

6 The new technological wave and the developing countries: problems and options

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Introduction

This paper intends to explore the consequences of the impact of the new wave of technological innovations in Latin America, and the options open to the region. The frame of reference of our analysis will be the Kondratiev-Schumpeter theory of the 'long waves' of the world economy, a subject to which Christopher Freeman has made a considerable contribution in recent years.

For an adequate evaluation of the possible effects of the new long wave on Latin American countries, it is necessary to understand the present situation and its causes. In other words, we have to examine the impact of the previous 'Kondratiev cycle'—the one that started in the recession of the thirties, and culminated in the sixties—on the region. On the basis of this analysis, we will try to identify the main elements of a strategy for the future.

In an article published in 1935,¹ Kondratiev concluded that 'on the basis of the available data, the existence of long waves of cyclical character is very probable'. He added, 'In asserting the existence of long waves, and in denying they arise out of random causes, we are also of the opinion that the long waves arise out of causes which are inherent in the essence of the capitalist economy'. Kondratiev, although pointing out the association of technological innovations with the long cycles, did not establish a causal relationship between them. It was Schumpeter who, in 1939, proposed a theory for the cyclical behaviour of the capitalist economy.² In his view, the cause of the cyclical behaviour of the economy is technological innovation, which is promoted by entrepreneurs. The Kondratiev long cycles are the product of a series of articulated innovations, each of them constituting an 'industrial revolution'. A long cycle, in this view, would be a succession of 'technological transformations that affects the economic system'.

In a recent paper, Carlota Perez³ has made an outstanding contribution to the understanding of the mechanisms and dynamics of the long cycles. She starts by pointing out that, in Schumpeter's theory, the whole process of 'creative destruction' generated by one, or by a group of innovations,

develops within the economic system conceived as a self-regulated entity relatively independent of the social milieu. Society is affected by, and affects the economic process, but it is mainly an environment. In Perez's approach, society is seen as basically composed of two sub-systems: the techno-economic, and the socio-institutional, the first having a much faster rate of change than the second. The structural crisis produced by a cluster of technological innovation is not only a process of 'creative destruction' in the economic sphere, but also involves deep transformations in the socio-institutional system. As the rate of response of the two systems is different, the long cycles are the result of the resistance offered by the socio-institutional system to the transformations taking place in the techno-economic system.

For Perez, the long waves represent different 'modes of development', which are the response to the appearance of successive distinct 'technological styles'. The modes of development stretch from trough to trough in each cycle, but the technological styles evolve from the peak of one cycle to the peak of the next. This is due to the fact that a new technological style begins when the previous one approaches the limit of its possibilities. An important point in Perez's theory is that the final form that a mode of development will take does not depend solely—or almost solely—on the characteristics of the new technological style: 'The final form the structure will take, from the wide range of the possible, and the timespan within which the transformation is effected to permit a new expansionary phase will, however, ultimately depend on the interest, actions, lucidity and relative strength of the social forces at play.'⁴ (My italics.)

We are aware that the set of hypotheses so briefly summarized above is still under discussion, and that many gaps must be filled before a complete picture of the dynamics of the cyclical behaviour of the economy can be built. The questioning of present theories today ranges from the notion that cycles are an inherent characteristic of capitalist economy, to the validity of systematic correlations between economic cycles and waves of innovations.⁵ Nevertheless, we accept this theory as the frame of reference of our analysis, for two reasons. The first is that it constitutes a conceptual construction that is internally consistent; it does not contradict the facts and, in our opinion, it has more explanatory power than any other proposed theory or hypothesis. The second, but more important, reason is that we are at present confronted by a recession of the world economy that has all the characteristics of the down-swing of a long cycle, associated with the emergence of a wave of technological innovations which is deeply affecting the structure of the whole economic system. So, whatever the difficulties we may have in applying the theory to past long waves, there is little doubt that it is the best instrument we have with which to understand the present one.

