



## THIRD ITEM ON THE AGENDA

**Promoting technological change for higher productivity, job creation and improved standards of living**

1. During the November 2004 Governing Body session, the Officers of the Employment and Social Policy Committee requested that the Office continue its elaboration of the core elements of the Global Employment Agenda (GEA) by focusing on the second element: “the promotion of technological change for higher productivity and job creation and improved standards of living”. This is one of four of the ten core elements of the GEA that address the need to harness the forces of contemporary change in the global economy. The present paper provides an overview of the issues surrounding technological change in their relation to the labour market and the aspiration for decent work.
2. While not synonyms, “technology” has often been popularly associated with “know-how”. The association makes sense, as it has the benefit of ascribing the knowledge of how to perform a particular activity not only in relation to particular equipment or machinery but also to the people who use that equipment. As such, progress on how best to engage in a particular activity resides not just in improved generations of machinery, or thoroughly new inventions – as fundamentally critical as these are – but also in the “supply side”, the native cognitive talent, education, skills, and creativity of people. It is also the case that technology or know-how spans the spectrum of scientifically sophisticated discoveries and their applications, such as the creation of the Worldwide Web, to far more mundane activities: there is a right way and a wrong way to use a simple shovel most effectively, for example.
3. In successive world employment reports,<sup>1</sup> the ILO has presented both conceptual and empirical arguments that technological change has historically been the main force behind the growth of new products, processes, and markets, and with them, jobs and earnings. In short, a view of technological change as primarily job-destroying is a narrow and parochial one – even if, indeed, job destruction is one, undoubted consequence of technological change. The matter was most recently elaborated in the *World Employment Report 2004-05*, which evaluates the long-term positive relationship between productivity and employment growth, both of which are dependent, inter alia, upon technological change.

<sup>1</sup> ILO: *World Employment Report 1995, 1996/97, 2001, and 2004-05* all take up these arguments from different perspectives.

## Technology and the labour market

4. This paper deals explicitly with technology and the labour market. As noted above, the secular, positive effect of technological change on people's livelihoods is demonstrable. It occurs through the opening up of new employment opportunities that technological change creates; it occurs as well through the higher productivity with which people work as a result of technological change and thus the higher incomes that they are able to enjoy. Neither favourable outcome, however, whether it is job growth or income growth, can be considered an automatic, unmediated outcome of innovation and scientific progress. Institutions matter crucially, a point on which this paper concludes. As shown in *World Employment Report 2001: Life at work in the information society*, social dialogue has a critical role to play in managing most equitably and efficiently the social outcomes of technological change.<sup>2</sup>
5. On the supply side, favourable outcomes rely on the education and skills of workers, important factors in their ability to absorb changes in technology and thus in how well the labour market functions. On the demand side, outcomes rely on the macroeconomic factors that either encourage or impede technological change, such as investment policies, spending on research and development, and competition policy (which can in turn constrain or encourage innovation). The labour market itself is mediated by institutions that influence whether productivity gains are meted out in the form of higher earnings, equitably, or are realized as technologically induced opportunities for work reorganization and higher productivity. The quality of social dialogue is, again, an important ingredient in whether technological change results in more jobs and better earnings. This is all the more the case as periods of rapid technological change are associated with higher rates of job destruction as well as job creation. With the advent of "advanced manufacturing technologies" in the 1980s, for example, research showed that collective bargaining structures influenced both the use and diffusion of technology.<sup>3</sup>

## Product versus process innovation

6. As it relates to the labour market, technological change has two predominant effects: it can be either labour-saving (process innovation), as when a new machine replaces jobs previously undertaken by workers; or it can result in "product innovation", which creates new demand in product markets and thus new employment opportunities in satisfying that demand. The remarkable success of the Apple Corporation's iPod digital music player is but one of countless recent examples.
7. Labour-saving technological change is part and parcel of industrial history, a history that is replete with examples of the entire disappearance of occupations. Again, however, job loss is merely a partial view of the consequences of labour-saving technological change. Two analytical queries relating to labour-saving technological change are of particular salience. First is the question of whether technological change results in "deskilling" (and consequently lower incomes). There are clear examples of such technological change, as when the emerging factory system of the 19th century replaced the master craftsman with the unskilled or semi-skilled production worker. Examples of deskilling also exist today although, as discussed below, the nature of the current era of technological change is "biased" in favour of higher skills.

