Is a biased technological change fueling dualism ? [1]

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ABSTRACT :

Is a biased technological change fueling dualism ?

Analyses of structural transformations of modern developed economies have led in the second half of the 90s to two important debates. One bore on the skill bias nature of technological change, the other underlined the likely overestimation of consumer prices and therefore the underestimation of past rates of real economic growth, following misappreciations of changes in product quality. From the many factual and theoretical points made in these debates, one can select some major features of contemporary economic growth. On both the supply side (reorganisation of productive processes) and on the demand side (changes in consumer strategies) characteristics of the learning and adjustment processes to respond to the new environment appear. This working paper retains from these debates over the organisation of productive processes and the changes in product quality both the differences in behaviours and capabilities (among producers and consumers alike) and the interdependencies between supply and demand processes. Economic growth thus appears as largely conditioned by the capacity of economies to take advantage of these interdependencies while limiting the hampering effects of dualist trends.

RESUME :

Un progrès technique biaisé favorise t-il une évolution dualiste des économies développées ?

L'analyse des transformations structurelles des économies développées contemporaines a dans la deuxième moitié des années 90 suscité deux débats importants. L'un a porté sur le caractère biaisé du progrès technique en faveur du travail qualifié, l'autre a souligné les possibles dérives de nos mesures d'indices de prix et de volumes de production liées à une mauvaise appréciation de leurs changements qualitatifs. Dans les nombreux éléments factuels et théoriques impliqués dans ces débats on distingue in fine quelques uns des traits majeurs de la croissance contemporaine. On y perçoit en effet tant du côté de l'offre (réorganisation des processus de production) que du côté de la demande (évolution des stratégies des consommateurs) certaines caractéristiques majeures des « schémas d'apprentissage/ajustement » aux situations nouvelles. Le document de travail dégage de ces débats sur l'organisation du travail et sur l'appréciation des évolutions qualitatives des productions de biens et services à la fois des capacités différenciées selon les catégories (de producteurs ou de consommateurs) mais aussi des interdépendances nouvelles entre activités de production et de consommation. Aussi la croissance des économies considérées apparaît-elle nettement conditionnée par leur capacité à tirer parti de ces interdépendances et à limiter le caractère dualiste de ces développements.

MOTS CLES : changement technique, modalités de la croissance économique, dualisme

KEY WORDS : technical change, economic growth pattern, dualism,

CLASSIFICATION JEL : O1, O3, D2, E2

1. Introduction : A period of "transition" with lasting effects ?

Over the past two decades, major structural changes have affected the growth process in developed economies. A cluster of radically new information and communication technologies (ICTs) has emerged, accompanied by the internationalisation of markets, financial capital and production processes, and the transformation of work in general and the structure of the labour force in particular. Such changes have both transitory and longer-lasting effects, and only through experience and learning will economic agents ultimately adjust their behaviours to the demands of the new environment.

Learning processes exist at various levels: within the technology-adopting firm, where efficient use of new technologies is heavily dependent on other users (subcontractors, customers or other firms and partners); among technology producers, who must adjust equipment to meet different user needs and confront different national technical standards; and among consumers, where cultural barriers slow the diffusion of new "practices" in some cases, and erect barriers to access in others. This nexus of only loosely related learning processes lends credence to the assumption made by Freeman (1987) and David (1991) that transitions from one technological system to another may be long drawn out.[2]

But we should also be aware that all transitional periods have historically specific features that can condition final outcomes (Amendola and Gaffard, 1988). Schumpeterian evolutionary theory (Nelson and Winter, 1982 ; Dosi et al, 1988 ; Arthur, 1989) stresses that adjustment paths may be irreversible, and that the evolutionary nature of long-run development can completely transform choice sets and policy options following a so-called "period of transition". This path dependency is all the more important if there exists some interplay between the various learning processes described above, that results in a self-reinforcing growth process of the sort identified (in other contexts) by Myrdal (1957) and Kaldor (1972).[3] Three stylised facts suggest that such a growth process currently exists – one that could further divide societies and limit their ability to offer fair conditions of personal and collective development to their citizens in the future :

i) Growing income inequalities

Inequality has increased in nearly all OECD economies over the last two decades. While the situation differs amongst countries and the type of income one considers (family or personal, before or after taxes and specific allowances, etc.), there is a clear general trend within the industrialised world towards increased dispersion in wage incomes.[4] As economic growth has slowed down, some post-war trends in income distribution have been maintained (such as the life-cycle earning patterns of salaried professionals), some have been dampened (such as income growth among middle-income groups) and others have been reversed (such as income growth among low wage earners and people on welfare).

These developments reveal differences in the tactical and strategic abilities of public and private agents. Some private agents have taken advantage of the new labour market, accessing new jobs and new sources of income, while others have struggled to follow suit for both economic and cultural reasons. Meanwhile, governments in most countries have been forced to reduce the magnitude and scope of income redistribution by a fiscal revolt, examples of which include the California balanced budget amendment and the fiscal crisis of the Swedish welfare model.

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[2] The diffusion of electrical power and the dynamo, for example, took fifty years.

[3] Neoclassical endogenous growth theory, stressing the external effects of increasing returns, has been inspired by this tradition.

[4] See Atkinson et al (1995), Gottshalk (1993), Freeman and Katz (1993), Sharpe and Zyblock (1997) and Mishel et al (1997).

ii) Skill biased technological change

Technological change, which has a broad systemic dimension and involves the reorganisation of many tasks and activities, appears to display a strong skill bias. This bias will tend alternatively or cumulatively to reduce the share of unskilled jobs, decrease the relative wages of un-skilled workers and downgrade the working conditions of the un-skilled.[5]

There may be numerous reasons for skill-bias that are not technologically determined. Employment of skilled workers can help firms to face increased uncertainty, for example. Furthermore, innovators are increasingly prepared to pay for skilled workers as the costs associated with tangible investments (for example, in machinery) fall. The development of trade with low wage countries also contributes to skill bias, by increasing the specialisation of developed economies in production activities that require more skilled labour and/or advanced technologies. Finally, the growing supply of more educated workers may also promote increases in skilled work. It should also be noted that there are counter-trends at work. Shifts in the composition of demand that have increased the size of the service sector, for example, have enlarged the overall number of unqualified jobs.

iii) A biased intangible consumer surplus

Products and services have undergone large and interrelated quality changes in terms of their content and conditions of use. Not all consumers are positioned to fully appreciate and benefit from these changes, especially when they are intangible. The debate over the mismeasurement of price indices demonstrates the magnitude of this phenomenon (see, for example, Boskin, 1996). While there are good reasons to doubt whether all of the biases in US CPI measurement are important in other countries,[6] there is little doubt that the omission of quality improvements and poor measurement of new products and services is a world-wide phenomenon.

Quality improvements may be perceived in different ways by different consumers. This claim is consistent with analyses of consumption that stress the importance of social differences in attitudes towards new technologies. Consumers are in very different positions to organise their time and consumption when this requires specific competencies and information. Moreover, quality changes require users to spend time in learning processes before adjusting their choices. Finally, different capacities for interaction will affect the design and provision of "networked" goods and services, in the development of which user-producer relationships are decisive.