The new wave of innovations

As is well known, the first Kondratiev long cycle was based on the steam engine and the textile industry; the second, on the railroad and the metal-mechanical and steel industries; and the third, on the internal combustion and electrical engines, and on chemical industry. In each of these cycles, the whole profile of the productive system was transformed from energy and transportation to final consumption goods. The dominant characteristic of the 'new' wave—centred on microelectronics—is that its impact seems to be more important to the organization of production, the labour process, and the social division of labour, than to the general profile of the productive system. The Industrial Revolution, with the first great modern wave of technological innovations and the emergence of the proletariat, consolidated the capitalist economy, and changed Western society. The subsequent technological waves changed the whole profile of the productive system, but did not alter significantly the structure of capitalist society; this new wave, in our view, will affect the very basis of our society, as can be seen by considering briefly its central protagonist: the process of automation and robotization.

It is clear that in the advanced countries the basic cause of unemployment is the fact that every day we need less labour to produce the same amount of goods and services. This historical tendency that started to intensify almost from the beginning of the post-war period, but whose effects were to a great extent concealed by a high rate of economic growth, will be enormously accelerated by the progress of microelectronics.⁶ Its main impact will be in the social division of labour. The suppression of most forms of physical or routine work will gradually eliminate the proletariat in the Marxist sense, because the role of wages will fundamentally change.

In all modern societies, access to goods and services is essentially conditioned by wages in the widest sense: the remuneration of personal work in any of its forms. In the future, this central role of wages will decrease—firstly, because one of the consequences of automation, by eliminating most jobs which do not require 'non-programmable' skills or creativity, will be to obliterate most significant forms of hierarchy in the labour process; secondly, because participation in the productive system will become a diminishing fraction of total human activity, and so will gradually disappear as the central determinant of distribution.

The transition to the new 'mode of production' will undoubtedly take a long time to be completed—of the order of two or three generations—but its first effects are already with us. The duration and characteristics of the cycle will basically depend on the response of the socio-institutional structure to the changes—or to the range of options of change—induced

by the new technological style. In this cycle the effects of automatization and robotization will be, in our opinion, the most difficult to absorb by the socio-institutional structure, and consequently they constitute the main element of our analysis.

The impact of the new wave in the advanced countries

Virtually all forecasts of levels of unemployment for the advanced countries predict a continuous worsening of the present situation.⁷ The institutional response that the advanced societies are giving to the growing problem of unemployment is based primarily on the payment of a 'salary' to the unemployed through social security services. The non-institutional response is a rapid growth of the service sector, and of the so-called 'informal sector' of the economy. Both types of response can only be transitory, and are mainly symptoms of the lack of an articulated strategy for confronting the problem. However, the growing recognition that the character of present unemployment confronts the advanced countries with a problem that cannot be solved without a complete questioning of the relationship between technology, employment and work, is leading to proposals that, although still very general, point in a fresh direction.

In a recent paper, Prof. W. Zegweld summarizes well the basic philosophy of this new approach:

The problem is to organize the breaking down of barriers between traditional wage-earning employment and work in the widest sense of the term. Such work can provide income but also offers a social role, contact with others, an opportunity for creation or enterprise. It must not be proposed in a single, rigid setting identical for all but must be flexible enough to meet the wide variety of demands and respond to freely expressed choices. Instead of offering everyone a problematical full-time job, the aim is to allow everyone to find and choose a job in which working hours, level of pay and social security coverage are no longer pre-determined and closely linked but can be adapted, above an indispensable minimum, to the wishes of the individual. . . . This strategy . . . presupposes a close link between technological and social innovation, allowing greater flexibility in the organization of production . . . without neglecting an adequate level of protection for everyone.⁸

The problem is not whether or not traditional forms of work and employment will be abolished; that change is inherent in the socio-economic transformation induced by the new technologies and is, as such, irreversible. In the words of André Gorz: 'The choice is between the liberatory and socially controlled abolition of work (in the traditional

sense of wage-earning employment) and its oppressive and antisocial abolition'.⁹ We believe that the first option will prevail, partly because of its social and economic rationality, and partly because the oppressive imposition of new forms of work would be extremely difficult in a society where social control is largely based on discipline imposed by the traditional relationship between work and employment, precisely the relationship that will be radically changed.