<sup>2</sup> Chapter 9 of that report is entirely devoted to industrial relations in the information society.

<sup>3</sup> G. Vickery and D. Campbell: "Technology, flexibility of manufacturing, and industrial relations" in OECD: *Science, Technology and Industry Review*, No. 6, Dec. (Paris: OECD, 1989).

8. The skill effects of technological change have a significant gender dimension. Evidence suggests that, where deskilling occurs, women are often more likely to be affected than men – and the opposite. When technological change results in the demand for higher skills, women workers are sometimes displaced by men. That the “technology gap” in access to and use of new technologies is also a gender gap has long been recognized and attributed in part to patterns established at a very young age: boys are disproportionately represented among graduates in science, mathematics, and engineering. The “digital divide”, as analysed by the ILO, was also found to be pronounced not just between poor and wealthy countries, but also between women and men, with few exceptions, irrespective of the country. Redressing the technology gender gap must begin by ensuring that girls as well as boys have access to and are encouraged to pursue that sort of coursework that forms the bedrock of future innovation and higher skills.
9. A broader issue relates to whether labour-saving technological change can increase labour supply for more productive (or at least more remunerated) activities elsewhere in the labour market; that is, whether job loss in a particular sector or occupation is more than compensated for by job creation elsewhere in the economy. It can be noted that there is a gender dimension here, too, and this time more favourable for women: the post-war diffusion of consumer durables such as washing machines and dishwashers, for example, is considered an important factor in the increase of women’s labour force participation. The more general proposition, discussed in *World Employment Report 2004-05*, is whether technologically induced and job-losing change in a particular sector results in higher productivity, lower costs, and thus higher real income among consumers. The argument is of current relevance to the interest in “off-shoring”, itself a technologically propelled phenomenon to which discussion returns below.
10. As to the creation of new products and new markets through technological innovation, the history of labour market consequences is less ambivalent and more sanguine. The present era of change is dominated by three “root” technologies, each of which has certain, if as yet not thoroughly known, labour market consequences. The first of these are fuel cell technologies tending toward the expansion of commercial use of renewable energy sources. The second broad platform of innovation is in biotechnology where, for example, recent advances in genetics hold promise for innovation in the treatment of disease, one consequence of which will be to diminish the economic cost of morbidity and mortality through longer, healthier (and economically active) lives.
11. The third set of innovations on the technological frontier is that associated with advances in information and communication technologies (ICTs), a frontier the implications of which are so pervasive that it is difficult to dissociate from globalization as a phenomenon. Discussion of ICTs deserves pride of place not only because of its pervasive nature as a general purpose technology, but because it is advances in this technological field that have reshaped the global division of labour and the skill content of work. Four topics are briefly passed in review: international capital mobility; recent changes in the global production system; within-country income inequality; and the uneven diffusion of technology (i.e. between-country inequality).

## International financial markets

12. Although the scope of the present paper is too narrow to treat the subject in depth, it is nevertheless ICTs that underlie the integration of international financial markets. There is positive potential in this in that it accelerates the free flow of capital to locations that can most use it. There is, of course, a downside as well. Indeed, an argument can be made that technologically driven integration outpaced the informational base on which beneficial

investment decisions could be enhanced. As the Asian financial crisis,<sup>4</sup> and others like it showed, the lightning speed with which capital is transferred, i.e. invested or disinvested, can paradoxically coexist with information gaps, in particular the substantial information asymmetries with which investment decisions are wisely or poorly made. It is also the case that the increased macroeconomic volatility arising from the information technology revolution as it has affected international financial markets has produced substantial fallout in labour markets around the world. Some have in fact argued that the havoc that can be wrought by short-term capital flows is the most damaging facet of globalization for workers.<sup>5</sup>

### **Global production systems: A (technology-induced) changing international division of labour**

13. Arguably, the most fundamental economic impact of the ICT revolution is the associated reduction in “transaction costs”, particularly in the form of reduced transport and communication costs. This, in turn, has ushered in a new phase in the creation of global production systems.<sup>6</sup> Using ICT, firms have been breaking down their production processes into separate components which can be relocated or outsourced to other parts of the world, thereby leading to the emergence of global production networks and a new international division of labour. Notions of an “international division of labour” are certainly not new; nor is the migration of low-skilled, labour-intensive production from high-cost locations to those in developing countries that possess the comparative (labour) advantage to attract such activities. What is new, however, and enabled by ICT, are two systemic developments. One is the greater coordination or integration potential afforded by technology – again, the reduction of transaction costs – that has rendered the divisibility of stages of the production process more economically attractive. The other is the growth of a “service economy” characterized by “intangible” product markets, the output and distribution of which is digitally available in real time. These activities include software development, call centres, data processing, such as accounting and medical or legal transcription activities, and a range of other information-intensive services.
  
