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Factory discipline, health and externalities in the reduction of working time in nineteenth century France

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The role played by health considerations in the reduction of working time in nineteenth century France has been largely overlooked. This paper sets out to demonstrate their importance. Section 2 documents health deterioration in the workplace. Section 3 argues that the worsening of living conditions is a negative externality suffered by workers. It arises out of 'factory discipline' and inter-firm competition. Section 4 highlights one of the necessary conditions for any reduction in this externality: the recognition by both employers and workers of the long-term health effects of the prevailing working conditions. Physicians played a decisive role in this change. Section 5 concludes.

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JEL classification: J22, J28, H23

1. Introduction

Working time was reduced in most European countries over the course of the nineteenth century, despite the prevailing context of increasing real wages.[1] What economic mechanisms and social processes were responsible for this

[1] According to Marchand and Thélot (1997), the period from 1835 to the present day is 'unique in history', for it has been characterized by 'a very considerable reduction in working time' from 3000 h per year at the beginning of this period to 1630 h in 1995, with the downward trend being more particularly pronounced from 'the beginning of the 1880s onwards'. However, these data are not based on new sources, but on estimations in the function of production. So doing, the fact that they are consistent in their trend with those of Maddison (1991), although the level of the latter is lower, does not prove anything about the evolution of the duration of labour. It only shows that the specification of the function of production is compatible with the Maddison's results.

phenomenon? According to the standard theory, working time declined spontaneously, as the result of an optimal allocation of productivity gains achieved during the same period (Levy-Leboyer and Bourguignon, 1985; Mitchell, 1988; Scholliers and Zamagni, 1995). Moreover, the liberal position (Ashton, 1949) maintained that the Industrial Revolution improved not only real wages, but also workers' living standards, which have been rising since 1820.[2] Lindert and Williamson (1983) reinforced this thesis. These authors produced new statistical series on manual workers' pay in Great Britain between 1755 and 1851,[3] showing that living standards rose significantly during the first Industrial Revolution (for an interesting criticism of this thesis, cf. Feinstein, 1988, 1998; Mokyr, 1988). One of the arguments is based on the fact that towns and cities attracted individuals because wages were higher than in the countryside. For Williamson (1981), this wage gap is a measure of 'urban' or 'industrial disamenities'. However, Lindert and Williamson's thesis has been criticized first in strictly economic terms, in particular by Mokyr (1988), who argued as follows. If Lindert and Williamson's revision wage series is right, the evolution of consumption should tend in the same direction. Mokyr established that living standards—measured by the consumption of tea and sugar—actually remained unchanged from 1815 to 1840. Second, criticisms of the standard argument arose outside the economic paradigm. For some researchers, living standards cannot be accurately measured without taking indicators of well-being into consideration. From this perspective, scholars reached the conclusion that living standards had declined. Moreover, many recent studies (Weir, 1997; Steckel and Floud, 1997) based on anthropometrical or demographic indicators (such as size and mortality) documented the worsening of workers' health in France.[4] Georges Boyer (1998) also emphasized the contradiction between the growth in real wages and the deterioration in health indicators. Moreover, Engerman (1994, pp. 60–1, 1997) having taken all necessary precautions to ascertain exactly what a change in height signifies (it may be the result of changes in diet, but also in work intensity and environmental health), stressed the fall in average heights during the period of strong wage growth, from 1850 onwards. From the perspective adopted by the standard papers, the only relevant dimension is the economic one.

[2] This article was subsequently republished in a book edited by Hayek in 1954.

[3] The new statistical series were based on the exploitation of a new source 'The House of Commons' Account and Papers'. They mainly concerned about the occupational services.

[4] This critical approach has affinities with the analyses of Marx, who used size as a possible indicator of subsistence level in the *Critique of Political Economy*. Huck (1995) showed that infant mortality in the towns and cities of Northern England increased between 1813 and 1846.

Can this model account for the reduction in working time during the second part of the nineteenth century in France?

Our thesis is that the standard theory does not provide a fair understanding of the working time trend during the nineteenth century in France. We shall point up another interpretation, which focuses on workers' health. On the one hand, physicians established reports that reached the conclusion of a worsening of workers' health. In particular, Villermé's report alerted the political power, and contributed to set up the well-known 'pauperism question'. On the other hand, a growing part of the employers understood their own interests in having a more productive labour force. These two arguments deal with the present debate concerning the sources of the economic change. More precisely, are the actors involved in a change, outside the social relations, or are they inside them? It is obvious that the role played by physicians constituted a necessary condition for a change in employers' management of workers. Although there were important externalities to employment relationship, agents who set and impulse the change in motion—the physicians—were not themselves involved in this relationship. The change studied in this article shows that it may have come from outside the economic world.