The impact of the new wave in the Third World

To analyse the impact of the new wave of technological innovations on the countries of the Third World, and the options available to them, we will consider the Latin American case. The first reason for this selection is that the diversity of the Third World makes any global treatment too general. The second is that new technologies are entering faster and more massively into Latin America than into any other Third World region. What we can learn in this exercise can provide a frame of reference—or at least a general guideline.

It is not necessary to describe in detail the socio-economic development of Latin America—and most of the Third World—in recent decades. Its development was based upon the evolution of the developed economies, particularly in Western Europe, in the post-1945 period. The success of the Marshall Plan and the rapid acceleration of technological progress were associated in those countries with a period of prosperity without precedent in the history of capitalism.

Two elements—the influx of capital and the introduction of new technologies—were adopted by the dominant classes of Latin America as pillars upon which to sustain economic and social development. Beside the intrinsic advantage of those technologies, and the pressure of the advanced countries—basically through expanding multinationals—to disseminate those technologies, this strategy of development offered two important advantages. The first was its simplicity. It involved the mechanical translation of a conception originated in advanced countries and accepted on the basis of its demonstration effect. Secondly, it seemed to ensure economic growth—its association with social progress was taken for granted—without substantial changes in prevailing social and economic structures.

The results of this strategy are well known, and a few indicators are enough to describe, in general terms, the present situation. The GNP per capita of the region was 10 per cent lower in 1983 than in 1980.¹⁰ The rate of inflation in the most industrialized countries of the region—Argentina, Brazil, Mexico, Venezuela, Chile—has reached values without precedent in the past, and the external debt of the region amounts to about \$340 billion.

Those figures only indicate the overall situation, and do not reflect the most important results of the strategy of development. During most of the period we are considering, the rate of economic growth of the countries of the region was high: between 1965 and 1981 the GNP of the region quadrupled, while the GNP per capita doubled. However, the benefits of that sustained growth reached only a minority of the population, because the pattern of industrialization was mostly directed to the requirements of a bourgeoisie and a middle class with the same pattern of consumption as their equivalents in the advanced countries. The rest of the population was, at the end of the period, in a situation not much better than in the past, and sometimes even worse. A partial exception to this overall picture lies in the countries of the 'Southern cone' of the region—Argentina, Chile, Uruguay—where a better distribution of income allowed a greater proportion of the population to benefit from economic growth.

Latin America now confronts a situation which leaves little room for the superficial optimism prevalent at the beginning of the post-war period. The previous strategy of development based on the massive influx of capital and technology is no longer viable. Beside external debt, which makes it very difficult for the region to incorporate more foreign capital, the world recession is a fundamental factor in restricting the transference of capital from the centre to the periphery.

Summing up, it is clear that the wave of innovation associated with the previous long cycle failed to generate more and better-distributed wealth in Latin America as it did in the advanced countries. As a consequence, while the developed countries are entering a 'post-industrial' era, the countries of Latin America—as well as most of the Third World—are receiving the impact of the new wave without having received the benefits of the previous one, or of the Industrial Revolution more generally.

The reasons for this failure have been amply discussed in Latin America in terms of dependency theory, which places the main cause of the persistence of underdevelopment in the Third World countries on their mode of insertion into the international economic structure. A variation on this general outlook—with many advocates in the advanced countries—recognizes the role of international and social settings, but tends to stress the relative backwardness of developing countries in science and technology. According to this interpretation, an adequate capability in science and technology is an essential precondition to benefit from the process of change induced by waves of innovations. The absence of that precondition would explain, to a great extent, the failure of the Third World in the so-called process of modernization.

On balance, we believe that the available evidence supports dependency theory. However, in the context of the present analysis we want to focus on the direct agent or mechanism responsible for the failure to

benefit from the previous cycle. A reasonable understanding of that mechanism is one of the essential preconditions to a strategy for the future.