Transitory or lasting cumulative processes of segmentation ....and slow growth ?

Our contention is that the dynamics of the three trends discussed above are linked in ways that are mutually re-inforcing. Technologically-driven skill bias puts downward pressure on the wages of the less qualified, limits the scope of their on-the-job training and hence re-inforces rising income (wage) inequality. This, in turn, limits the capacities of these groups to develop new patterns of consumption, and induces producers to design their products and services in accordance with this market segmentation (even if such adjustment reduces the mass-market potential of their innovations). This process fuels dualism and specialisation in consumption patterns. At the same time, differences in consumption patterns

[5] See Howell and Wolff (1992), Berman, Bound and Griliches (1994), Card, Kramarz and Lemieux (1995), Machin (1996) and Nickell (1996).

[6] See Lequillier (1997), Fenwick (1997) and the OECD survey of the measurement of CPIs presented at the Economic Policy Committee meeting, December 1997. The Boskin Report is, itself, much debated of course (see Moulton et al 1997).

influence the structure of the labour forces' qualifications. Hence learning takes place through consumption patterns and life styles, so much so that some processes (such as ICT use) can be considered a form of training. Meanwhile, work practices influence life styles and consumption choices. These interrelated learning processes increase inequality by allowing those already well positioned in the labour market to reap the advantages of technology-intensive consumption goods.

An important question is whether these developments are transitory or lasting. They may represent a transitory phase during which the diffusion of new life styles and new work practices necessarily begins among those who are initially best able to adopt them. Increases in inequality will thus be confined to a temporary phase of innovation diffusion that will ultimately benefit all members of society. However, increased inequality may represent a durable characteristic of a new growth regime, in which the segmented development of production and consumption hinder the growth potential of the new technological system and lock economies into slow growth paths. There are reasons to believe that actual growth trajectories will fall somewhere between these extremes. For example, the diversity of individual learning trajectories may create a new form of social mobility that re-fashions the boundaries between traditional social groups. How large this effect is likely to be in practice remains, of course, an important and open question.

These complex issues cannot be resolved within the confines of this chapter. They can be clarified, however, by drawing attention to some on-going debates and empirical findings that reflect on the workings of certain relationships and the magnitudes of some of the effects discussed above. In section 2, then, we begin by showing how the learning processes inherent in both production and consumption activities are linked and interact cumulatively. We then investigate in more detail the complex nature of these learning processes, and their relationship to skill-biased technical change on one hand, (in section 3), and the underestimation of the consumer surplus on the other (in section 4). Finally, section 5 concludes.

2. Interrelated learning processes and economic growth.

When studying the effects of a change in the technological system, analysts often invoke organisational problems in order to account for unexpected outcomes. The debate surrounding the productivity paradox in the 1980s and 90s (a large-scale technological change, manifest in the omnipresence of computers, which had relatively little impact on productivity growth) provides a good example of this. For most analysts, the productivity paradox resulted from problems of organisation on the supply side. We believe that this explanation has merit, but that it would be more comprehensive (and less of a black box) if it referred explicitly to the role of "broad" learning processes operating simultaneously and interdependently in production and on the demand side. We suggest, moreover, that these learning processes are linked (much as learning by doing and learning by using are linked in some activities) and have a strong sectoral dimension. As much is obvious, if only in the fact that the productivity slowdown is more marked in certain service sector activities where productivity is difficult to measure.[7]

We take a broad approach to what we call the learning processes in production and on the demand side.[8] Numerous studies have looked at the dynamics of production. One could begin with Adam Smith's claim that the division of labour responds to the extension of

[7] According to Griliches (1994), three quarters of the output of the computer industry goes to activities where real output cannot be measured.

[8] The use of the term "learning process" is somewhat metaphorical, as it combines various time-dependent processes, only some of which constitute real microeconomic learning processes. This "global" use of the term "learning process" will become clearer as we proceed.

markets. Some Marshallian notions of the industrial district are also good illustrations of "meso" learning processes, as is Allyn Young's (1928) notion that the extension of markets promotes a division of labour stimulated by the dynamics of product and process innovations. Solow's (1957) work constitutes an explicit step towards accounting for increasing efficiency in production, even though his schematisation of technical change is an entirely exogenous "learning process". Contemporary endogenous growth theory overcomes this, by combining the insights above. It centres its approach on the learning process taking place in production through the creation of externalities, whereby an activity, internal or external to the firm, has an impact on the dynamics of all firms. Many factors have been cited as generating these externalities. The accumulation of various forms of human capital (or research) is the factor referred to most frequently. It underlies the accumulation of on-the-job experience (which varies directly with the net capital stock, as in Romer, 1986), efforts to develop research activities (as in Romer, 1990) and the positive effects on labour efficiency of the general level of training (identified by Lucas, 1988).

Another related aspect of the literature on endogenous growth focuses on the positive externalities brought about by the successful development of certain activities, such as intermediary services (for example, banking, transportation, telecommunication and distribution). Ashauer (1989, 1994) and Barro (1990) study the positive impact on growth of public expenditures, Berndt and Hansson (1992), Munnel (1992) and Morrison and Schwartz (1996) that of public infrastructure, Röller and Waverman (1996) that of telecommunications, and Amable, Chatelain, De Bandt (1997) that of the financial system. Theories of endogenous growth focusing on the role of equipment investment (as in De Long, Bradford and Summers, 1991) should also be included in this group.

These two branches of development in endogenous growth theory present a two-sided view of the global learning process in production. One focuses on the role of human capital, while the other focuses on the benefits of various types of infrastructure (including public infrastructures and intermediation services) that support productive activities. Notice also that the first branch tends to look at characteristics incorporated in individuals, while the other focuses more on organisational issues (if only because large public and private network services are central to this last approach). This distinction is not clear cut, however, since the first branch includes discussion of R&D (an organisational issue) while the second discusses the effects of general equipment investment (a decision of individual firms).

Similar schemas exist on the demand side, although they are treated less frequently in terms of learning or adjustment processes. But to describe consumption in terms of levels of experience, income or capital is similar to describing it in terms of learning processes. Analytical studies of the diffusion process of new products present just such a perspective, whether they invoke imitation effects in the epidemiologic model, or changes in purchasing power as in the probit model of diffusion. More generally, analyses which show how the consumption patterns of particular social groups either imitate or become more differentiated from the consumption patterns of other social groups over time and as prices and/or the distribution of wealth change) are invoking precisely the sort of "broad learning processes" on the demand side that were alluded to earlier in the case of production. Again, one may distinguish the process of individuals learning from reference groups (an individualistic process) from learning processes in which consumers respond to changes in the structure of market intermediation (an organisational issue).

Let us now consider the interdependence between the learning processes in production and on the demand side as discussed above. Both dynamics are bound to be functionally linked, if only because of the Smithian observation that the extent of the market influences the organisation of production. But conversely, institutions (including those at the point of production) condition distribution in ways that determine the growth of various

components of demand. This two-way interaction, which can be thought of as a process of cumulative causation *à la* Kaldor, is at the core of the interdependence between the two broad learning schemes that we wish to emphasise. The relationships linking these learning processes can be understood to operate at three levels : functional, institutional and ethical.