Going back to history allows us to improve our understanding of the present situation in European countries, characterized by working time flexibility. To what extent do changes in labour contracts and working conditions (flexible teamwork, reduction in the number of hierarchical layers, performance-related pay systems, working from home) represent a return to the liberal policies of the nineteenth century? Although working hours are shorter than before, according to the European Foundation for the Improvement of Living and Working (2000, 2004), the new organizational practices induced by working time flexibility account for the increase in labour intensification. Since 1996, burnout and musculoskeletal disorders have risen in most European countries (Askenazy *et al.*, 2002).

The rest of the paper is organized as follows. Section 2 documents health deterioration in the workplace. We will refer to some European findings, which are also relevant for France. Section 3 argues that health deterioration is a negative externality suffered by workers. It arises out of inter-firm competition and 'factory discipline', which developed during the Industrial Revolution. The employers dictated when and how working time was effected. Workers faced a 'Hobson's choice' between compliance and job resignation. Factory discipline took over from workshops or 'manufactories' where workers controlled their own hours, work pace and conduct (Clark, 1994). Following most of the historians such as Michelle Perrot (1978) and Gregory Clark (1994), we hypothesize that factory discipline was the prevailing organizational model of firms. Indeed, we believe it was one of the visible faces of the 'disciplinary societies' analysed

by Michel Foucault (1975). Factory discipline was imposed through a series of convergent micro-processes, which were first applied in schools, hospitals and the army, and then in factories, in a more discreet fashion. Factory discipline was not the employers' policy alone, nor did it depend on Civil Law or the establishment of Labour Law (Table 1). Rather, it was grounded on the power embodied in a number of different institutions, including family, education system and police,[5] and which was reflected in tight surveillance of space and control of working time. Section 4 analyses one of the necessary conditions for any reduction in this externality. Both employers and workers had to recognize the long-term health effects of the prevailing working conditions. Section 5 concludes.

2. Overwork and health deterioration: basic facts

The immediate and most visible consequence of the working day was 'exhaustion through work' that the physician Villermé (1840) highlighted in the case of France. A combination of factors related to industrialization contributed to health deterioration: the length of the working day combined with harmful working conditions, but also insalubrious dwellings in the polluted neighbourhood of factories, insufficient and poor quality food, little access to health care and excessive alcohol consumption.

Occupational injuries are a direct measure of the health consequences of overwork. The physician Ilia Sachnine's (1900) work gave an accurate observation. Using occupational injuries data compiled by insurance companies, she calculated that the number of occupational injuries increased at the end of the day or at the end of the week.

Illness and disease[6] rose with overwork to such an extent that they became a preoccupation for physicians. In 1822, the French physician Patisser followed Bernardo Ramazzini's works *De morbe artificum diatriba* (1713) on occupational illnesses caused by dusts, fumes, smokes and other by products of chemical processes. He published a treatise on industrial illnesses. Phthisis was a consequence of working in the preparation of cotton fibres. Rheumatism was common among wool pickers, who often worked in water or very humid areas (Villermé, 1839; Sachnine, 1900; Bertillon, 1913). However, the idea of occupational disease is not easy to assess empirically, because workers did not keep the same jobs during their whole lives. Furthermore, a major problem deals with

[5] In this regard, the 'Work Book' introduced in 1803 and abolished in 1890, was a prototype for police control over labour. Cf. Germe (1978).

[6] Cf. Sachnine (1900). Describing the 'weavers' hell', Bonneff (1908) observed that in Lille, a major centre of the textile industry, 'Deaths from tuberculosis account for 25% of all deaths'.

