

THE NECESSITY OF REDUCING WORKING TIME AS A MEASURE TO ERADICATE UNEMPLOYMENT

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1. The Problem

In this paper I maintain that the most effective way to cope with the present unemployment problem is a substantial and sudden decrease in working time. I shall also show that, under certain conditions, it is even possible to reach full employment without having to cut wages and avoiding inflation.

To support my argument, in the first part of the paper I shall summarize the results of recent theoretical investigations and present some empirical evidence on the relationship between radical technical change, growth and employment in order to detect the most likely future trend for employment in Western countries (Reati 1995; 1998). It will appear that the most likely medium/long term trend for employment stemming from the diffusion of the technological revolution in computer and information technologies will be stagnation (or perhaps even a slight decline).

The problem then is how to restore full employment in a situation where the labour demand will be stationary and where, at the beginning, there is a very high number of unemployed people. I think that the solution can only be found by measures to reduce total labour supply and, subsidiarily, by developing labour intensive activities in the service sector.

II. The Prospects: Growth without employment

1. To assess the impact of present technical change two distinctions are important:

i) process and product innovations

Process innovations aim at improving production costs and the competitive position of the innovator, while product innovations intend to increase the demand for a final commodity accruing to a firm;

ii) radical and incremental innovations

Radical innovations imply a fundamental change in the prevalent method of producing (process innovations) or a completely new final commodity (product innovation). Incremental innovations refer to improvements in the existing technological base, which fundamentally remains the same, or to product differentiation for final commodities.

To understand the present situation, attention should be focused on radical innovations - the innovations which, according to historical experience, are at the origin of long waves (the so called Kondratieff cycles) of capitalist economies (Van Duijn 1983; see also the collected papers in Freeman 1996).

2. The economic analysis on the relationship between technical change and employment is well known. Here I just recall that in the case of process innovations two conflicting forces are at work: a) the productivity effect, which reduces employment; b) the compensation effect (i.e. the increase of demand resulting from the decrease in price of the commodity involved), which expands employment. Which of the two effects will prevail crucially depends on the level of price and income elasticities of demand.

On the contrary, the case of product innovations is more clear cut, in the sense that we can expect a growing employment trend both at sectoral and aggregate level. This positive outcome is nevertheless reduced when radical process innovations also extend to the manufacture of new products.¹

3. Two elements explain the likely long term future trend for output and employment: the progressive diffusion of a new technological paradigm and its pervasive nature.

(3.a) A new paradigm

The innovations in the field of computer and information technology which developed in the 1970s, in connection with the large scale application of micro-electronics, present the characteristics of a technological revolution. They are, in fact, innovations that radically change production methods in an increasing number of industries and services, making the existing plant and equipment obsolete and requiring profound organisational change in firms and institutions.

Computer and information technology was accompanied, in the Eighties, by a cluster of radical innovations. They started with the introduction of new materials (optical fibres) and products (laser), developed independently of the computer innovation, and we are now witnessing an interesting and promising combination with the computer (telematics, bio-informatics, sensors and switches). Also, the

establishment of networks between information technology-based equipment is leading to a wide creation of knowledge and know-how in the economy, which encourages the cumulative adoption of many small innovations². The present technological paradigm³ of information and communication technologies is arising from the convergence of information and computer technologies.

One of the main features of information and communication technologies is that they entail a substantial increase in the level of productivity of the innovator. According to recent micro-economic evidence concerning a representative sample of US large firms, for instance, the leap in the productivity level associated with the use of computer capital is more than 50% (Brynjolfsson and Hitt 1993).

In terms of the theory of production, this means that information and communication technologies are "dominant techniques" - i.e. techniques that, as compared with all the other alternative techniques to produce a given commodity, yield a higher rate of profit for any level of the wage rate (Pasinetti 1977, chapter 6)⁴.

(3.b) Sustained growth

In my view one point is clear: the present technological revolution will produce growth. This assessment is based on the results of Reati (1992 and 1995). In Reati (1992) I pointed out that the technological revolution in computer and information technologies, initiated in the 1970s, reproduces the long-waves mechanism, in which a cumulative process of expansion is originated by massive investment in radically new plant and equipment. Thus, most probably, we are at the eve of a new long-term expansion induced by technological change. This conclusion found a theoretical support in Reati (1995), in which I introduced long-waves into Pasinetti's model of structural change. Figure 1 (taken from Reati 1995, p.52) provides the results of a numerical simulation⁵.