14. Features of the latter phenomenon were analysed at length in the *World Employment Report 2001*. More recently, however, attention has turned to the perception of an acceleration in the displacement of jobs in the international service economy from developed to developing economies. On the positive side, technology has enabled the location of work to occur in developing countries with pools of appropriately skilled labour and cost advantages, such as India. The promise of job creation in such locations is all the greater as, in these service economy markets, reliance is greater on human capital than on physical infrastructure or financial capital, which are often insufficient in developing countries. On the negative side, concern has been raised in developed countries over “jobless growth”, or gains in both output and productivity growth unaccompanied by the growth of job creation. The basis of the concern is the ease with which activities once performed in high-cost locations can now be relocated to lower cost locations. Fuelling the concern, too, is the perception, for which some anecdotal support exists, that jobs at ever

<sup>4</sup> E. Lee: *The Asian financial crisis: The challenge for social policy* (Geneva: ILO, 1998).

<sup>5</sup> See, for example, M. Rama: “Globalization and workers in developing countries”, World Bank Policy Research Working Paper 2958, Jan. 2003.

<sup>6</sup> For the ILO’s most recent discussion of this, see S. Hayter, “The social dimension of global production systems: A review of the issues”, ILO Policy Integration Department Working Paper No. 25, forthcoming.

higher levels of skill are now “contestable” by developing countries, in view of the fact that education levels have risen there.

15. The *World Employment Report 2004-05* comments on this technologically propelled change in the division of labour and concludes that it is indeed occurring and that the future may see an increase in the technological feasibility of job relocation. The report also concludes, however, that the magnitude of the labour market implications has to date largely been overblown, and the beneficial economic implications underemphasized. The box below discusses the phenomenon.

#### Technology and outsourcing: A mixed picture

It is certainly true that many multinational firms have shifted production facilities to developing countries to take advantage of lower labour costs – yet it would be an overstatement to assert that a large share of developed economy jobs have gone overseas. Recent statistics based on job losses due to outsourcing in some of the developed economies illustrate the previous point:

- In the United States, by far the largest outsourcer of the industrialized economies, estimates of job losses due to outsourcing represent only a small fraction of jobs lost in a given period. For example, in the first three months of 2004, less than 2 per cent of mass layoffs in the United States were due to outsourcing (this includes domestic outsourcing).
- In Europe, the outsourcing phenomenon is not yet as widespread as in the United States. Germany is by far the largest outsourcer in Europe, perhaps due to its proximity to Eastern Europe. Outsourcing in Germany resulted in a loss of roughly 8,000 jobs per year from 1990 to 2001, mainly to Eastern Europe. This figure represents only 0.2 per cent of Germany's labour force, which comprises 40 million people. It is also a small fraction of total jobs lost on a yearly basis.
- Additionally, outsourcing is a two-way street: economies might lose jobs due to outsourcing, but they also gain jobs as the result of *insourcing*. Another study based on the United States shows that its economy insources far more business than it outsources: in 2003, it outsourced approximately US\$77 billion worth of “business, professional and technical services” to foreigners and insourced over US\$130 billion.
- But statistics can only give a partial picture, and if one downplays the current statistics and focuses instead on the increasing trend in jobs being outsourced, then a different depiction of the phenomenon emerges. For example, half of the major companies in the United States currently engage in some form of outsourcing and more expect to do so in the coming years. Additionally, the expansion of outsourcing across occupational groups, including highly skilled jobs in the service sector, suggests that all phases of the production process can be “globalized”. As one study notes: “Even if many of the outsourced jobs are low-skilled call centre positions, reports of software programmers and ... analysts being outsourced creates in millions of workers the fear that a college education and a professional job are no longer enough.”