Table 1 Chronology of French Labour Law (1803–1900)

Dates	Subject	Effectiveness of the Law
Law of 13 April 1803	Law establishing the *Work Book* (*Livret ouvrier*): labour control through the obligation made to the workers to give their civil status, the date of hiring and of departure. This system was under police supervision	Yes. It was an obligatory for the workers to give it to the next employer
Law of 26 August 1806	Law establishing the *Conseil des Prud'hommes* in Lyon (labour conflicts courts)	Yes
Decree of 3 January 1813	Prohibition of work by children under 10 years of age in mines	
Law of 18 November 1814	Law on Sunday rest	Yes, in industry. No, in retail trade
Law of 22 March 1841	Children's protection Act regulating hours of work	No because they were no factory inspectors to enforce the rule
Decree of 22 march 1848	Adults: reduction of working day by 1 h repealed by the decree of 9 September. The working day is of 12 h	
Decree of 17 May 1851	Organization of overtime by departures from the law	Yes
1866	Congress of First International demands 8 h day	
Law of 19 May 1874	Children's protection improved. Protection of women under 21 years of age. Law introducing the beginning of a Labour Inspection	The effect of the law was nearly nil because there were only 15 inspectors for all the country
Law of 12 July 1890	Repeal of the law on Sunday rest that will be reestablished in 1906	It depended on the local usages and the employers' religious nature
Law of 1890	Law ending *Work Book* system	Yes
Law on 2 November 1892	Factory Act on children's and women's employment and establishing Labour Inspectorate in its modern form. Prohibition of night-work for children	More than in 1872 because of the transformation of Labour Inspection
Law of 1900	Limitation on working day to 10 h	Yes in the big industry: a survey conducted in 1893–96 showed that the mean of the working day was around 10 h

the 'selection bias', owing to the self-selection effect that Bertillon (1899) observed without being able to resolve (because of the lack of knowledge in this kind of statistical problem). Workers who decided to become coal miners were among the strongest and the healthiest. In some cases, they ultimately died older than other employees did. Towards the end of the century, statistical studies attempted to link mortality rates and working conditions. According to Blum (1990), W. Farr (1877) in England and J. Bertillon (1891) in France produced the first important studies. They set out to demonstrate a relationship between mortality rates by occupation and working conditions. However, it was Huber (1912) who obtained the most convincing results. First, his detailed study of mortality rates by age group and occupation showed that these rates were very stable. This means that the effect of occupation is real. Second, he made clear that some occupations were more dangerous than others were due to well-known reasons (lead workers have a mortality rate up to 80% higher than the mean of their age group for male workers). Some professions were unexpectedly less concerned: the mortality rates of coal miners and of a proportion of textile industry workers were lower than the mean rate. Two main explanations may be advanced. First, the selection bias, described above, plays a role. Second, by the end of the century, mining and textile industries had benefited more than other industries from improvements in working conditions. Despite these few exceptions, it is still relevant to use occupational mortality rates as an approximation of the consequences of poor working conditions and long working days. Similarly, the variation in mortality rates is the most usual way to characterize differences in well-being on a non-economic basis.

At the national level, this rate had declined smoothly during the nineteenth century, in comparison to the falls that occurred earlier (during the second half of the eighteenth century) and later (during the twentieth century). Life expectancy had been almost stagnant: around 38 years for men after the Napoleonic wars, 40 years after 1870. This stagnation occurred despite periods of rapid industrial growth, such as during the years 1860–69. The same pattern prevailed in most industrializing countries (Steckel and Floud, 1997). For example, in the United States, life expectancy for men aged 20 years fell from 47 years at the beginning of the century to 41 years in the 1850s (Pope, 1992, quoted by Costa and Steckel, 1997, p. 51).

In all countries, during industrialization, mortality rates were higher in cities than in rural areas. According to M. Haines's (1989) study, in 1841, life expectancy was up to 40.2 years for men in England and Wales, 44 years in Surrey, a rural and farming county, but only up to 35 years in London, 25 in Liverpool and 24 in Manchester. In France, Weir (1997, pp. 178–9) pointed up a rise in

the differential of mortality rates between urban and rural areas during the early nineteenth century.