But will a new long term expansion solve the problem of unemployment? A careful examination of the information and communication technologies paradigm suggests a negative answer.

..... and high unemployment

4. In fact, information and communication technologies paradigm has a historically unique characteristic, which differentiates it from the technological revolutions of the past, i.e. *pervasiveness*. Indeed, information and communication technologies are not only transforming all manufacturing sectors, but also diffuse in a substantial and growing share of services (OECD 1996). Finance, insurance, real estate, wholesale and retail trade, communications and business services now depend crucially on information and communication technologies and account,

governments do not allow these employment implications to follow through in full, then perhaps only 500,000 jobs will be shed" (ERECO 1994, p. 81).

Having, thus, outlined what is, in my view, the most likely future for employment, let us pass to examine the possible remedy.

III. The Policy Response

1. Employment policy has two main aspects:

- the measures necessitated in the normal course of events by structural change;
- the specific measures imposed by the pervasive nature of the present technological revolution.

(i) The diversified impact of technical change entails a permanent shift in the structure of employment which calls for a continuous flow of workers from contracting to expanding sectors. There is considerable scope for government action in this field. The first task is to foster the sectoral shifts in the labour force: besides disseminating appropriate information on labour market opportunities, the public authorities must provide constant retraining and skill development for the population.

(ii) Of course, the above measures are not sufficient to achieve full employment because we are starting from a situation of high unemployment, and the most likely outcome is a further deterioration due to pervasive radical technical change. In this context, the only solution that could strengthen social cohesion in the European Union and present it as a desirable model for its citizens is a reduction in the overall labour supply by acting on two parameters: the share of the labour force in the total population, and the share of working time in total time.

As for the first parameter, the public authorities could lengthen the period of compulsory education, encourage people to take early retirement, promote part-time work and sabbatical periods. In most European countries, the first two ways for reducing labour supply have already been widely followed and, therefore, we should not expect too much from them. Part-time employment and sabbatical periods can provide some results, but they are necessarily limited in scope⁸. There remains the reduction of working time.

2. The relationship between the reduction of working time and employment growth is easily seen by writing the identity which describes the factors determining the level of physical output at any period of time:

$$Y = L H \pi_h \quad (1)$$

Where

Y is the physical output of any commodity for a given period of time (one week, one year, etc.)

L is the number of workers

H is the individual working time for the same period of time (e.g. weekly hours per worker)⁹

π_h is the hourly productivity level: $\pi_h = Y/(L \cdot H)$

We see that, for any given level of output and productivity, employment (L) can increase by reducing the working time (H) of present workers.

Identity (1) holds at both micro and macro level, because I am considering here the phenomenon from its additive aspect (total employment is the sum of employment in individual enterprises, and it is the same for output). However, we shall see later that, when we go beyond this simple characteristic of additivity and take into account the mechanisms which determine sectoral demand, one cannot simply extrapolate the microeconomic results on the whole economy.

Box 1 provides an illustration of the microeconomic aspects. Let us consider, at the start (point A), a small enterprise employing 10 workers under normal conditions: 8 hours a day for 5 days per week for a total of 400 hours per week and an (hypothetical) output of 1200 units of commodity. Hourly productivity is thus 3 units.

In the first example (point B) I make a double assumption: (a) a relatively important reduction in working time, let us say 10%; and (b) an increase in capacity utilisation, by reducing weekly idle time for plant and equipment. Employees will thus work 36 hours per week (instead of 40) - spread over a 4 day week at 9 hours a day - while the enterprise will produce during 6 days per week (9 hours per day). Consequently, with no change in productivity (3 units per hour), the output will increase by 35% and employment by 50%. In fact, the enterprise must now engage 10 new workers for two days, which corresponds to half of the hours worked by its old employees. If another firm reduces the working time under the same conditions, the new employees would obtain a full-time job by taking a second part-time employment in this enterprise. We see that, if all enterprises of the European Union would behave like the enterprise in question, something like 40 million new jobs would be created in the market sector (EUR-15), an amount which is far bigger than present unemployment (even taking into account hidden unemployment).