Source: *World Employment Report 2004-05: Employment, productivity, and poverty reduction* (Geneva: ILO, 2005), pp. 86-87.

### Skill-biased technological change

16. A debate of now relatively long standing that has accompanied the growth of economic interdependence centres on the empirical observation of widespread rising income inequality within countries. At issue is whether this phenomenon is attributable to “trade” or to “technology”. The trade argument holds that increasing trade between wealthy and developing countries has reduced the demand for low-skilled employment in developed countries, the consequence of which, as mediated by differences in labour market institutions, is either higher unemployment among the low-skilled, where wages cannot easily adjust or, where they can, a decline in their wages relative to the more highly skilled.

The “technology” argument holds on the contrary that technological change is “biased”<sup>7</sup> in favour of higher skills, thereby reducing the demand (whether quantitatively or in the wages they receive) of lower skilled workers.

17. Consensus in economic research outcomes is often not the norm, and it is therefore all the more significant that there is substantial agreement that “skill-biased” technological change is the principal culprit behind the observation of widening income inequality within labour markets. Analytical foundations of this conclusion are manifold, but two are particularly salient for the present discussion. The first is that, if widening income inequality expressed as the relative decline in demand for lower-skilled labour were the consequence of trade with low-wage countries, then such inequality would be more apparent in sectors more exposed to trade. Empirically, however, this is not the case: sectors that are open to trade as well as those that are not have both seen declines in the demand for less skilled labour, which leads to the conclusion that another factor, i.e. the skill content required of new technologies, is responsible. The second factor is that trade continues to be concentrated among developed countries with similar skill levels and income standards, a fact that erodes the potency of the argument that low-wage competition is a dominant source of income inequality in developed countries. Further still, the labour market consequences of trade could well be overstated to date.<sup>8</sup>
18. That said, it can be reasonably argued that a strict distinction between “trade” and “technology” as sources of income changes may not be all that tenable. Wood (1994), for example, observed that technology is embodied in trade through the transfer of sophisticated production technology to developing country locations.<sup>9</sup> The point is important on two grounds. First, with globalization and the diffusion of ICT, most often through foreign direct investment (FDI) and the activities of multinational enterprises, technology is more freely disseminated throughout the globe than ever before. This is a fact that stands contrarily with another: technological dissemination (and absorption) are by no means uniform across the globe. The FDI, as noted in the report of the World Commission on the Social Dimension of Globalization,<sup>10</sup> remains quite concentrated within a subset of developing countries, and is perhaps increasingly so. Second, and quite contrary to standard trade theory, *developing* countries have also experienced a rise in the relative demand of skilled labour. The assumption that a developing country’s comparative advantage in global markets resides in large measure on the abundance of low-skilled labour supply needs to be qualified by the observed rise in skill demand of the most export-oriented industries in developing countries. One possible explanation is that, with rising economic interdependence, firms have fewer “degrees of freedom” in their technology choices for competition in demanding global markets.
19. Of course, it is also true that data inadequacies do diminish the clarity of the point: it is, in particular, important to distinguish between high-tech “industries” and high-tech “activities”, and high-tech industries, such as electronics, often employ “low-tech” skills in

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<sup>7</sup> Technological change is said to be “biased” if it results in changes in the demand for skills (whether higher or lower), and “neutral” when it does not.

<sup>8</sup> Richard Freeman: *World Economy*, Jan. 2004.

<sup>9</sup> A. Wood: *North-South Trade, employment and inequality: Changing fortunes in a skill-driven world* (Oxford: Clarendon Press, 1994).

<sup>10</sup> World Commission on the Social Dimension of Globalization, *A fair globalization: Creating opportunities for all* (Geneva: ILO, 2004).

developing countries. A call centre, for example, uses sophisticated networking technologies whereas the skill content of a call-centre job is debatable.<sup>11</sup>

20. The diffusion to the developing world of the demand for higher skilled work has a straightforward and powerful conclusion for policy: “that (skill-biased technological change) seems to have had pervasive effects on labour market structure around the globe makes it eminently clear that governments must properly support education and train workers to use new technologies that are becoming central to the nature of work. The rapid pace of technological change, and its rapid diffusion across international borders, makes education and training a policy issue fundamental to the organization of work in the 21st century.”<sup>12</sup>