Functional links follow directly from the very structure of the production and consumption processes, as exemplified by the development of mass production and mass consumption in the past. This implied that patterns of consumption of final durable goods developed in lagged but similar ways among social groups with different incomes. Part of this development of consumption patterns relied on the fact that consumer durables freed some labour time from domestic activities, so that this labour time could then contribute to the development of organised lines of mass production and generate new sources of income. These linkages also had a strong institutional dimension, as evidenced by the wage setting and welfare institutions that helped to stabilise demand. One could add an ethical value dimension, meaning that attitudes towards work, family and consumption all contributed to the overall interdependence of consumption and production.

A variety of linkages accounted for the self re-enforcing development of mass consumption and mass production, then. But this model of mass production and mass consumption is largely *passé*, and we now need to describe the equivalent features of the "new economy". Our understanding is that learning processes in production and consumption (intermediate or final) are now interacting on a new scale (and in ways that may either re-enforce or hinder one another), at two levels: that of personal qualifications (individual human capital) and that of intermediation infrastructures (physical capital at the level of large organisations). In other words, the two perspectives on endogenous growth described earlier can help us to assess the specific linkages at work in the present mode of development. We shall try to clarify these linkages by reviewing the debates on skill biased technology and on the intangible consumer surplus.

It may also help to present a preliminary model of the various relations we have so far described. Part of the complexity of this exercise stems from the fact that we must deal with at least two productive sectors, two types of workers and two types of consumers.

Let $i = 1,2$ be the two sectors of the economy, where sector 1 broadly corresponds to manufacturing, and sector 2 to intermediation services broadly defined to include most business services and social services. Sector 2 thus comprises activities with strong external effects.

Following the Smithian tradition as elaborated by Kaldor, wherein productivity gains are stimulated by the expansion of markets, and adding some of the insights developed in endogenous growth theory, we begin with the following general expression for productivity gains in each sector:

$$z_i = f_i\,(x_i, Ip_j, Ih_i)$$

[E.1]

where z_i and x_i represent, respectively, the growth rates of productivity and production in sector i over the medium run, and Ip_j is an indicator of the external effects of production in sector j on productivity in sector i. We postulate that $Ip_2 > Ip_1 = 0$, since sector 2 encompasses large network services that are more likely to influence growth in sector 1 (according to the second line of thought in endogenous growth theory). Finally, Ih_i is an indicator of the quality of the human resources employed in sector i. This indicator of human capital formation (which corresponds to the first line of thought in endogenous growth

theory) could be proxied by the ratio of qualified to unqualified labour in each sector.[9] *Ih* would thus reflect the rise in the demand for qualified labour that has been observed during the last decade. Conversely, this effect seems to have been more important in sector 1 (manufacturing) than in sector 2 (services).

Assumptions about the dynamics of demand must now be added to the preceding description of the dynamics of productivity gains. In accordance with our previous discussion, we suggest that the growth of demand in each sector depends not only on the usual price and income effects (subsumed here in the effects of productivity on demand), but also on two indicators, one measuring the "qualifications" of consumers, *Il*, and the second capturing the external effects of the organisational quality of a sector ("provisionability"). For the sake of simplicity, we assume that provisionablity is approximated by Ip_2 (our measure of the external effects of service infrastructures).

The growth of sectoral demand (q_i) can thus be described as follows :

$$q_i = g_i\,(z_i, z_j, Ip_2, Il)$$

[E.2]

where z_i is productivity growth in sector *i*.

It seems reasonable to believe that Ip_2 (the organizational and provisional quality of sector 2) can be linked with the qualifications of users (*Il* for consumers and Ih_1 for firms) and the qualifications of the workers in sector 2, Ih_2. These linkages – together with those in equations [E.1} and [E.2] - are illustrated in Figure 1, which shows how interdependent learning processes on the demand side (distribution and demand formation) and in production (the generation of productivity gains) are influenced by human capital formation and the organisation of intermediation (where services play the main role). These latter two, broadly interdependent features of endogenous growth thus strongly condition the dynamics of an economy.

[FIGURE 1. GOES HERE]

The effects on demand and production that are captured in the model above are somewhat crude and are based on the general assumptions presented in the introduction. However, it is possible to take advantage of two contemporary debates linked to the impact of new technologies on production and consumption to demonstrate the relative importance of what are postulated above as being the main traits of the growth process in contemporary developed economies. The first debate concerns the skill biased nature of technological change, and tells us about changes at the point of production. The second debate concerns the measurement of the consumer price index, and reflects changes in consumption. Both debates are unresolved, something which is, itself, a reflection of the as-yet hazy features of this period of transition in capitalist economies.

3. On the skill biased nature of technological change.

During the 1980s, when investment in new ICTs was growing, a marked change in the structure of manufacturing employment occurred, in favour of skilled labour (Howell and Wolff, 1992; Berman, Bound and Griliches, 1994; Machin and Van Reenen, 1998; Berman, Bound and Machin, 1998). This skill bias seems to represent a major characteristic of the impact of ICTs on the labour market, and has even been coincident with a reduction in the

[9] Note that this is a restrictive measure given the assumption in endogenous growth theory that the *entire* stock of human capital impacts the efficiency of production.

demand for low-skilled labour in most countries (see Table 1). The impact of ICTs on service employment is much less clear cut, however, the situation varying from one country to another.

[TABLE 1. GOES HERE]

These observations suggest a new, *complementary* relationship between capital and skills (both being a substitute for unskilled labour), which contrasts with the fact that during the "Fordist" era, capital was more often a *substitute* for skilled labour. Griliches (1969) explains this complementarity in terms of a decline in the relative price of capital,[10] whereas Denny and Fuss (1983) attribute the phenomena to specific effects of technical change. The questions arise as to how new technologies have had such an impact on work organisation, and whether this impact is transitory, or a lasting departure from the old Fordist model? Moreover, if the new technologies possess such strong characteristics, why is their impact so different from one firm to another, from one country to another, and most markedly, from one sector to another (especially from manufacturing to services)?

Before investigating these questions further, we first examine whether changes in the composition of employment may not have resulted from factors other than technological change, such as increased competition from low wage countries (the trade effect) or an excess supply of qualified labour (resulting from a rise in the average level of education).

i) A trade effect ?

Skill-biased technological change (SBTC) may be an indirect effect of trade specialisation, whereby developed countries with high wages are forced to specialise in activities that are more skill intensive. Although trade effects certainly explain part of the changing composition of employment, however, they cannot account entirely for the phenomenon. Most sectors are affected by technological change regardless of their exposure to trade (Berman et al, 1994; Machin, 1996). Berman, Bound and Machin (1998) estimate that SBTC accounts for 70 % of the bias in labour demand by skill, whereas trade accounts for just 9%.

Moreover the trade effect argument can be broadened to include any change in demand, be it internal or external. Some studies insist that changes in competition, which have given more weight to non-price factors (such as product innovations, delivery and after sales servicing improvements, etc.) have upgraded production processes towards more sophisticated products which make more use of qualified labour (see, for example, Goux and Maurin, 1995). At this stage, it is difficult to distinguish between labour market changes due specifically to technology and those due to a general change in product demand.[11] However, the narrow view that a mainly external trade effect accounts for the changing composition of employment can be discarded, because skill-bias impacts across *all* sectors, including non-tradables

ii) The effect of an excess supply of skilled labour ?