In our view, the immediate cause of the poor performance of Latin American economies in the third Kondratiev long wave was their failure to adapt the socio-institutional sub-system to the changes of the techno-economic sub-system induced by the wave of innovations. This is suggested by the key socio-institutional transformations associated with the last long wave: the redistribution of income, the strengthening of labour unions and their institutional acceptance, and the internationalization of the economy.¹¹

The redistribution of income in the developed countries as a consequence of the mass production technological style had two main effects: to enormously enlarge internal markets, and to change the pattern of product demand. The market which had previously been divided between luxury and staple goods evolved to meet the demand of the middle income sector which, including the middle class and considerable proportion of the workers, comprised the majority of the population. In Latin America there was no significant redistribution of income; in most countries, on the contrary, there was a continuous concentration of income in the upper classes. The most important consequence from the point of view of the productive structure was that the demand for non-staple goods came only from those minorities with an income equivalent to the upper and middle classes of the advanced countries. The result was that the pattern of production was not determined by the demand of the majority of the population as was the case in the advanced countries, but by the demand of that privileged minority. Thus, the imitative style of industrialization, with the concomitant massive and apparently indiscriminate transference of technology, was not a consequence of technological backwardness—even with the same basic technological elements, the composition of the final goods 'package' could have been different—but rather a response to the pattern of product demand.

Secondly, at the beginning of the period, we saw the industrialization of Latin American countries occurring with a small and poorly organized labour-force. Structural unemployment, aggravated in many countries of the region by the existence of a large, poor peasantry which migrated to the cities, put most of the industrial work force on the defensive. On the other hand, the chronic instability of the governments of the region made them suspicious of any potentially contestatory movement, and they used every possible means to repress or control trade union activities. Thus, despite a long history of sporadic struggles, the trade unions of Latin America—with the exception of Argentina, and Chile during the Allende Government—never had the social and political power of their counterparts in the advanced countries.

Finally, the internationalization of the economy with the rapid expansion of the multinational enterprises, and with the inter-country trade and investment regulated by international agreements, generated a new situation in world economic relations. The insertion of a country in the world system did not depend any more solely, or almost solely, on the market forces—controlled fundamentally by private enterprise—but also on the bargaining capacity of the nation states. Most of the Latin American states were, and are, intrinsically weak. Besides, the ruling classes whose vested interests were articulated with foreign interests have lacked the political will to fight for a more equitable world order, the only element that could have counterbalanced, at least partially, the superior political and economic power of the advanced countries. The natural result of that unequal struggle has been dependency, or 'neocolonialism'.

Latin American countries do not seem now to be in a better position than they were in the past to incorporate the new wave of innovations. On the contrary, their enormous external debt, with its paralyzing effects on the economy, the advancing world recession, and the social impact of automation and robotization, seems to make the incorporation of the new wave even more difficult.

Taking only the process of robotization and automation, a contrast between the advanced and the 'peripheral' countries is particularly revealing. The former, with low rates of demographic growth, high capacity for capital accumulation, and no structural unemployment until recently, cannot cope with the problem of unemployment which will probably reach the level of 20 per cent at the end of this decade. It is obvious that in Third World countries, with high rates of demographic growth, low capacity of capital accumulation and chronic structural unemployment, the employment situation will deteriorate much faster than in the advanced countries. This is particularly true in Latin America, where the large and middle-size countries are fairly industrialized.

The studies made in the advanced countries—the most important ones being Interfutures (OECD), the Presidential Report on the Year 2000 (USA) and the Brandt Report—seem to confirm a pessimistic view of the future of the Third World. According to those forecasts, the gap between the two worlds will be the same or greater than now in relative terms, or will diminish only marginally in the more advanced developing countries. In absolute terms, the situation in a great part of the Third World will probably worsen.

The question is, to what extent are these forecasts reliable? If we accept their implicit premises, they are, and those premises are essentially two: firstly, that there will not be radical changes in the present social and international structure, although they admit some adjustments, and possible changes in the pattern of distribution of power among the

advanced countries. Secondly, that the Third World countries will be unable to take autonomous decisions that can change their mode of insertion in to the world economic order. The only exception to this assumption is one of the OECD scenarios which, based on the Latin American World Model,¹² supposes that the Third World countries will break—at least partially—their economic links with the big powers, and will implement a policy of self-reliance based on South-South co-operation.