### Questions of catch-up

21. Two facts can be confidently maintained. Technological diffusion is more rapid and widespread than ever before. But, as noted by the report of the World Commission, diffusion is remarkably uneven, with large portions of the developing world excluded from the economic and social benefits of technological change. Indications of the disparity are many. One of these is the share of GDP invested in research and development. Another is the percentage of science and engineering-trained graduates across countries. Although there are some remarkable achievements in the developing world, particularly with respect to the percentage of science-trained graduates (in regard to which Brazil is a good example), the disparity between developed and developing countries in each of these measures is generally pronounced. The use of modern technology depends quite obviously on having access to it as well. The digital divide between developed and developing countries is a measure of the unevenness of technological diffusion; and the digital divide is also an economic divide. To the extent that the digital divide is not narrowing but, on the contrary, widening in many regions of the world, this is evidence of how uneven technological diffusion is a source of widening income inequality between wealthy and poor countries.<sup>13</sup>
22. Differences in economic structure can reinforce inequality. For example, although the dominant form of economic activity is small-scale the world over, it is particularly dominant in developing countries in both the formal and informal economy. Relative to large enterprises, small-scale activities most often operate at significantly lower levels of productivity – which, among other things, is likely to be a proxy for lower use and quality of technology.<sup>14</sup> Earlier it was noted that a positive side of the migration of increasingly higher skilled jobs from wealthy to poorer countries was that this was a sign of increased capacity to absorb higher technology in the poorer countries. This appears to be true, but the opposite concern is of greater magnitude: the uneven distribution of technology is an important source of inequality between developed and developing countries.
23. The international policy sphere is of relevance here: how can the global process of technology transfer be more equitably distributed? An important answer to this question

<sup>11</sup> See ILO: *World Employment Report 2001: Life at work in the information society*, Chs. 4 and 9.

<sup>12</sup> E. Berman and S. Machin: “Globalization and labour demand”, in E. Lee and M. Vivarelli (eds.): *Understanding globalization, employment and poverty reduction* (Houndsgrove, Basingstoke, Hampshire, UK: Palgrave Macmillan, 2004), p. 62.

<sup>13</sup> ILO: *World Employment Report 2001*, Ch. 2, discusses this at length.

<sup>14</sup> See ILO: *World Employment Report 2004-05*, Ch. 5.

lies in the private sector and in the patterns of foreign direct investment as they interact with domestic (national) capacities. To date, as noted, there are distinct cleavages and openness to technological absorption. Lall (2004), for example, notes that: “In a globalizing world mobile resources focus on a few locations with competitive complementary resources: given strong economies of scale, scope and agglomeration, global production systems tend to become increasingly concentrated. Countries that plug into globalization efficiently need to intervene extensively to build international links and leverage them successfully. The success stories in the developing world may thus be the exception rather than the rule; their experience may well reflect other factors – government strategy, location or just good luck – rather than the beneficial effects of global market forces, per se.”<sup>15</sup>

24. Although the above quotation is not wholly sanguine, it does reinforce the importance of government intervention in the promotion of technology access, creation, and diffusion. The “demand” side of technology upgrading and diffusion runs through macroeconomic policies that provide stability, stimulate investment, competition, and innovation, all policies that have profound repercussions on the labour market. The critical role of macroeconomic policy is illustrated in the fact that the relationship between investment and innovation is a two-way street: investment breeds innovation, but innovation also attracts investment.<sup>16</sup>

## Implications for the ILO

25. Beyond its publications, the ILO has been actively involved in the multilateral system on questions of technology and its implications for the world of work. Of note is the fact that the ILO has participated in the United Nation’s ICT task force, which primarily seeks to address the digital divide. With other agencies, the ILO has also organized a meeting on ICT, economic growth and social issues. The ILO was involved in the preparatory sessions of the World Summit on the Information Society (WSIS) as well as in the first Summit session in Geneva and will participate in the second Summit in Tunisia in 2005. The main focus of ILO involvement in these multi-stakeholder processes has been to ensure that the social dimensions of technological change are appropriately taken into account.
26. A major question is how national capacity can be built for the creation or attraction of technology and its absorption. It is the latter, technological absorption, where the ILO’s work has most relevance. Much of the ILO’s work needs to rely squarely on the supply side of the labour market. This includes “upstream” concerns such as the provision of quality basic and further education. It also includes a focus on the institutions and policies that enhance upward labour mobility. These comprise access to labour market information through public and private employment services, access to quality training in marketable skills, and labour market institutions through which earnings and employment opportunities are equitably available. As technological change can be disruptive on labour markets, mechanisms for social protection become of increasing importance. This in turn implies the need for the social partners to elaborate policies and mechanisms for the diffusion and absorption of new technologies, at the national level, and, through work reorganization, at the level of the workplace. The ILO could promote this through its technical cooperation activities, and through its advisory services on national employment strategies.