Let us notice that what is considered here is just the direct employment effect. Should we take into account the overall effect (i.e. the direct plus indirect effect), the employment increase would be much larger, probably 20 to 40% higher than the direct effect.

Box 1 shows also another example (point C), where employment growth is lower (35% instead of 50%) because I assume a productivity increase by 11.1% (each worker produces 3.33 units per hour instead of 3 units). We are now seeing that this example is particularly useful for the question of wages.

3. Wages are, in fact, the *punctum dolens*: each time that trade unions ask for a reduction of working time, employers' unions and governments - if they say "yes" - add a condition: the weekly pay must be reduced proportionally to the reduction in working time. Of course, one could object that, at present, the rate of profit is very high - at the level it reached in the 1960s¹⁰ - but this argument will have no success in collective bargaining because unemployment puts workers in a weak position. We live, in fact, in a capitalist society - a society which is conceived for profits and not for men - and we cannot ignore the constraints imposed by profit.

However, if the reduction of working time goes together with an increase in productivity, it becomes simultaneously possible to satisfy a double constraint;

i) to leave unchanged the level of the individual wage (e.g. the weekly pay per worker); and

(ii) to keep constant the share of profits in value added.

Let us start from the second constraint and reason, as before, at the *microeconomic* level.

To understand the trade-off between working time, productivity, wages, growth in output and employment let us write the expression for the profit share:

$$\frac{S}{pY - p_m Y} = \frac{pY - wHL - p_m Y}{pY - p_m Y} \quad (2)$$

where

S is the mass of profits

w is the wage rate (hourly wage)

p is the unit price of output

p_m is the unit price of intermediate output (raw materials, energy, etc.).

Formula (2) can be written as follows:

$$\frac{S}{pY - p_m Y} = 1 - \frac{w}{\pi_h} \frac{1}{p - p_m} \quad (3)$$

Calculating the derivative with respect to time of formula (3) and equating it to zero (since the profit share must be constant), after some manipulations we obtain:

$$\dot{\pi} = \dot{w} \quad (4)$$

where

$\dot{\pi}$ is the (instantaneous) percentage rate of change of the wage rate

\dot{w} is the (instantaneous) percentage rate of change of productivity

This well known condition for the constancy of the profit share is indeed the result of three separate movements: a decrease in working time and an increase in employment and output. To see it precisely let us rewrite formula (3) as follows:

$$\frac{S}{pY - p_m Y} = 1 - w \frac{H L}{Y} \frac{1}{p - p_m} \quad (5)$$

Calculating, as before, the derivative, with respect to time and equating it to zero, after several passages we have:

$$\dot{w} + (-\dot{H}) + \dot{L} = \dot{Y} \quad (6)^{11}$$

where

\dot{w} is the (instantaneous) percentage change of working time

\dot{H} is the (instantaneous) percentage increase of employment

\dot{L} is the (instantaneous) percentage increase of output.

Taking into consideration formula (4) we have the following, which shows clearly the trade-off in question:

$$\dot{\pi} - \dot{H} + \dot{L} = \dot{Y} \quad (7)$$

This is illustrated by the last numerical example in Box 1 (part II, point C).

The stability of individual wage (W) implies that the percentage growth of the wage rate (w) is identical to the percentage change in working time (H). In fact:

$$\dot{W} = \dot{w} H \quad (8)$$

Derivating with respect to time (W =constant) and proceeding, as before, to obtain the (instantaneous) percentage rates of change, we have:

$$\dot{W}_{tot} = \dot{w} + \dot{H} + \dot{L} \quad (9)^{12}$$

Finally, let us note that, in this case the percentage increase of output is exactly matched by the increase of the purchasing power of employees. In fact, the

wage bill paid by the enterprise (W_{tot}) is:

$$W_{tot} = w H L \quad (10)$$

which means that:

$$\dot{w} = \dot{H} \quad (11)$$

Taking into consideration formula (6) we have:

$$\dot{W}_{tot} = \dot{Y} \quad (12)$$

4. At the *macroeconomic* level, we could perform the same reasoning and derive equations (2) to (12). Within this logical framework, we could say that, if the double constraint of the stability of individual wage and profit share is satisfied, the economic system could enter into a virtuous circle of self-fulfilling expectations. Capitalists know, in fact, that if they increase their output, the mass of wages will increase correspondingly (equation 12) and the same holds for and the mass of profits; consequently, they will expect and increase in demand.