In our opinion, these models of the future are too static and do not reflect the depth of the crisis, and the real scope of options opened by it. There are alternatives which could allow the region to benefit from the new wave of innovations.

A commonly-used classification of scenarios distinguishes *tendential* scenarios, describing a possible future assuming the persistence of recent main tendencies, from *normative* scenarios, which propose a set of possible and desirable objectives to guide actions. In our view this classification, although analytically useful, is somewhat misleading. To assume the persistence of present trends implies a decision to ignore the tendencies and potentiality of change inherent in any social system, and that decision is essentially 'normative'. The difference between the two groups of scenarios is really which type of 'norm' they use; in the tendential group, the norm is given by present trends, while in the other group, that role corresponds to a selected desirable and viable future.¹³ In our treatment of the Latin American scenarios we will use the normative approach in *sensu stricto*.

Socio-institutional changes

We will begin with food production, a central element of any Third World scenario, whose main determinant is population. The average rate of demographic growth in Latin America is about 2 per cent, which implies that the region should more than double its food production in the next thirty years, taking into account that a considerable part of the population is now underfed. Such expansion of production—based mainly on increase in productivity, rather than on the incorporation of new land—should be guided by two main objectives: to provide food for the whole population, and to increase the income of the rural worker, whose cheap labour has until now been basic to the growth of the modern sector. The second objective is to contribute to the generation of the economic surplus required for the expansion of the industrial and service sectors. The transformation of the rural areas means a radical modification of the land tenure system, and the careful selection of the technologies and methods of production to be introduced. Although the

combination of technologies and the organization of production should try to minimize migration to the cities—basically through a sustained improvement in the well-being of the peasants—the net result will be a decrease in the manpower required for rural activities, with the ensuing increase in the labour-force potentially available for the other sectors of the economy.

The key to any desirable scenario lies in ensuring that the benefits of the process induced by the wave of innovations reach the whole population. It can be estimated that more than 40 per cent of the Latin American population is outside, or almost outside, the non-staple goods market, and a considerable part of it even below an adequate level or provision of staple goods. The effective incorporation of the whole population into the market of goods and services, through a redistribution of income, represents a formidable social, economic and technological challenge. But, beside its intrinsic desirability, it is also the central component of a strategy that could allow the region to successfully confront the impact of the new innovations.

The main effect of redistributing income would be a change in the pattern of product demand, including services. The average income, which conditions the market, would be less than that in the advanced countries, and consequently the pattern of consumption of non-staple goods should be different. It would be a process similar to the one that earlier changed the pattern of goods demand in the advanced countries.

The second result of the process, by expanding the productive system, would increase employment by counterbalancing—at least in a transitional period—the effect of automatization and robotization. As in the case of agriculture, the selection and introduction of new technologies should be carefully controlled through a strategy adapted to the specific conditions of the region.

These socio-economic changes are very few, but should be present in any desirable society. Most important, they would allow the region constructively to confront the new wave of innovations. The employment impact of automation—socially, most difficult to absorb—would be delayed by the incorporation of a greater mass of population into the market. This would give Third World countries an important advantage over advanced countries. The fact that the former would have to change their patterns of consumption would give them the opportunity to adapt material consumption to a new concept of well-being, more in accordance with the resources and values of post-industrial society, where free time devoted to creative activities, and the preservation of an equilibrium with the physical environment, will be the principal characteristics. When the full impact of automation finally reaches Third World countries, this new conception of development, and the experience of the

developed countries, could help them to absorb change with a minimum of social hardship.

This revision of the concept of development will necessarily also occur in the developed countries. We hope that this convergence will lead to a new world order based on solidarity and co-operation. The road will, however, be a long and difficult one.

The scientific and technological challenge

The proposed strategy represents a great scientific and technological challenge to the Latin American countries, and the weakness of their R & D systems is often considered the main obstacle they have to confront. However, the relative backwardness of the scientific and technological capacity of the region is not a cause, but rather a *result* of socio-economic development.