There is a tradition of research, which uses height and army exemption rates, rather than economic variables such as GNP per capita, to assess health aspects of human welfare (Aron *et al.*, 1972; Floud *et al.*, 1990; Steckel and Floud, 1997). These studies of human growth, called auxological epidemiology, began in the 1820s in France with Villermé's (1829) analysis of the heights of soldiers and continued in England, with the physician Edwin Chadwick's (1842) *Report on the Sanitary Condition of Labouring Population in Great Britain*. Comparing the heights of soldiers in France and in Holland, Villermé concluded that poverty was much more important than climate in the determination of growth. In France, Michelle Perrot (1973) stressed the very poor results recorded by army review committees in the textile regions. In 1879, the exemption rate was as high as 18% in some cantons, compared with a national average of 11%. According to Paul Pic (1930, p. 474, note 2), this situation seems to have been persistent: in about 1898, in Mulhouse, a town well known for its paternalism, 100 conscripts were adjudged fit for military service while 166, or 62%, were classed as unfit. From another point of view, Weir (1997) reported that in order to recruit enough soldiers, the army twice reduced the minimum height required (first from 1.55 to 1.54 m in 1830, then, after a rise up to 1.56 m, back down to 1.54 m in 1872). However, it is obvious that working hours were not the only cause of this physical exhaustion (or the difficulty encountered by the army in finding recruits). The Crimean war, for example, had a large impact during the middle of the 1850s.

In Great Britain, Floud *et al.* (1990, pp. 136–54) have shown that the average height of successive birth cohorts of military recruits declined between 1820 and 1840. Riggs (1994, pp. 70–3) reached a similar conclusion, observing a decline in the average heights of Scottish men and women.[7] Floud *et al.* (1990, p. 62) have also reconstituted the rejection rates between 1868 and 1908 at a national level. This rate varied between 37.6% in 1876 and 28.2% in 1908, and reached peaks in 1887 and 1888 with 45.6 and 45.9%, respectively.

Alcoholism was another consequence of excessive working hours. This widespread phenomenon preoccupied physicians throughout the century. Part of the attention given to alcoholism was due to its moral dimension. Moreover, it was easy to blame the workers themselves (in fact, this served as a reason to argue for low wages, since a higher wage would only mean more spending on alcoholic beverages).

[7] Riggs (1994) quoted by Floud and Harris (1997), p. 103.

3. Long working days: a source of external effects

3.1 The notion of externality

The lasting and cumulative effect of very long working days and of increasingly harsh working conditions became more and more evident. This was reflected overall in a deterioration of the health of a growing proportion of workers. The situation was not unlike the effects of pollution on people living close to a factory, a classic example of a negative external effect. To what extent can one apply the notion of externality to work, and its effects on workers' health?

In the standard conceptual framework (Laffont, 1970), an externality is said to exist when an agent's action directly influences the interests of another without being accompanied by a contractual, market exchange. In other words, agent A's behaviour affects agent B's well-being either positively or negatively without any agreement between A and B, and without B receiving or making any payment for the prejudice or the advantage resulting from A's behaviour. Meade (1954) gives the example of the beekeeper whose bees benefit a farmer's orchard and *vice versa*; Pigou cites the cornfields that are burnt by the ash and cinders from passing steam trains. Another example would be the noise pollution caused by a neighbour playing excessively loud music. In order to restore harmonious and efficient relations, Coase (1960) suggests that the best solution consists in establishing contractual conditions and that, provided the transaction costs are not too high, such an economic contract between the two agents is far preferable to enacting legislation or introducing an order banning the undesirable action or behaviour.

One obvious characteristic of the relationship between an employer and a worker is its contractual nature, which, according to the standard theory, should exclude any possible externalities. However, there are two scenarios, in which an employment contract does in fact generate negative externalities. The first occurs when workers have little scope for bargaining on working hours and working conditions. Having to choose between the current working conditions with the potential dangers to their health, and not having a job at all, workers are not in a position to protect their own interests. The second scenario appears when wages do not provide adequate compensation for the negative utility generated by working conditions. Wage compensation refers to the wage level that compensates for unhealthy working conditions. Higher wages may make it possible to repair the damage of hard work, or at least, lead to a satisfactory level of consumption that would make it worthwhile to jeopardize one's health at work. Mishan (1965) showed that externalities arise when an agent suffers from an 'unpaid factor', but they may also occur when there is an 'underpaid factor'. The following section is devoted to the demonstration of these two facts. It is a very difficult task to prove that industrial workers did not find factory wages

sufficiently attractive to justify sacrificing their health. In a sense, wages in factories were indeed higher than in rural areas, and workers left the countryside precisely for this reason. However, it is also true that those who left rural areas were among the poorest and, therefore, the most vulnerable. They accepted working conditions over which they had little, if any control, as we shall now see.