However, we shall see in section III that things are not so simple. But, before proceeding further, let us draw some first conclusions.

5. The previous analysis shows that the reduction of working time can solve the unemployment problem without creating difficulties on the income distribution side, provided that five conditions are fulfilled. Such a reduction must:

- (a) be important;
- (b) be sudden;
- (c) involve a large part of the economy;
- (d) be coupled with an increase in the degree of capital utilisation;
- (e) be concomitant with an increase in productivity.

The first and second conditions guarantee the effectiveness of the measure from the point of view of job creation. In fact, if the reduction of working time were not important and, moreover, if it were implemented gradually, enterprises could adapt themselves to the new situation either by trying to increase their productivity or by accepting a lower level of output, without hiring new workers.

The fourth and fifth conditions are of particular momentum, since we have seen that they allow to solve the problem of the conflict between profits and wages. Within this framework, it is essential that firms not producing around the

clock reduce the working time for their present employees from 5 to 4 days per week, since this reorganisation favours the hiring of new personnel.

IV. Discussion

Several difficulties arise. Before addressing them, let us clarify one point concerning productivity.

1. The numerical example above points out that productivity growth must be large (11.1% in this case), and one can wonder whether such an hypothesis is realistic in the present circumstances¹³. The reply is positive, because enterprises adopting radical process innovations experience a substantial leap in their productivity level. For instance, according to a recent microeconomic study of a representative sample of large American corporations, the introduction of computer capital increased the productivity level by more than 50% (Bryniolfsson and Hitt 1993).

However, at the sectoral level the increase in productivity is more gradual, since it depends on the pattern and length of the diffusion of technical change: enterprises of the same industry do not adopt simultaneously the new technology, in such a way that it normally takes 10-15 years for the new technique to completely substitute the old one. This means that an important and sudden reduction of the working time can be feasible only for the innovators; therefore, we should wait several years before the reduction in cause is spread to the whole sector¹⁴.

2. Problems arise on the demand side.

Formula (12) shows that, if all the enterprises of an economic system reduce the working time, at a global level, the growth of output is exactly matched by an identical percentage increase of the purchasing power of wage earners. For instance, in the numerical example of Box 1 both output and wages grow by 35%. Apparently, there are no problems; however, this is a case where my previous arithmetic is simplistic.

Indeed, if *global* demand grows at the same rate as output, this does not mean that for all *sectors* (and all enterprises) the growth of demand for their commodities will be exactly equal to the potential increase of their output. In fact, when *per capita* income grows, the demand for different categories of goods increases at a rate which is different from the rate of increase of income. This is an old result of economic theory, known as Engel's Law. For subsistence goods (food and other necessities), the growth of demand is less than the percentage growth

of *per capita* income; for all the other commodities, demand growth exceeds or is below the growth of income according to the different categories of goods. In other words, in an economy where there is technical change, the growth of the various sectors is non proportional (for a complete model of structural change see Pasinetti (1981)). For our problem this means that the reduction of working time should be modulated, according to the sectoral perspectives of demand, and this could drastically reduce the possibility of increasing employment in some sectors on the basis of the above mechanism.

Of course, this does not mean that the reduction of working time to absorb unemployment is not feasible, but rather that it requires a public intervention on the form of some fiscal incentive. It is worth mentioning, at this purpose, the French law de Robien, which was approved on June 1996 under the previous (conservative) government. The law grants a considerable reduction of employers' social security contributions for seven consecutive years to enterprises which reduce substantially the working time (by 10 or 15%) and that increase employment by the same percentage amount¹⁵. When the reduction in working time is 10%, the cut in social security contributions is 40%, for the first year, and 30% for the following years; it becomes respectively 50% and 40%, when the working time is reduced by 15% (and employment increased by 15%). A recent econometric estimate, by the semi-official body OFCE (Timbeau 1997), shows that this measure is very promising. In fact, a generalised cut of working time by 10% could generate two millions permanent new jobs - and a decrease of 1.5 million in the number of unemployed - with a relatively modest increase in net borrowing of General Government (a supplementary 2.2% of GDP in 1996).