Part of the skill bias may be the result of an increase in the demand for education in developed economies. This increased demand could be stimulated by slack in labour markets, which induces longer stays in initial formal education designed to delay entry into the labour market, and by individuals trying to improve their chances of finding employment. Such an effect has been underlined by, amongst others, Howell and Wolff (1992) for the US and by Goux and Maurin (1995) for France. The increased demand for education, which has led to

[10] The sharp reduction in the price of micro processors is an important feature of ICTs..
[11] See Nickell (1996) and Cotis et al (1995).

an increase in the average level of education in the labour force, is certainly part of the explanation for the skill bias in contemporary labour markets. Acemoglu (1998) suggests that skill bias can result from a large supply of skilled labour which, in turn, influences the organisation of the work process and the choice of equipment (an endogenous change from this perspective).

Such effects should not, however, be exaggerated. In Europe, the unemployment rates of those with diplomas have increased along with those of other groups, so that schooling - even at high levels - does not provide full protection against unemployment or poor jobs. Conversely, the average yield on educational investments for college graduates has risen in the US and UK (Mishel, Bernstein and Schmitt, 1997). If the supply effect described above had been the main cause of skill bias, one would expect the yields on educational investment to have fallen.

The discussion above suggests that the effect of the large supply of skilled labour on labour demand was mixed with other changes in the functioning of labour markets, particularly with regard to wage formation. Analyses of the impact of investment in and the use of new technologies on wages have been carried out at firm and sectoral levels, both for specific types of workers and for the work force as a whole. This last distinction is crucial for the skill bias issue. In the first case we are examining the premium to users of new technologies, and in the second, the shared benefits of new technologies amongst all workers. We can expect that investment in new technologies, when it substitutes capital for labour, will increase the average wage rate. At the individual level, however, the expected effects are less clear.

Krueger (1993) shows that in the US, the use of computers bestows upon workers a wage premium of some 15%. This premium could be attributed either to an increase in productivity, or to the personal characteristics of computer users, which would have led to them receiving higher wages regardless. Recent studies tend to counter Krueger's view (which favoured the first explanation). In France, for example, Entorf and Kramarz (1994, 1996a, 1996b) show that workers using computers are paid more, but that they were also paid more before the introduction of the new technologies.[12]

For the most part, these empirical findings suggest that the use of a computer does not necessarily lead to an "extraordinary" increase in personal wages. Individuals mainly receive a higher wage based on their personal characteristics. New technologies appear to be used by workers who already possess the personal characteristics that, according to conventional criteria, would result in their receiving higher wages.

But the introduction of computers is not the only change that occurred in labour markets at about the same time as the supply of educated labour increased. Changes in the economic environment coupled with adjustment to new technology and freer trade weakened the bargaining power of workers, as evidenced by the decline of unions and the reduction in minimum wages during the 1980s. This certainly helps to account for the relative decline in the wages of unskilled workers in the anglo-saxon countries at a time when those of skilled labour seemed to remain more or less constant in real terms. More precisely, as stressed by Storper (1999), the real wages of a small group of highly skilled professionals have increased on average, while the wages of the semi-skilled were losing ground and those of low-skilled workers declined significantly.

SBTC is therefore part of a large-scale re-organisation of work and labour markets, in which the supply of educated workers, trade technology and the dynamics of work

[12] Similarly for Germany, Di Nardo and Pischke (1996) show that the use of computers results in positive returns for individuals... but so does the use of pencils. Only Bell (1996), using a sample of one thousand individuals, born in 1958 and surveyed in 1981 and 1991, found a net increasing effect on wages for those using computers at work in 1991, thus supporting Krueger's view (assuming that no one used computers in 1981).

organisation (within firms and intra firms) and of labour market relations all play a role. Examining the content of skills and their sectoral dimensions assists further investigation of these transformations.

iii) What is the content of skills ?

The empirical findings reported above show that firms tend to select potential users of ICTs based on individual criteria that pre-date the introduction of the new technologies. Preferences for skilled workers *per se* (as opposed to those with job or firm specific skills) characterise a technological environment that requires more general knowledge and competencies that can be applied in various contexts. The content of these skills seems to be, to a greater extent than before, knowledge geared towards transversal problem solving (Gibbons et alii 1994) and personal experiences that demonstrate awareness and responsiveness. Firms do not seem to pay specifically for a skill bias (since they do not upgrade the jobs of those using ICTs) but do seem to attach importance to certain personal characteristics and to ensure that ICT users possess specific individual competencies. This focus on the abilities of individuals seems to be more important than any collective re-organisation of work designed to service the new technologies.

The notion of skill used in many of the studies referred to above makes only a crude distinction between production and non-production workers.[13] Moreover, jobs require a multitude of different skills. By considering three major dimensions of skill - cognitive (analytic and synthetic reasoning, numerical and verbal facilities), motor (physical abilities, coordination, dexterity) and interpersonal skills (supervisory skills, leadership) - Howell and Wolff (1992) and Wolff (1995) construct three skill scales on which basis they grade occupations by sector, and document changes in these grades during the 1980s. The more sophisticated picture given by these studies confirms the general decline in the demand for unskilled labour, but associates it with a drop in the demand for motor skills.[14] Meanwhile, the demand for higher cognitive and interactive skills is shown to increase. These studies also suggest that the effects of investment on the skill structure may differ depending on whether investment is in general equipment or ICTs. As the latter represents only a small fraction of total investment (Oliner and Sichel, 1994 ; Sichel, 1997), the specific effects of ICTs on skills may sometimes be obscured by conventional capital/labour substitution effects.

iv) Are there sector-specific biases in skill bias trends ?

Most of the studies referred to above concentrate on manufacturing industries. But as two thirds of employment and ICTs are found in service industries, it is not appropriate to draw conclusions about skill bias without verifying that most of the arguments apply to services.

The evolution of low skilled employment in Table 1. shows just how different the experiences of the manufacturing and service sectors have been. Looking in more detail at the evolution of employment by skill level in French service industries from 1982 to 1991, we observe that in activities like social services, public administration and household services, the growth of unskilled employment outpaced the growth of skilled employment (OECD, 1994).[15] In most services, the number of unskilled workers continually rose, though at a lower rate than for skilled workers. Only in finance and communication do we observe a net decrease of the unskilled labour force as observed in all manufacturing industries (as well as

[13] This distinction is correlated with a number of alternative distinctions based on broad characteristics of educational attainment or of occupational category, as Berman, Machin and Bound (1995) have shown for the US.

[14] The shift towards service activities is a major cause of the decrease in demand for motor skills.