3.2 'Factory discipline' or the unilateral fixing of working hours and working conditions

Workers had little opportunity to refuse work in the hope of getting a better job. Their situation contrasted with that of their masters, to say the least. As Jean-Baptiste Say remarked in his *Traité d'économie politique*, '[...] the master says to the worker who refuses to work at a low wage: ''you're fired'' and he thinks to himself: hunger will bring him back'. This reasoning was common, and factory masters succeeded many times in pushing workers to a dreadful state of misery where their health declined. Masters, whatever the newspaper *Les Débats* said, were able to impose their will in a discretionary fashion; hunger acted as their lever. Adam Smith recognized this fact when he said: 'In the long run, the workman may be as necessary to his master as his master is to him; but the necessity is not so immediate'.

Workers negotiated their contracts individually and were unable to alter their working hours or working conditions, which were the same for all employees in the factory. This point has been emphasized by Feinstein (1988, p. 649).

The genuinely new factor in the nineteenth century, arising out of the Industrial Revolution, were the methods of control over workers, and the essential role that time played in this control. Thus, timetables, schedules, work rates and break times were an important part of the rules laid down and imposed by employers.[8] Rolande Trempé (1971), for example, showed how employers used severe time constraints to prevent miners in Carmaux from working outside the mines. Working days were long not only to increase output and return on capital invested, but also to make it more and more difficult for miners to combine their work in the mines with work on the land, which was prejudicial to their work in the mines for a number of reasons. It limited their availability, particularly during the harvest period, it made them less productive because of the double workload and, finally, it made them less dependent on the mines.

[8] This is the basis for E. P. Thompson's celebrated argument on 'time, work and capitalism', which shows how the notion that 'time is money' is in fact a product of recent history, specific to the Industrial Revolution and to the organization of work in factories and owing a great deal to the clock, which made it possible to measure time (cf. E. Thompson, 1967).

When the employer's authority was firmly established in the factory, he determined his employees' working hours and working conditions and, to some extent, the way they lived. Fines,[9] clocks, factory rules and the enclosure of the factory[10] were the main instruments used by employers to exercise their power. They all helped to establish factory discipline and, in particular, to enforce long working hours. Finally, employers forced workers to remain with the company by setting up company stores. Workers were obliged to buy their daily necessities from the factory store. The products sold there were more expensive than in ordinary shops, to which workers did not have access either because they were too far away or because they were forbidden. One of the effects of this system was to force workers into debt, which in turn meant they had no choice but to go on working in the factory for their entire lives. In this way, employers were able to gain complete control over their workers. It became difficult for them to go on strike, because that would deprive them of food. The factory store would not extend credit for that very reason. The widespread practice of working overtime provides supporting evidence for the hypothesis that workers had no control over their working hours. According to the Labour Department survey of *Wages and Working Time in Manufacturing Industry* (1894–97), 76.3% of factories (81% of workers) in Paris and 33.3% of factories in the provinces (40.2% of workers) worked overtime, as shown in Table 2.

Overtime worked to deal with peak workloads and for the purpose of machine maintenance was more frequent in Paris than in the provinces. Overtime was found in very different industries: food processing, textiles, mechanical engineering, metal working and masonry in Paris (Figure 1) and leather and skins, iron working, mechanical engineering and the working of base and precious metals in the provinces (Figure 2). We put forward the following hypothesis to explain the great disparity between Paris and the provinces. Outside Paris, it was normal for workers to be engaged in several activities: work on the land supplemented factory work. This was obviously not possible in Paris, although workers' financial needs were comparatively greater, with rents in particular being higher.

[9] Workers were still being fined for lateness or absence at the end of the 19th century. According to the 1894–97 Labour Department survey, fines were imposed in 22% of factories in the provinces and in 6% of Parisian factories.

[10] The closing-off of factories to all the workforce took a long time to achieve: it was still an open building, without any real control, so much so that Michelle Perrot (1983, p. 6) could write that 'The domestic space and the work space continued to be interlinked. Vagrants came in to warm themselves up in front of the ovens. Factories were a sort of night shelter open to itinerant workers'. In our view, the slowness in closing off factories can be explained by the fact that the reverse side of this repressive measure was greater solidarity among workers, which was a necessary condition for disputing the wage relationship.