3. Other obstacles come from the profound *reorganisation of enterprises* as well as by the *flexibility of labour* that is required by the reduction of working time. For instance, managers do not always dispose of the skills to implement the changes in the organisation of their company and, moreover, they could not necessarily find enough financial incentives for doing this.

Some resistance to change could also arise from workers, because a large share of employees will be obliged to accept two part-time jobs and to work on Saturday. However, it should not be too hard to get rid of such a resistance, because the flexibility which is required is a "positive" one, which is directly linked with an increase in employment. This is completely different from flexibility in the current (neoclassical) sense, whose primary goal is to submit workers to the requirements of profit by job precarization, wage cuts, reduced social protection and easy dismissals.

4. A *cultural* change is also required, which concerns both the working environment and leisure.

Within the enterprise, a reduction of working time imposes a change of mentalities to managers as well as to employees, since everybody has to work with an increased number of colleagues. This would be particularly hard to accept for managers, who will have to share with somebody else part of their supervisory functions.

On the other hand, an increased spare time presents the problem of its good use, because one should avoid to pass from the "empty" time of unemployment to "empty" leisure. Thus, there is a thorough personal effort to reorganise their own activity and, also, an effort at the society level to offer sufficient opportunities at the cultural and social participation level.

5. The reduction of working time poses a formidable challenge in the field of *education* and *vocational training*.

The overwhelming majority of new jobs will be linked - directly or indirectly - with the information and communication technologies: the new demand for labour will, thus, concern qualified labour. Or, for a big share of present unemployed people (particularly elderly and long-term unemployed), there is a large gap between their skills and what is required by the new jobs. There is here a serious bottleneck, which could be overcome only at a price of huge investments by public authorities and serious efforts from the individuals involved.

V. The "Hard Core" of Unemployment

1. Even if, in theory, the reduction of working time could allow a complete absorption of present unemployment, there is a certain number of unemployed people who will never find a job, thanks to the measure in question. Unfortunately, this "hard core" of unemployment exceeds largely the 1.5-2% unemployment rate, which characterised the full employment situation of the 1960s. This for a double reason.

Firstly, because - even if the training facilities for the new technologies were sufficiently available - not all the unemployed persons have the capabilities to be recycled. To this, one should add the destruction of personality produced by the long periods of inactivity. It is well known that, after one year's unemployment, a worker becomes hardly employable and that, after two years, the capability of being reinserted in an enterprise is almost nil¹⁶. What solutions can we envisage?

2. For the unemployed persons who are still susceptible to be reinserted in the productive flow, governments should create jobs in the "third sector" (the "social utility" sector), a sphere which at present is very much underdeveloped, in spite of the fact that there exists a huge unsatisfied demand¹⁷. One can refer, just to provide some examples, to the following activities: environmental protection, support to persons suffering from social difficulties, creation of networks for exchanging knowledge, remedial teaching, family help, development of forms of integration of immigrants (elimination of illiteracy, legal advice, assistance for the administrative procedures, multi-cultural events), set-up of micro-projects for North-South cooperation, initiatives to combat social exclusion in all its forms, etc.. For France, Cette *et al.* (1993) estimated that public incentives in these fields could generate (directly and indirectly) more than 350,000 new jobs in a five years period. A similar estimation, sponsored by the European Commission (1995) for three countries, (France, Germany and UK) found a (direct and indirect) potential of 1,009,000 new jobs, to be created in four years' time (235,000 in France, 164,000 in the UK and 610,000 in Germany).

Also in this field a cultural change is required, because it is necessary to switch from the usual narrow definition of employment, as wage-earner, in the market sector of the economy to the notion of socially useful and socially recognised activity. This social acknowledgement of an activity implies that these new community workers will benefit of the same legal status of ordinary employees of the market sector: minimum wage, paid holidays, social contributions and benefits, union representation, application of laws concerning dismissal.