[15] A similar result is observed in most large OECD countries (see OECD 1996)

in agriculture, mining and construction). As these industries have also invested more in ICT equipment than the others, this observation provides some support for the SBTC thesis. The diffusion of ICTs may also increase the relative demand for skilled labour in other service industries, but the demand for unskilled labour in absolute terms is likely to remain important as these activities continue to grow. And because of the absolute amount of employment in these activities, the way in which they use the new technologies is a crucial issue.

v) A re-organisation of the supply side

Most of the studies discussed so far analyse the skill-bias of new technology as if it were an individual issue, disregarding the fact that the primary concern of a firm is with work organisation as a whole. These organisational issues are certainly difficult to typify in times of structural change, where diverse reactions by firms are frequently observed (Attewell, 1994). This explains the lack of statistics on organisational structures in general and, in particular, the lack of studies exploring skill bias and the productivity paradox as extensively as these issues have been examined in the context of more individual aspects of employment.

Questions about work organization can be addressed by referring to Aoki's (1988) distinction between the information structures embodied in the different forms of work organization in Japan (horizontal structure of decentralized decision making processes) and the US (vertical structure of centralized decision processes).[16] Hence Piore(1988) suggests that the US model has used the new technological context to change towards more horizontal channels of communication, with less hierarchy and reduced specialization (thus moving closer to Aoki's Japanese model of organization). However, even, if this is true, the "tacit" channels of horizontal communication typical in Japan cannot be perfectly replicated by communication based on information technologies, which is bound to be more codified. In the new systems created by these latter organisational changes, there may be more communication between units, but fewer ways to control the instability at lower levels of the organisation that this creates. The factors that inhibit the strengthening of linkages between individual and organisational productivities, as discussed by Goodman, Lerch and Mukhopadhyai (1994), are effectively universal: the permanence of slack, the hierarchy between core and peripheral activities, compatibility between problem solving methods and so forth. The question, then, is why are ICTs diffusing in all sectors and countries if their uses are so problematic ?

The most fundamental reason concerns firms' need to respond to market pressures, to differentiate and enrich products, and to provide commodities in new ways. Such responsiveness to product market forces necessitates greater interdependency within productive systems. A second reason is that "codified" horizontal communication is much more open to central control that the tacit horizontal co-ordination of information, and therefore permits greater responsiveness to radical process or product innovations. This is vital for firms operating in global markets and organising their production on an international basis as well. Both of these reasons are compatible with the increased demand for cognitive skills and interactive/supervisory skills noted earlier.

These comments on qualifications of organisational change remain highly tentative. but their spirit is broadly in accordance with studies that insist on the diversity of work organisation responses to technical change. These studies confront us with two hypotheses.

[16] These structures display different capacities for facing and organizing technological change, with the Japanese horizontal structure of information (in its work organisation) being more fit to diffuse and implement incremental innovations in products or processes, whereas US firms, with their more vertical structures of information (as characterised by their hierarchical work organisation) would be better at facing radical technical changes.

First, that firms undergo a standard process of trial and error before one best practice of work organisation imposes itself and diffuses to a majority of firms[17]. And second, that the new technological environment of the firm is such that there is no dominant model, only specific applications that are relevant in particular competitive/cooperative contexts. It follows that the work reorganization process becomes chronic (Attewell, 1994). In such a rapidly changing work organization environment, skills are bound to become obsolete more quickly than before. The relative instability of this environment, which leads firms to opt for organisations that can be continuously transformed and adapted, is also related to the increasing number of linkages that have developed between firms (see the contributions to Harris, 1994).

If a significant change in firms' perspectives on work organization has, in fact, occurred, and if work re-organisation has become a chronic issue with diverse solutions (as illustrated by the continuous spread of new organizational forms, such as re-engineering, merging, networking, externalizing, work-flow processes, groupware, etc.), then it is likely that the relationship between the spheres of work activities and household activities will be transformed as well. The fact that skills are becoming obsolete more quickly will be an important factor in the evolution of this relationship. The conclusions drawn from this brief survey of the skill bias issue lead us now to review how the new technical system can be viewed from the "other" sphere, i.e. from the perspective of the consumer and worker.

4. New consumers and the distribution of the consumer surplus

Our main claim here is that the divisions that are occurring in society in terms of the desire and ability of individuals or families to use new technologies are closely related to what is happening within work organisations. This broad learning process occurring outside the firm concerns not only the composition of the baskets of consumption goods and services that consumers buy, but also the way in which the provision of these commodities, together with the processes through which they are consumed, incorporate new technologies and the know-how associated with them. This is especially relevant for those services organised in networks. Linkages between the two broad learning processes (within and outside the workplace) may be transitory, and may correspond to a classic sequencing in the access to new lifestyles, as a result of which everyone will eventually converge to some general standard. But they may involve a more lasting and structural drift with detrimental long-term effects on social cohesion that could, in turn, hinder the process of economic growth. We return to this possibility below, but begin by discussing some of the stylised facts about changes in consumption patterns that have been highlighted by the debate about the "consumer surplus" [18].

i) Lessons from the debate over the Consumer Price Index.

The current debate over the CPI helps illustrate some of our concerns. Questioning the accuracy of the CPI raises questions about measurement techniques and about how well consumers are able to appreciate changes in the content of goods and services and in the way they are provided. In what follows, we do not discuss the techniques of CPI measurement employed by national statistical agencies. This issue is important, due to the role that price indexing plays in fixing wages, public transfers and contracts in most countries, but it is not directly linked to our topic. However, those aspects of the CPI measurement debate that are

[17] This hypothesis would explain the current period a standard period of transition.

[18] This debate seems more active in other social science disciplines, such as sociology, political science, geography or business and management sciences. Most economic studies of the consumer surplus deal with very narrowly defined products (see, for example, Fischer and Griliches' (1995) study of two prescription drugs, Trajtenberg's (1990) discussion of CAT scanners, or Hausman's (1994) analysis of a new breakfast cereal.

concerned with the difficulties involved in comparing the real values of two baskets of goods and services at different points in time when a large, systemic technological change has occurred, are central to our topic.

The debate over the CPI has drawn attention to those areas where diverse technological changes are most difficult to appreciate, and attempted to attach an order of magnitude to the underassessment of quality change. In the US, the Boskin report (Boskin, 1996) provides a detailed account of the "guesstimations" that the commission arrived at for measuring various components of CPI mis-measurement, on the basis of a large body of pre-existing econometric work. The report concludes that the underestimation of quality change may have led to an upwards bias in the CPI of 0.6 % per year. The impact of an increasing ability to substitute one type of retail outlet accounts for a further 0.1% upward bias[19]. Overall, the unmeasured consumer surplus, net of the technical drawbacks due to measurement procedures, amounts to 0.7% a year[20]. This net bias is quite sizeable if one compares it with the average growth rate of large OECD economies (1.6% per annum from1989-1993).

Most critics of the Boskin report have emphasised two points: the inevitability of delays when taking account of innovations, and the report's biases in selecting information on quality changes.

Delays when taking into account innovations present a dilemma for national institutions measuring the CPI. If, in order to keep pace with the behaviour of the average consumer, they wait until a sizeable share of consumers has adopted a new product, then its price will already have fallen significantly and the quality improvement may go unnoticed. If, however, they include the product at too early a stage, it concerns too few consumers carries little weight in the CPI. The introduction of new product or service thus necessitates a careful choice as to when to include the product in the CPI basket, and an appreciation of the quality improvement it involves. Neither is easy. It seems that institutions measuring the CPI tend to include new products with some slight delay[21]. Meanwhile, estimates of quality improvements require detailed information and are all the more open to the criticism that the innovation in question is radical.