Table 2 Overtime in the Seine department and in the provinces

	Seine department		Provincial departments	
	Percentage of factories	**Percentage of workers**	**Percentage of factories**	**Percentage of workers**
All private industry, of which	76.3	80.8	33.3	40.2
Overtime at regular times	14.4	12.6	10.5	8.5
Overtime at any time depending on need	61.9	68. 2	23.8	31.8

Note: Office du Travail, 1894–97, Volume 1 (Department of Seine): pp. 482–3. Volume 4 (Provinces): pp. 130–1. The survey concerned 2957 establishments which corresponded to 674 000 workers (operatives and employees). The chief of the establishment was asked if he generally practices overtime in its establishment. The percentage of workers in columns 2 and 4 is the mean of all the workers of the establishments who have answered yes to the different questions.

The next point to prove is that most overtime was 'worked at any time depending on need'. Analysis of the questionnaire sent to factories shows that the needs in question were those of the employers rather than those of the workers. The questions asked about overtime were as follows:

- Which categories of workers do overtime?
- At what times of the year?
- From what time to what time?
- Is overtime compulsory? If not, what proportion of workers do overtime?[11]

Mobility was a limited form of defence for workers against the working conditions imposed by employers. Finally, and this is an essential point to emphasize, it was rare for overtime premiums to be paid. According to the same survey, 18% of factories in Paris (Figure 3) and 24% of those in the provinces (Figure 4) paid higher rates for overtime.[12] In most cases, employers applied the standard pay rate to overtime, which gives good grounds for supposing that there was an imbalance of power between employers and employees. Nevertheless, workers accepted overtime not only to avoid dismissal, but also to make ends meet. It is difficult to dispel these uncertainties, since they are closely linked to the notion of subsistence, which is debatable at the very least. Fogel (1994, p. 377) stressed

[11] These supplementary questions appear at the bottom of the page in the questionnaire. It is question no. 6 [cf. Office du Travail, 1894–1897, Volume 1 (Paris and Suburbs)]. Information has not been provided on the question whether or not overtime was compulsory.

[12] Office du Travail (1894–1897) Volume 1 (Seine Department), pp. 482–3. Volume 4 (Provincial areas), pp. 130–1.