A major problem arises: how to finance such activities? A thorough treatment of this point goes beyond the limits of this paper. I would just observe that the reduction of working time that I am suggesting here produces a strong acceleration of growth that will provide to households and to the State the means to satisfy the demand for the new services.

3. It remains the problem of the unemployed who are not employable, for whom the State must guarantee a socially acceptable income and social benefits.

VI. Conclusion

1. In the first part of this paper I argued that the most likely medium/long term trend for employment stemming from the diffusion of the technological revolution in computer and information technologies will be stagnation (or perhaps even a slight decline). This is because the present technical change in processes

has an historically unique characteristic, which differentiates it from the technological revolutions of the past, i.e. pervasiveness. The new technology covers not only the whole industry, but also a substantial and growing part of services. Thus, we cannot expect that - as in the past - the service sector will absorb the manpower shaken out by industry.

Of course, product innovations could redress such a situation, but, unfortunately, the scene is dominated by process innovations and - in spite of the many potentialities which exist - there are no signs that the situation will reverse in the next few years (let us say five to ten years).

In this context, the compulsory path to restore full employment is a reduction of total labour supply, mainly through the reduction of working time.

2. In the second part of the paper, I have presented a numerical example to show that the reduction of working time is potentially able to solve the unemployment problem. This possibility - which already appears when considering the *direct* employment effect - is strongly reinforced when we take into account the overall (direct plus indirect) effect of the suggested measure.

To be effective, the reduction of working time should fulfil a number of conditions: it should be important (for instance, the weekly working time should be cut by 10%), it should be enforced suddenly, it should concern a substantial part of the economy and, above all, it should go together with an increase of the rate of capacity utilisation, by a lengthening of the weekly running time of plants (e.g. from 5 to 6 days per week). If this is coupled with a productivity growth (a modernisation of present production structure by the adoption of new technologies), it would even be possible to avoid conflicts on income distribution because the increase of employment could be obtained without cutting wages.

What precedes implies that, for some sectors (those adopting radical technical change by means of computer and information technologies and which benefit from strong demand), it is technically possible to attain the above objectives for employment and income. No public incentives are needed, but enterprises have to overcome the cultural and organisational obstacles which arise every time that a substantial reduction of working time is envisaged. Considering that one of the main characteristics of information technologies is pervasiveness, the share of the economy that is susceptible to benefit of that possibility is large and rapidly growing.

For enterprises and sectors which are left aside from radical technical change and which face a weak demand, it will be necessary to provide some fiscal incentives. Some interesting proposals are available (Rocard 1996; Larrouturou 1995) and, also, a promising experience has been initiated in France with the de

Robien's law.

3. As just mentioned, several obstacles make difficult a generalised reduction of working time. They belong to culture, mentalities as well as to lack of managerial skills. In particular, the measure in question requires an enormous effort from public authorities in the field of education, to upgrade the skills of unemployed people in order to meet the demand for new jobs.

Another serious obstacle arises from demand. If, at the macroeconomic level, the increase in output which results from the increase in capacity utilisation is exactly matched by the increase in the purchasing power of households, for some sectors there will be a discrepancy between the potential increase of their output and the development of the specific demand for their commodities. In this case too, the fiscal levy could be useful.

4. In conclusion, contrary to the well known thesis which links the solution of the unemployment problem to the growth of output, in this paper I have tried to show that it is rather the inverse which is true. In fact, it is the reduction of working time, which will induce the growth of output and employment and, moreover, with growth, public authorities will dispose of the resources to finance the social activities (the "third sector") which could provide a job for those who will be excluded from the development of the market sector.