The second line of criticism also bears on the quality of information on innovation. The Boskin report has been criticised for relying on limited sources of pre-existing information (specifically, the hedonic pricing of innovations) that are biased towards suggesting that price inflation is over estimated. Indeed, the argument that, in some instances, price inflation may have been underestimated is hard to deny. But even if the overestimation of price inflation suggested by the Boskin report is, itself, overestimated, the CPI measurement debate has drawn attention to important sources of uncertainty surrounding the quantification of goods and services, and the increased importance of product innovation.

At this point, it must be acknowledged that, when changes are as far reaching as those induced by ICTs, the very meaning of a cost of living index is transformed. Moreover, many of these changes are taking place in domains where change has always been difficult to measure. The housing category, for instance, encompasses various issues that are not given much weight in the correction of the CPI in the Boskin report, such as housekeeping services (where an ever-increasing variety of services is on offer). Medical care is accorded a relatively high unmeasured rate of technical change, but entertainment and educational

[19] This is based on Reinsdorf (1993).

[20] The total bias in CPI measurement in the US amounts to 1.10 % a year when all of the technical improvements in measurement made by the BLS since 1996 are taken into account.

[21] The Boskin report gives some examples of this delayed inclusion (p.39), mentioning that cellular phones (with over 36 millions users in the US at the time of writing) were not included in the CPI basket at the time of the report's writing, despite being used by over 36 million people.

services are not, despite the profound structural changes in these activities brought about by ICTs.

In sum, those areas where the magnitude of unmeasured technical change is uncertain remain important. These are mainly service activities. Nakamura (1995), who performed an exercise similar to that of the Boskin Commission on the BEA national accounts, estimates that the net unmeasured technical change in personal consumption is as high as 2.5% per year over the period 1984-1993. The differences between Nakamura's and the Boskin report's findings arise from the recreation services, education and housing industries.

This leads us to stress that, in addition to the way in which products and services are provided, the *context* in which consumption occurs matters. If products are more differentiated, then it follows that their utility is more context specific. It becomes ever more difficult to appreciate a consumption basket as a collection of separate items. The welfare effects of the consumption of these products are more interdependent, because the temporal and personal dimensions are becoming more closely tied to consumption. The facts that people are faced with a time budget constraint and that consumption is becoming more time consuming (if only because of its increasing service content) implies, when technologies are transforming these time constraints, that changes in the management of time constraints will take place. The fact that products are becoming ever more customized also implies changes in consumer behaviour. These transformations, which are bound to be highly dependant upon individual characteristics, generate a consumer surplus that is largely "hidden" and very likely unevenly distributed.

The next step is to consider how this "hidden" consumer surplus affects different social groups, and what it tells us about the dynamics of consumption and the learning process that is shaping consumer behaviour.

ii) The distribution of the consumer surplus : the role of large service networks.

The debate over the unmeasured consumer surplus is motivated by two issues. One is a fiscal issue; many public transfers, pensions and revenues are indexed on the basis of a CPI, and overestimation of this index has a sizeable effect on the public budget deficit. The second issue relates to the distribution of income; income inequalities have been growing in most developed countries over the last two decades.

It is relatively easy to get a rough estimate of the impact of mismeasurement of the consumer surplus on the budget deficit or on the balance of taxes and transfers to various social groups. It is much harder to get an idea of its effect on the distribution of welfare, however. One can argue that gains and losses to different groups balance out. Groups with less income, education and culture will certainly miss out on some of the advantages of unmeasured quality changes, but will gain by having improved access to, and facing lower prices for, goods and services. But this hypothesis underestimates the facts that we begin with very unequal distributions of income and education, and that the existence of an unmeasured quality change underscores the opacity and inequality that exists in access to and the diffusion of new commodities. People will differ as to how they access new goods and services, and with regards to what they get out of them.

The large variety of goods (see Gordon 1990) together with the increase in the range of services at our disposal, has been accompanied by a proliferation of the ways these goods and services are bought and sold, and financed. Consumption in this environment has become more complex, and has broadened the opportunities for "smart" consumer behaviour. Indeed, the pressure of smart consumers (either individually or organised in associations and through the media) is playing a major role in increasing competition and shaping more demand-oriented market economies – although conversely, large numbers of people in the lower reaches of the income distribution find it hard to escape quality changes they cannot avoid,

varieties they cannot afford or improvements that are of no use.

We have chosen to analyse two dimensions of consumer "skills": those linked with appropriate and efficient use of intermediation services, and those embodied in personal skills. We begin by focusing on the intermediation provided by large (public or private) services.

The provision of services via large network systems is one area in which social discrimination is both effective and structuring. Particularly important in this respect are financial services, which have greatly increased in variety and have led to a wide spectrum of results, from rapid fortunes built on speculation to the unbearable indebtedness of some low income households. Similar increases in the range of consumers' capabilities to use new services efficiently can be observed in education, health, communication, transport and public services. This social differentiation in patterns of use can originate from two factors: the differing abilities of users to take advantage of modern intermediation systems, and the tendencies for large systems to develop their organisations while taking this differentiation for granted.

Education is a classic case, even if it has not yet been thoroughly transformed by ICTs. The fact that an increase in the average number of years of schooling years has been accompanied by rising illiteracy and other poor results (such as the increasing incidence of drop outs, of unqualified school leavers, of poor scores on general and specialized tests - see OECD, 1998) suffices to illustrate the widening of the range of achievements.

The development of telecommunications between the various agents and phases of treatment in health systems is still at an early stage, but already raises some of the main issues regarding the path of contemporary technological change. These developments imply an active interface between health system professionals and their patients. The design of this interface presents a standard trade off: the larger its scope, the more useful and beneficial will be its operation in terms of the range of interventions covered. Conversely, the more complex the interface, the higher will be the barriers to access, depending on the general "skill level" of the population. Modern treatment systems - such as HMOs – have improved the quality of care, but have also been accompanied by some ordering of access which, in the context of large inequalities in education or income, may result in the exclusion of some patients from care (see Boulier, 1994).

Financial services, and especially retail banking, have already experienced various phases of computerization of their network facilities. Increased competition and improvements in the quality of equipment fueled the reorganization of financial networks and organisations, which has, in turn resulted in some exclusion of access to services. For example, banks in the US and UK have closed local branches, replacing them with the limited services of automated tellers (see Prat, Leyshon and Thrift, 1996 for the UK and Dymski and Veitch, 1993 for the US). This has had detrimental effects on local communities.

When examining these developments, we must distinguish between personal services (such as education and health) and intermediation services, which are offered to both firms and individuals and where technological and/or organisational transformations are interdependent. While in the first case the potential created by ICTs is being realised only slowly, and depends extensively on public policy interventions, the dynamics of market competition have resulted in a rapid transformation of the ways in which most intermediation services (distribution, transportation, communication, banking, etc.) operate. This pressure to restructure has been both a cause and consequence of recent deregulation and re-regulation initiatives, an institutional context that is crucial to the provision of these intermediation services.