Our position, developed in detail elsewhere,¹⁴ is that all countries have a science policy—explicit or implicit—which is determined by the character of its national project—i.e. the set of objectives (or model of the country) to which the social classes which have direct or indirect economic and political control aspire. History shows that when a national project demands an autonomous policy, scientific and technological backwardness is never an insurmountable obstacle, as is strongly suggested by the experiences of Japan, China and the Soviet Union.

On the other hand, new innovations offer developing countries the opportunity to enter those technological fields in their early stages of development. As it takes some time to transform innovations into transferable technological packages, this would allow, at least to the most advanced Third World countries, the development of technological versions more adapted to their own conditions and needs. This possibility is well illustrated by the success of Brazil in the arms industry.¹⁵ Through an intelligent policy of exploring the specific needs of the developing countries, Brazil has become one of the main exporters in one of the most sophisticated and competitive technological fields of the world. If applied to civilian needs, there is no reason why that strategy could not be as successful as it is now—unfortunately—in the arms race.

In a recent paper, Giovanni Dosi develops the concepts of the 'technological paradigm'—a concept parallel to Kuhn's scientific paradigm—and of 'technological trajectory', or the way the paradigm evolves.¹⁶ A technological paradigm is not a closed system whose evolution is unequivocally determined, but consists of a core of knowledge and basic technological elements which offer a variety of possible trajectories, whose direction is to a great extent determined by the social environment. The main objective of R & D systems should be the exploration of possible technological

trajectories, in order to concentrate on those best adapted to the conditions of the region. This task, given the relative weakness of private enterprise and of the R & D systems of the region, will require strong support from governments—not only in terms of financial assistance, but through well-articulated policies with clearly defined priorities.

Towards the future

The proposed strategy for the future implies the introduction of radical changes in the socio-institutional structures of the Latin American countries. The obvious question is: which are the social forces able, and willing, to implement those changes?

One of the main results of the previous long cycle was the emergence of a middle class with some characteristics without precedent in the history of capitalism. That middle class is, numerically, in developed countries and in some Third World countries, as important or more important than the proletariat. It is also the repository of practically all the scientific, technological and administrative knowledge required by society. Thirdly, most of its members are wage-earners; in other words, they have a similar position in the social structure—although with better salaries—to the proletariat.

The impact of new innovations on that middle class will be as dramatic as it will be for industrial workers. Automation is entering into services which have always been basic fields of employment for the middle class, as fast, or faster, than in industry. Automation is already replacing the routine component of professional work, and is resulting in a growing army of unemployed university graduates. Besides, the advances of telecommunications, which poses the possibility of managing and controlling production units of the multinationals located in the Third World countries from the centre, will deprive the middle class of one of its main sources of high-level professional positions.

It seems obvious that there are common interests between that middle class and a labour force which is starting to understand—above all, in its most advanced sectors—that its main problem is how to confront a process of transformation that will radically change the traditional relationship between employment, work and technology. Unless an adequate social strategy can be implemented with the support of other social forces, the process could be as traumatic for the proletariat as was the introduction of mechanization in the first stages of the industrial revolution. Whether and how that class alliance or agreement can be articulated is difficult to forecast.¹⁷

Such a combination of social actors can bring the social consensus necessary for strengthening the nation state: one of the essential

conditions for the success of Latin American countries in negotiating an equitable insertion into the emerging international order. It can also open the road to a democratic and participatory society which can mobilize the creative potential of the whole social body. In Christopher Freeman's words,

Just as an individual combines intellect, imagination, reason, feeling and intuition, so must a healthy society blend the fragmental compartments and artificial divisions in our knowledge system and our professions. Only in this way can alienated technology become human technology. Innovation is far too important to be left to scientists and technologists. It is also far too important to be left to economists or social scientists.¹⁸