<sup>15</sup> S. Lall: “The employment impact of globalization”, in E. Lee and M. Vivarelli, op. cit., p. 97.

<sup>16</sup> N. von Tunzelmann and U. Efendioglu (2001): “Investment technology, growth and employment in post-war Europe: Short-run dynamics and long-run patterns”, in P. Petit and L. Soete (eds.): *Technology and the future of European employment*, Aldershot: E. Elgar.

27. The important role played by social dialogue cannot be underestimated. National productivity councils, such as those in Asia although not exclusively there, in which the social partners participate have excellent mechanisms for the elaboration of national productivity policies and strategies and the diffusion of best practices as they relate to training and retraining needs, new forms of work organization, and sharing the gains of productivity growth that comes from technological change. As the knowledge economy expands, ILO constituents will have a vital task in ensuring that the economic and social gains for which knowledge work holds potential are fully harnessed. The role of the social partners is paramount, particularly in the use and diffusion of new technologies. It ought not to be lost sight of, moreover, that the impact of technological change is fundamentally a “shop floor” issue. The quality of the labour-management relationship at the enterprise level is a critical determinant of the outcomes of technological change. The ILO can assist constituents in devising effective strategies for the absorption of new technologies.
28. An important portion of the ILO’s work lies not only on the supply side of the labour market, but on the demand side as well. As noted earlier, SMEs have an important role in job creation, and much can be done to encourage them to move towards better management and adoption of technology. Ways in which this is being done include business development services, public awareness campaigns, innovation centres, etc. The same applies to enterprises in the informal economy, where strategies to raise productivity and apply technology – the Grameen mobile telephone project, for example – even in very basic ways can have a positive effect on the overall economy and its ability to create productive jobs. In Rajasthan, India, for example, the ILO, in collaboration with UNIDO, is investigating ways in which the adoption of a different sort of handloom could lead to product diversification while preserving the distinctive weave of women sari weavers in the informal economy.
29. Finally, there is clearly scope for further ILO research and analysis in emerging areas. Two of these have been mentioned already: further analysis of the offshoring phenomenon would seem warranted and would include an evaluation of the proposition that jobs at ever higher levels of skill are now moving from developed to developing countries; second, and consistent with the recommendations of the World Commission on the Social Dimension of Globalization, considerably more needs to be known about emerging global production systems. Questions relevant to the ILO would include those relating to the factors, both “human” or “natural”, such as accidents of geography, that determine inclusion or exclusion into global production systems. It would be equally useful to evaluate the scope that developing country enterprises have to improve their placement in global value chains, as well as to analyse both the quality and quantity of jobs created. For example, one feature of “technology-borrowing” enterprises (and the latter predominate in developing countries) has been argued to be that they directly employ fewer people than technology “innovators”.<sup>17</sup> Were this true, however, the fact in itself says little of what alternative employment opportunities might be. Inclusion in the global economy on the best possible terms remains the underlying objective, and to further this objective requires knowledge accumulation.
30. The focus of research on global production chains could ultimately lead to important policy recommendations in ILO technical advisory work. For example, diffusing technology might imply adopting an industrial policy that favours vertical supply chains within countries. Such would enhance “network” economies. It would also mean business development services that simplify access and “collectivize” access costs, improve entrepreneurship and, ideally, provide access to the credit system and to markets. Policies

<sup>17</sup> Some evidence for this proposition is discussed in Ch. 2 of the ILO’s *World Employment Report 2004-05*.

of this nature could also be influential tools in local economic development strategies promoting local innovation and local technology adoption.

- 31.** With reference to paragraphs 25 to 30, the Committee may wish to offer guidance to the Office on how it might best use its advisory and analytical capacities in the promotion of technological advance for productive employment.

Geneva, 11 February 2005.

*Submitted for information.*