The development of large network services, as stimulated by the new technologies, can thus perpetuate segregation in the provision of the sort of consumer services that are

crucially important in the new economy. Moreover, these developments possess a strong path dependant dimension that may hinder the development of new personal skills. In this respect, universal access to such services does not guarantee that there exists equal opportunity to use service networks with the same efficacy.

iii) The distribution of the consumer surplus: the role of personal skills.

Consumer behaviour is supposed to be determined by income, education and social background. These social roots have been very important in shaping the preferences of consumers in the post war period, making all consumption projects in a given society more or less commensurable (see, for example, Galbraith, 1958 or Packard, 1957). A characteristic of the current period may be a loosening of these social ties, transforming societies of classes into societies of individuals or transient small groups.[22] In these more atomistic societies, what do "consumer skills" consist of ? Their generation is more evolutionary, meaning that they are more dependent on individual experience within the universes of markets, law and public (welfare) interventions (universes that are, themselves, evolutionary). The use of ICTs, at work or at home, contributes to these interfaces. It is in this sense that we can speak of a broad learning process for the building up of consumer skills. Beyond some common hedonic principle, social links have become more uncertain or differentiated and casual personal networks more important. Paradoxically, this lack of social cohesion, because it means the absence of centripetal forces, leads to more risky dynamics, where failures will be more difficult to overcome and will tend to cumulate over one's lifetime.

Atomistic societies may therefore lead not to more egalitarian societies but to more divided societies. Such will be the case if the level of individual risk has increased. Such may be the case if one considers the relative erosion of the means of social promotion or of self achievement brought about by education and work. We have already discussed this development, which may be due to excess supply of educated people as well as to rapidly changing markets and production processes, in section III. If ICTs play a role in this evolution of the labour market, however, then they can also confer new abilities on individuals, helping them to overcome some of the drawbacks of labour market developments.

But the private use of ICTs has its limits. It may be complex and require much coordination, while opportunities for misuse proliferate (see Landauer, 1995). Personal ITC use may also be too specific and hence ultimately irrelevant in terms of skill development and personal autonomy, while the overlap between cognitive skills developed at work and in the home may vary considerably. And yet, the development of skills in the home, where the learning process may last longer, is especially important when the learning process at work is limited or constrained. Ultimately, the interplay of skill development at home and at work is bound to be very different across groups with different experiences and backgrounds. Cultural and financial barriers to the access to new facilities or the use of new equipment has led experts to express fears that a two tier Information Society could develop. Policy statements have emphasised the important role that domestic ICT use can play in curtailing this development (see, amongst others, the Group of Prominent Persons (1994) and the EU's High Level Experts Group on the Social Aspects of the Information Society (1996, 1997)).

Elites and professional classes will have more opportunities to benefit from what ICTs can offer, while those at the margins, with low income, little education and limited social connections, will find it increasingly difficult to keep "in touch" with the capabilities bestowed on consumers by ICTs. The shift towards services in consumption patterns is increasing the challenges this dilemma presents. Time becomes a binding constraint in producing one's own welfare (Petit and Soete, 1996), a problem that consumers can solve

[22] Forse (1998), for instance, stresses this weakening of class ties.

with differing efficiencies depending on their ability to use ICTs[23].

Parallels can be drawn between the personal requirements for a skilled consumer and the requirements for a skilled worker. In both cases, a skilled person will be expected to respond positively to external challenges induced by ongoing structural changes, and to constantly find ways to improve the internal efficiency of their actions (the ability to develop a learning by doing process). In a world of bounded rationality and limited information, one way to balance these internal and external learning processes is to have access to various groups or networks (either more or less formal) from which information and support can be obtained. Two illustrations of this are instructive. Gollac (1996), looking at how computer users at work manage their work, finds that those using their computers in the most innovative ways (programming or using several software programmes) typically form a reference group based on relations outside the firm. Referring to colleagues in remote positions within their own firm is listed second in importance, and close colleagues third. By contrast, for people using computers in limited ways (for example, always using the same software for definite operations), the order of importance was the opposite.

Similar signs emerge from investigations of the best means of protecting individuals against unemployment: those with a large range of diverse connections enjoy the most effective protection. It follows that having strong links within a particular network or community may not be as valuable as a portfolio of connections[24]. Having numerous weak ties (in the sense of Granovetter, 1985) markedly increases an individual's reach, the scope of their action and their ability to respond rapidly to changes in the labour market.

The similarity between the abilities and skills required of individuals at work and in the home seems to be a key feature of the new environment. Similar capacities to learn and to adapt to new contexts are required in production and consumption. Learning processes at work and home are therefore broadly complementary at an individual level. Nevertheless, these processes are affected by the intermediation structures that provide education and the various logistics of services that we discussed earlier. Moreover, it does not follow that the two processes are spontaneously self re-enforcing. There are many reasons to believe that this cumulative interaction involves risks, and that part of the learning process concerns how best to monitor these risks. For instance, the fabric of weak ties and the logistic support systems mentioned above have a high rate of obsolescence. Individuals may then be exposed to hazards that result in lasting or irreversible consequences ("accidental" poverty and unemployment can act as traps in some cases). There is also uncertainty as to the best portofolio of connections. Moreover, as Attewell (1994) suggests, the use of ICTs may have considerably increased risks by multiplying the number of cases that involve asymetric information, as schematized in principal-agents problems. Finally, it is a general property of systems to become more unstable when the number of internal linkages they involve increases.

5. Conclusions : on unbalanced and unequal growth

Both the productivity paradox and the difficulties most economies have encountered when trying to turn the diffusion of contemporary technological change into steady and evenly distributed rates of economic growth have largely been attributed to the length of the learning processes involved. On the production side, these learning processes seem to require

[23] These problems are compunded by the fact that low skilled workers subject to rigid work schedules, while skilled workers and professionals have more flexible working arrangements, even if their hours are longer (see Schor, 1999).

[24] We use the word "portfolio" in reference to studies in industrial organisation (see Dunning) which stress that new large firms are engaging in a series of alliances, joint ventures and the like, which they attempt to manage in an optimal fashion so as to deal with rapid changes in competition and technologies in various markets.

intricate co-ordination, which is largely decentralised and therefore difficult to implement (Freeman and Soete, 1994, David 1991). Our survey of the "skill bias" issue stressed some of the characteristics of this learning process. It conveyed the impression of a rather atomistic approach to the reorganization of work, which puts a new emphasis on personal characteristics. From this perspective, the changes occurring in the workplace and in consumption activities appear similar: "smart" consumers seem capable of improving their share of a "reconstructed total welfare", while many others find that their situation has deteriorated[25]. A review of the debate over the unmeasured consumer surplus lent support to this view, and emphasised the fact that consumer learning processes now appear more casual and less dependent on a pre-existing class structure, even if both education and the infrastructure of service provision play a major structuring role. Moreover the development of a sizeable set of skilled or "smart" consumers, which, together with globalisation, accounts for the more competitive nature of markets, is related to the development of a group of skilled workers who succeed in tying together the learning processes in which they are engaged at work and in the home. Meanwhile, no sign was found of any significant catch up mechanisms, which would ensure that those currently lagging behind will do so only temporarily. On the contrary, the system seems to have generated new risks and instabilities which, thusfar, policies have not learned to cope with.