NOTES

- * Commission of the European Communities, Directorate-General for Economic Affairs, Brussels. The opinions expressed here are my sole responsibility and do not involve at all the European Commission.
- 1 For a theoretical development of all this see Reati (1995)
 - 2 Biotechnology is at least as revolutionary as the computer and micro-processors. Its potential impact in agriculture is enormous, as genetically transformed plants could solve the famine problem of the Third World. In industry, the scope for biotechnology is more restricted, even though production methods in a wide range of sectors, such as pharmaceutical, chemicals, food and drinks, will change drastically and it could also be possible to apply biotechnology to mineral extraction. However, it is quite unlikely that biotechnology could be the basis for a technological revolution to put the economy on a new long term growth path because it is not yet perfected. For industry and services of the industrialised countries, most of the far-reaching innovations derived from biotechnology will probably be implemented at the beginning of the next century, when the microelectronics paradigm has already become established and has produced its economic effects.
 - 3 "Technological paradigm" is taken here by analogy with the scientific paradigm in the Kuhn sense, "as a model and a pattern of solution of selected technological problems, based on selected principles derived from natural sciences and on selected material technologies" (Dosi, G. 1984, p. 83). In other words, the technological paradigm refers to "the prevailing engineering and managerial common sense for best productivity and most profitable practice, which is applicable in almost any industry" (Freeman and Perez, 1988, p. 48).
 - 4 Or a higher wage rate for any level of the rate of profit
 - 5 The simulation is based on the following assumptions:
 - (i) radical innovations appear in the final sector i as well as in the capital goods sector k_i ;
 - (ii) the technological revolution materialises in one-shot increase of 30% of the productivity level of the innovator; after this leap, the enterprise in question implements only incremental innovations, entailing a 1% increase in productivity per year;
 - (iii) the diffusion function is a logistic and the diffusion of innovations within a sector takes 15 years to be complete;
 - (iv) the price and income elasticities of demand for the final commodity are 0.5;
 - (v) the degree of mechanisation of the final sector is "medium", in the sense that the share of direct labour incorporated into commodity i is 40%.
 - 6 Figure 3 is based on the same assumption as figure 2 on technical change and its diffusion. See footnote 10 above.
 - 7 Chapter VI: "*Privatisation in Europe*" (by I. Moore, Cambridge Econometrics) of ERECO (1994).
 - 8 Of course, part-time jobs must be chosen and not imposed.

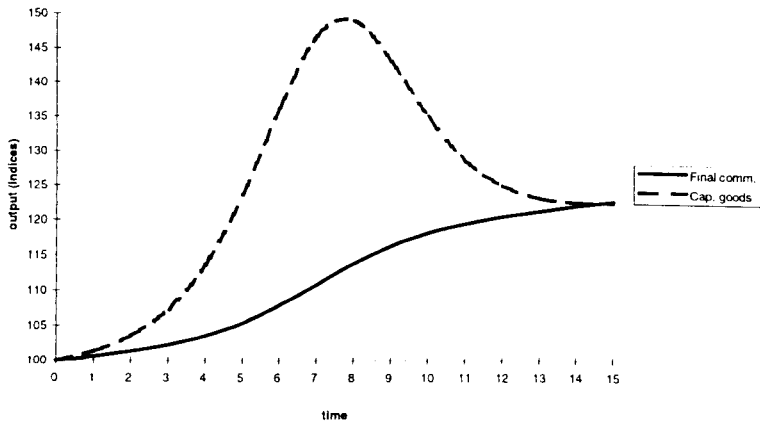
- ⁹ Note that, in the numerical example of box 1 below, H refers to the length of the working day.
- ¹⁰ See, for instance, EUROPEAN COMMISSION (1997, Fig 9).
- ¹¹ The sign minus referring to H is because, by assumption, there is a reduction of working time ($dH/dt < 0$)
- ¹² In the second part of Box 1 (point C) the percentage increase of the wage rate (11.1%) is higher than the percentage reduction of working time (10%), because equation (9) holds only for small changes (the instantaneous percentage changes).
- ¹³ Note that the 11.1% increase is one shot and not per annum.
- ¹⁴ It is in this sense that it should be modified the proposal of those who suggest to gradually reduce the working time, at the same pace as the growth of the productivity of total economy (cf. Jossa 1996).
- ¹⁵ The new personnel must be kept for at least two years.
- ¹⁶ Neoclassical economists have smuggled the idea of a "natural" rate of unemployment. However, there is nothing "natural" or inescapable in unemployment, which is rather the sign of a bad performance of the system. The adjective "natural" is thus very misleading.
- ¹⁷ I follow here the report by Europe 99 (1993). For similar proposals see Rifkin (1995) and Lughini (1995).

