing to bear these costs, measuring them against the gains to be obtained in the longer run.

The presence of learning effects does not always mean that policy intervention will be necessary. However, it is well established that market forces will produce underinvestment in technological learning (see Arrow, 1962). The main reason for this is the prevalence of externalities and the imperfect appropriability of knowledge by firms. It is also observable that in many countries, the learning process has been encouraged by state intervention (see Pack and Westphal, 1986, for a particularly clear account of the process of 'selective interventions' followed by the Korean Governments). This means that often the costs of learning will appear in part in the form of subsidies to maintain productions that are initially uncompetitive until such time as learning processes render them efficient. There is not much hard evidence about the size of these learning costs, but one can give some plausible guidelines to the factors that will affect them. Firstly, they are likely to be larger the longer the learning period involved, particularly if the appropriate discount rates are high. Secondly, since longer learning periods are probably associated with bigger technological 'jumps', costs are likely to be larger the greater the technological 'distance' between technologies currently in use and the technologies about which it is desired to learn.

All this suggest some simple ground rules for policies of technological upgrading. First, it is important to establish the types of skills which are likely to be required by the 'target' technologies. Second, smaller technological 'jumps' will generally be less costly and less risky than larger ones; the size of the jump is a relative matter and depends on the skills available and the degree of technological sophistication of the existing pattern of production. Discussions about how to 'pick technological winners' can be misleading in this regard, in so far as they implicitly suggest large 'jumps' to technologies which are well outside the present

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[24] The different patterns of technological capability that have to be built up, and some of the actions needed to achieve them are discussed by a number of authors. A basic reference is Dahlmann, Ross-Larsen and Westphal (1987). See also Lall (1992) inter alia.

[25] The problem of mobilising the capabilities of scientists and technicians employed in large national laboratory systems has begun to get a great deal of attention - often in the context of economic reforms. For an analysis of policies in the People's Republic of China, see Gu (1994). Lall (1992) has a useful discussion of institutional requirements.

range of production activities. Probably the most efficient procedure will be to stick close to sectors and projects in which there has already been an accumulation of capabilities. Third, the least costly and least risky learning processes are those associated with sectors in which there is already a static comparative advantage, but where, up till the present, there has not been much productivity growth. It seems sensible to start an upgrading policy by trying to generate technological learning in such sectors. Fourthly, since it is important to examine the extent to which firms responding to market forces alone might invest in learning processes without there being recourse to protection or subsidy. It might be that such investments by individual firms will be stimulated by relatively limited support - for example the provision of better information about foreign technologies available in relevant lines of production. If markets can generate learning processes without intervention, it may be best to encourage them to do so. And finally, technological upgrading whether done by firms alone responding to market forces, or done with the support of the state, is an inherently risky business, involving - by definition - technologies which are new to the country. It is important that this is recognised, and it is also important that in so far as the state is involved in the process, it should be able to put it in reverse if it should turn out in any particular case to be misconceived and excessively costly. State bodies involved should be prepared to cut their losses. This is inherently difficult - indeed politically difficult - since it may involve reversing policies of support to particular firms and sectors.

A summary of main policy conclusions

A main finding of this paper has been that whilst technological change plays an important part in the manufactured trade performance of some countries - and whilst the fact of technological change in an increasingly open international economy effects all countries to a greater or lesser extent - it is nevertheless possible for countries to achieve a high degree of competitiveness in manufactured trade, without paying much attention to 'technology'. They do this by *exploiting patterns of short run comparative advantage*. We emphasised the importance of this for policy:

- All developing countries which subsequently achieved high productivity growth and technological upgrading started out with labour intensive manufactured exports and low levels of factor productivity. These types of exports must perforce play a major role in countries which have not yet entered international trade in manufactures to any great extent - and which are in the main technologically weak;

- Low productivity, labour intensive exports are important even in those economies which are pursuing technological upgrading. The development of labour intensive exports can help the rate of accumulation in technologically more sophisticated sectors - and hence the rate of learning. In this sense development of low productivity exports is a complement to technological upgrading. It is also an important hedge against the risks involved in moving to more sophisticated sectors.

- Low productivity exports are potentially important for employment levels, especially if international trade is growing slowly. So they may play an important distributional role in development - though they may also be associated with the use of women's labour as a way of de facto reduction of the real wage

Technological upgrading - i.e. a shift towards technologically more sophisticated outputs associated with higher factor productivities, and higher rates of learning and productivity growth - presents some important advantages. It may be thought of as a process of moving from a situation of slow productivity growth associated with labour intensive or resource intensive lines of production, to one of high productivity growth. Upgrading opens the way to higher real wages, and a higher rate of growth of earnings. Provided exports expand fast enough it need not lead to slower growth of employment. It may result in the displacement of female labour from erstwhile labour intensive lines of production, but as against this, it is associated with faster growth of the service sector - because of rising incomes - and this can expand employment opportunities for women. Upgrading is necessary as economies approach the end of labour surplus. It is also a way in which countries may respond to low wage competition from other developing countries which are at an earlier stage in the development of manufacturing exports. In this regard, upgrading by developing countries which are established exporters of simple manufactures is in the interests of follower countries trying to enter world trade in these sectors. Finally, technological upgrading enables countries to move towards manufactured exports which have a higher income elasticity of demand in developed country markets.

However, the preconditions for successful upgrading are demanding.

- There has to be an effective transfer of technology from abroad, through some combination of machinery suppliers, licensees, joint ventures, or other forms of foreign direct investment;

- There has to be a supply of skills and production experience on which to base the shift in the production pattern. This requires a prior period of 'technological accumulation'. It also requires a substantial prior development of the higher education and training system. Since the issue of women's employment is a central aspect of the distributional impact of technological change, the incorporation of women in these technical training efforts is particularly important;

- The national system of innovation has to be appropriately developed - in particular the network of technological research institutes needs to be linked to production, and technological information systems need to be developed.

Upgrading involves important social costs, whether it is mediated by market forces or stimulated by state intervention. This is because upgrading involves an initial period during which resources are shifted to outputs which are at first produced at low factor productivities - until the learning process takes over. Policy needs to keep these costs under control. To do so, the 'technological jumps' involved in upgrading must not be too big. The least costly and least risky learning processes will probably be in sectors where there is already a comparative advantage. So it may be sensible to start with learning in the established labour intensive sectors and then to move on to the next level of outputs (i.e. those which require similar skills).

It follows that technological upgrading will not be an immediately relevant policy in all developing countries, though the social investments in education, training and technological support services for the industrial sector is so in most. Countries can probably be classified as follows as far as technology and competitiveness is concerned

First a large group of countries, not at present engaged in sustained exports of manufactures will be mainly concerned to find technologically simple, labour or resource intensive outputs with which to enter the international markets. These countries should pay attention to developing the preconditions for technologically more sophisticated production in the medium term future, by developing education and training.

Second, a smaller group of countries - which have already established patterns of comparative advantage in simple manufactured exports - will seek to maintain and expand these, in part to generate the resources of foreign exchange needed to sustain industrial investments These countries should also seek to improve the technological level of production in the export sectors.

Third, a further group of countries will be well enough established in terms of the skill levels attained by their firms, to search for new outputs at higher technological levels so as to upgrade production. In addition, countries which have already successfully upgraded in the past will be seeking to move up the 'innovation' ladder.

The role of state intervention in upgrading policies is clearly established by the practice followed in the NICs in the recent past. It remains the case however, that even without intervention, individual firms acting in response to market conditions will undertake investments in learning. There is not much empirical knowledge of how effective this is likely to be.

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