The prospects for economic growth are thus related to two interdependent "macro" learning processes, which in turn provide an important perspective on the relationship between inequality and growth. Inequality of access to education and service infrastructures hinders developments that utilise ICTs to best advantage, as they limit the positive network externalities that would otherwise occur. That some groups are able to take increasing advantage of networks and even adjust them in order to do so does not seem to counter-balance the negative effects of exclusivity.

Mechanisms capable of countering this dualist trend are few in number. Income redistribution can help, but cannot by itself fill an access gap that includes non-monetary barriers. Education and the services which provide the intermediation necessary to reduce access inequalities certainly contain the solutions, but effecting these solutions in turn poses a variety of quantitative and qualitative problems. In particular, it is difficult to set up the idiosyncratic formulae that will help countries to take advantage of their specificities, design the proper learning schemes that will develop the mechanisms enabling them to strengthen social cohesion, and thereby make the best use of contemporary technological change.

The aim of this chapter has been to summarize the architecture of the linkages between technical change, inequality and growth. In short, we have stressed that inequalities in welfare hinder growth prospects as never before. They impede economic growth without developing any self-correcting mechanisms, while simultaneously limiting the efficacy of old remedies, such as income redistribution. The sooner these issues are understood and rendered manageable, the better able society will be to benefit from the current historical turn.

[25] There are absolute and relative dimensions to this dissatisfaction. Some have increasing difficulty coping with the contemporary challenges of more demanding labour markets and consumer know-how (a euphemism for those with low incomes), while others (as stressed by Storper, 1999) resent the growing range of consumer outcomes, based on the fact that individual satisfaction may depend on the position of others as well as oneself.

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Table 1.
Employment growth breakdown by skill level in manufacturing and services
(annual percentage growth rates)

	Blue-collar low-skilled		Blue-collar high-skilled		White-collar low skilled		White-collar high-skilled	
	Manuf. Ind.	Market Services	Manuf. ind.	Market services	Manuf. ind.	Market Services	Manuf. ind.	Market services
United States 1983-93	-0.2	0.2	-0.1	0.2	-0.1	1.4	0.2	0.9
Canada 1981-91	-0.7	0.1	-0.2	-	0.1	0.8	0.4	1
Japan 1980-90	0.1	0.3	-0.2	-0.1	0.5	1.3	0.4	0.9
Germany 1980-90	-0.8	-0.2	0.2	0.3	0.2	1	0.3	0.6
France 1982-90	-1.4	0.2	-0.3	-	-0.2	0.5	0.4	1.2
Italy 1981-91	-0.5	0.6	-1.0	0.1	-0.1	1.2	0.2	1.0
Australia 1986-91	-0.6	0.5	-0.3	0.1	-	1.2	0.4	1.8
New-Zealand 1976-91	-0.5	-1	-1.3	0.3	-0.1	0.8	-0.1	2.3

Source : OECD (STI/EAS Division)

Table 2.

Productivity Growth by Sector

(over two periods (1) 1960-1973 ; (2) 1984-1993)
for The USA, Canada, Japan, Germany and France
w : share in value added ; Z : labour productivity growth rate;
P : contribution to total productivity growth

COUNTRY	USA			CAN			JPN			DEU			FRA		
VARIABLE SECTOR	w	Z	P	w	Z	P	w	Z	P	w	Z	P	w	Z	P
AGR (1)	3,1	2,4	-0,1	3,1	0,2	-0,1	3,1	1,7	-0,1	2,7	7,0	0,0	7,8	8,4	0,1
(2)	1,9	3,6	0,0	3,3	0,7	0,0	3,2	0,7	-0,1	2,0	1,8	0,0	4,1	2,0	0,0
MID (1)	5,0	3,5	0,0	5,0	13,1	0,0	5,0	11,2	0,0	4,0	3,3	-0,1	2,9	-0,6	-0,1
(2)	3,3	5,8	0,0	6,3	4,1	0,1	0,3	4,0	0,0	0,9	1,4	0,0	0,9	6,3	0,0
MAN (1)	19,9	3,3	0,5	19,9	5,0	0,5	19,9	7,3	0,5	33,5	4,5	1,3	20,3	4,7	1,0
(2)	19,6	3,2	0,2	18,8	2,2	0,0	27,9	2,9	0,6	32,2	0,9	-0,1	23,6	2,4	0,0
EGW (1)	2,8	4,7	0,1	2,8	5,9	0,1	2,8	0,8	0,1	1,6	5,5	0,1	1,2	8,9	0,1
(2)	3,1	2,7	0,1	3,3	0,0	0,0	3,0	3,6	0,1	2,8	2,5	0,0	2,5	3,7	0,1
CST (1)	8,5	-2,4	-0,2	8,5	-1,1	-0,2	8,5	1,3	-0,2	8,6	2,5	0,2	7,8	2,8	0,1
(2)	4,1	0,2	0,0	5,9	-1,0	0,0	7,8	2,2	0,2	5,8	0,6	0,0	5,6	1,9	0,0
RET (1)	13,2	1,7	0,3	13,2	2,7	0,3	13,2	2,7	0,3	11,5	2,3	0,3	na	na	na
(2)	16,5	1,2	0,2	13,1	1,2	0,2	14,3	1,2	0,2	10,3	1,3	0,2	15,3	0,7	0,1
TRS (1)	4,8	3,7	0,1	4,8	3,1	0,1	4,8	1,1	0,1	5,0	4,0	0,2	na	na	na
(2)	6,3	2,5	0,1	7,0	2,7	0,1	6,3	1,7	0,1	5,8	3,1	0,2	6,3	4,2	0,3
FNI (1)	17,2	0,1	0,4	17,2	2,8	0,4	17,2	7,8	0,4	9,3	7,8	0,4	13,3	1,8	0,7

(2)	23,1	-1,0	0,2	18,0	0,8	0,4	14,6	1,8	0,3	12,9	1,8	0,3	18,8	-0,5	0,5
SOC (1)	8,2	1,1	0,1	8,2	-4,8	0,1	8,2	1,2	0,1	9,8	1,2	0,3	na	na	na
(2)	8,9	-0,9	0,1	5,4	1,3	0,1	13,5	1,2	0,2	13,0	2,1	0,7	5,1	1,1	0,2
TIN (1)	85,5	1,7	1,4	85,5	3,0	1,4	85,5	4,8	1,4	85,9	3,7	2,9	77,6	4,3	3,3
(2)	88,2	1,0	0,9	81,2	1,3	0,9	90,0	1,5	1,5	85,8	1,7	1,4	82,2	1,9	1,2
TET (1)	100,0	1,5	1,5	100,0	2,2	2,2	100,0	4,4	4,4	100,0	3,3	3,3	100,0	3,6	3,6
(2)	100,0	0,9	0,9	100,0	0,9	0,9	100,0	1,5	1,5	100,0	1,5	1,5	100,0	1,4	1,4

Notes : Growth rates are in yearly percentage points, sectors: AGR, MID(mining), MAN (manuf), EGW(utilities), CST(construc), RET (distri. trade), TRS (transport comm), FNI (financial and business services), SOC (social services), TIN (total indust.), TET (total).
Source : OECD ISDB