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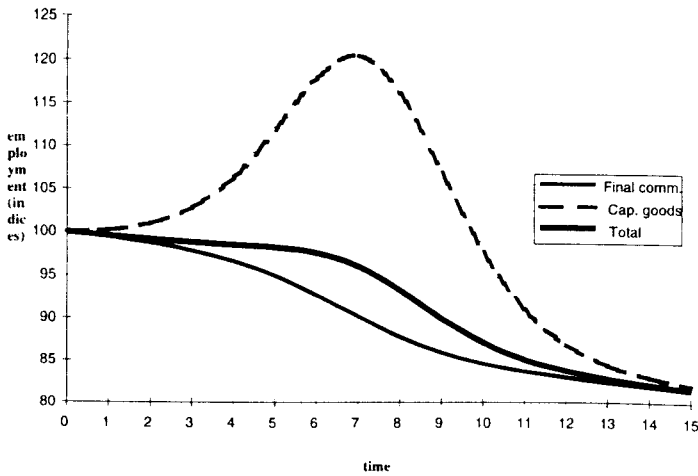
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Fig. 3: Physical output



price and income elasticities of demand = 0.5;
 technical change in both sectors (pervasive technical change)

Fig. 4: Pervasive technical change and employment



(price and income elasticities of demand = 0.5)

Box 1 (*)*The effects of the reduction of working time***(I) Employment***(A) The situation at the start*

working hours for the enterprise: $10 L \times 8 H/d \times 5 d = 400 \text{ h/week}$

(L = number of workers; H = hours; d = days)

π_h (hourly productivity): 3 units

Weekly output (Y)

1200 units

(B) Reduction of working time by 10% and lengthening of the working time for the enterprise

working hours for the enterprise:

present workers: $10 L \times 9 H/d \times 4 d = 360 \text{ h/week}$

new workers: $10 L \times 9 H/d \times 2 d = \underline{180 \text{ h/week}}$ tot. 540h/week

π_h (hourly productivity): 3 units

Weekly output (Y)

1620 units

(C) Reduction of working time by 10%, lengthening of the working time for the enterprise and increase in productivity by 11,1%

working hours for the enterprise:

present workers: $10 L \times 9 H/d \times 4 d = 360 \text{ h/week}$

new workers: $7 L \times 9 H/d \times 2 d = \underline{126 \text{ h/week}}$ tot. 486 h/week

π_h (hourly productivity): 3,33 units

Weekly output (Y)

1620 units

(*) I thank A. Dramais for suggesting to me this example

The effects of the reduction of working time

(II) Costs and profits

selling price of the commodity (p), 5 ecu
 other costs per unit of output (raw materials, energy, etc.) (pm) 2 ecu

(A) Situation at the start

labour costs per week (400 h x 6 ecu/h) 2 400 ecu
 (wage rate: 6 ecu per hour)
 other costs (2 ecu x 1200 units) 2 400 ecu tot. 4800 ecu

 revenues (5 ecu x 1200 units) 6 000 ecu
 profit (S) 1 200 ecu

weekly wage per worker: 40 h. x 6 ecu/h = 240 ecu/week
 labour cost per unit of output 2 ecu
 profit share 33,33%

(B) Reduction of working time keeping unchanged the weekly wage

labour cost per week:
 present workers: 10 L x 240 ecu 2 400 ecu
 new workers: 10 L x 120 ecu (2 days): 1 200 ecu tot. 3 600 e-
 cu
 other costs: 2 ecu x 1620 units 3 240 ecu
 total costs 6 840 ecu
 revenue: 5 ecu x 1620 units 8 100 ecu
 profit (S) 1 260 ecu

 wage rate (w) 6.67 ecu
 labour cost per unit of output 2.22 ecu
 profit share 25,9%

(C) Reduction of working time, 11.1% increase in productivity and weekly wage unchanged

labour costs per week:

present workers: 10 L x 240 ecu	2 400 ecu	
new workers: 7 L x 120 ecu (2 days):	<u>840 ecu</u>	tot. 3 240 ecu
other costs: 2 ecu x 1620 units		<u>3 240 ecu</u>
total costs	6 480 ecu	
revenue: 5 ecu x 1620 units	8 100 ecu	
profit	1 620 ecu	
wage rate (w)	6.67 ecu	
labour cost per unit of output	2 ecu	
profit share	33,33%	