Notes

1. N. D. Kondratiev, 'The Long Waves in Economic Life'; *Review of Economic Statistics*, **18** (1935), pp. 105-15.
2. J. S. Schumpeter, *Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalistic Process*, New York, McGraw Hill, 1939.
3. C. Perez, 'Structural Change and Assimilation of New Technologies in the Economic and Social Systems', *Futures*, **15** (1983), pp. 357-75.
4. *Ibid.*, p. 360.
5. A general discussion on the subject of technological innovations and long cycles can be found in *Futures*, **3**, No. 4 (August 1981), with articles by Jos Delbeke, 'Recent Long Wave Theories: a Critical Survey'; J. Tinbergen, 'Kondratiev Cycles and So-Called Long Waves: The Early Research'; J. J. Van Duijn, 'Fluctuations in Innovations Over Time'; G. Mench, C. Coutinho and K. Kaasch, 'Changing Values and the Propensity to Innovate'; A. Klein-knecht, 'Observations on the Schumpeterian Swarming of Innovations'; J. Clark, Christopher Freeman and L. Soete, 'Long Waves Inventions and Innovations'; J. W. Forrester, 'Innovation and Economic Change'; E. Mandel, 'Explaining Long Waves of Capitalistic Development'. See also Christopher Freeman, 'Long Waves and Technical Innovations', paper presented to the International Symposium on Perspectives of Science and Technology Policy, Guanajuato, Mexico, February 1984.
6. For a good analysis of present trends see R. Rothwell and Walter Zegveld, *Technological Change and Employment*, London, Frances Pinter, 1979.
7. In a conference at the International Symposium on Perspectives of Science and Technology Policies (Guanajuato, Mexico, February 1984), Dr Ricardo Petrella reported in a recent study by the FAST Programme (Forecasting and Assessment in Science and Technology) of the Commission of the EEC which suggests that the 12 million unemployed today will grow to 20 million by the end of this decade.
8. W. Zegveld, 'Technology, Employment and Work', paper presented to the International Symposium on Perspectives of Science and Technology Policy Guanajuato, Mexico, February 1984.
9. A. Gorz, *Adieu au prolétariat*, Paris, Éditions Galilée, 1981, p. 17.

10. CEPAL, *Notas sobre la Economía*, Nos. 387-8 (December 1983); A. Furtado, '1º Relatório de Andamento—Dinâmica Sócio-Econômica de América Latina', Projeto Prospectiva Tecnológica para a América Latina, São Paulo, Brazil, CEBRAP, 1984, mimeo., pp. 21-5.
11. C. Perez, *op. cit.*, note 3, pp. 368-71.
12. A. O. Herrera, *et al.*, *Catastrophe or New Society?*, Ottawa, International Development Research Centre, 1977.
13. For general reviews of the subject of forecasting and scenarios, see L. Miles, 'World Views and Scenarios'; I. Miles, S. Cole and J. Gershuny, 'Images of the Future'; S. Cole, 'The Global Futures Debate, 1965-1976'; and S. Cole and I. Miles 'Assumptions and Methods: Population Economic Development, Modelling and Technical Change' in Christopher Freeman and M. Jahoda (eds), *World Futures: The Great Debate*, London, Martin Robertson, 1978.
14. A. O. Herrera, 'Social Determinants of Science Policy' in Charles Cooper (ed.), *Science, Technology and Development*, London, Frank Cass, 1973.
15. R. Dagnino, 'Technological Prospective for Latin America, Towards a Methodology of Analysis', paper presented to the International Symposium on Perspectives of Science and Technology Policy, Guanajuato, Mexico, February 1984; and 'A Indústria de Armamentos: O Estado e a Tecnologia', *Revista Brasileira de Tecnologia*, **14** (1983), pp. 5-17.
16. G. Dosi, 'Technological Paradigms and Technological Trajectories', *Research Policy*, **11** (1982), pp. 147-62.
17. This subject has been treated by, among others, A. Tourain, *Production de la Société*, Paris, Seuil, 1977; Anthony Giddens, *A Estrutura de Classes nas Sociedades Avançadas*, Rio de Janeiro: Zahar, 1978; A. Gorz (ed.), *The Division of Labor*, New York, Humanities Press, 1976.
18. Christopher Freeman, *The Economics of Industrial Innovation*, London, Penguin, 1974, p. 309.