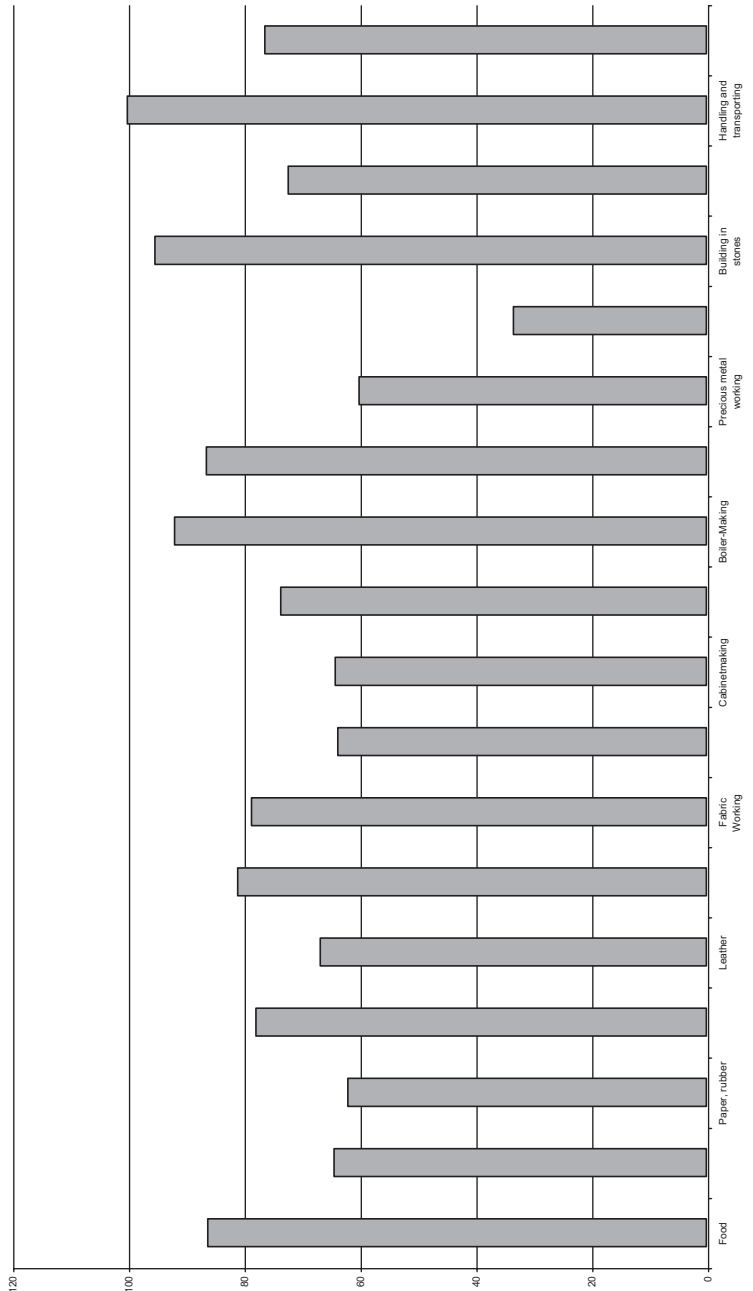

Figure 1 Percentage of firms practicing overtime hours (Paris, 1894) (Office du Travail, 1894–1897).

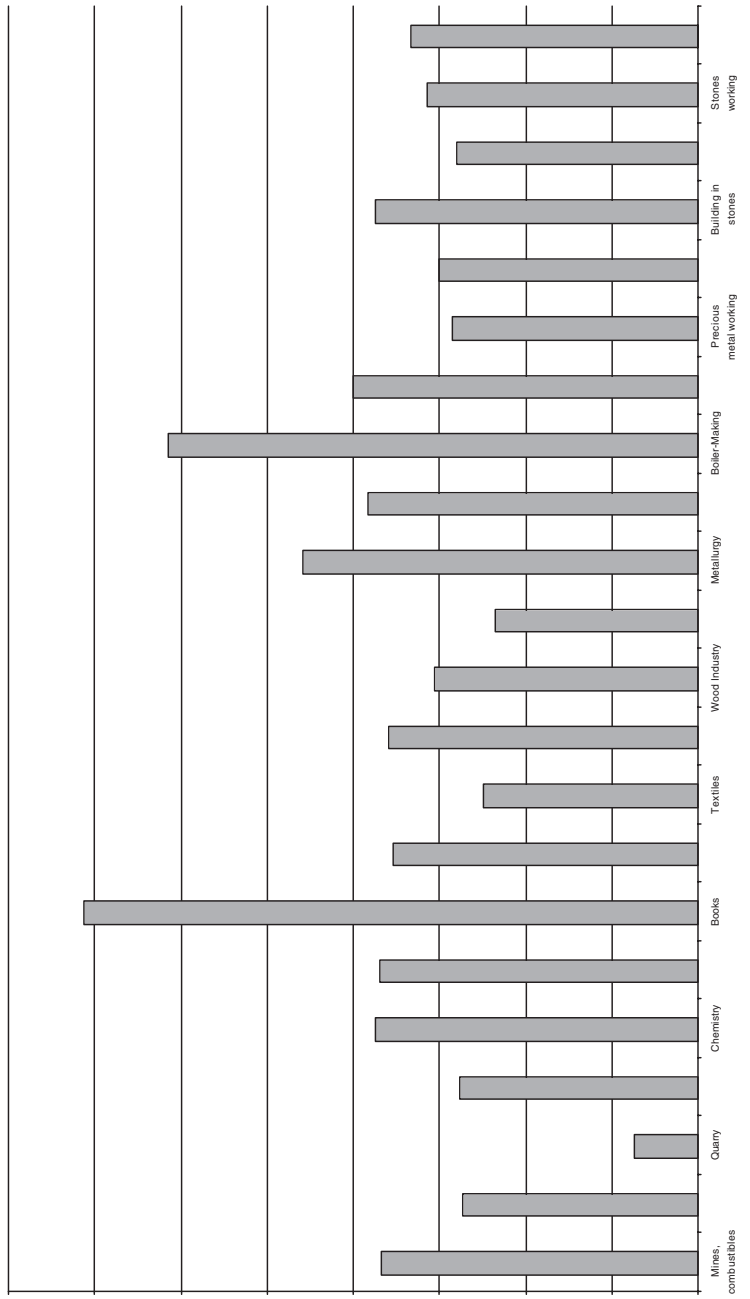

Figure 2 Percentage of firms practicing overtime hours (Provincial areas, 1894) (Office du Travail, 1894–1897).

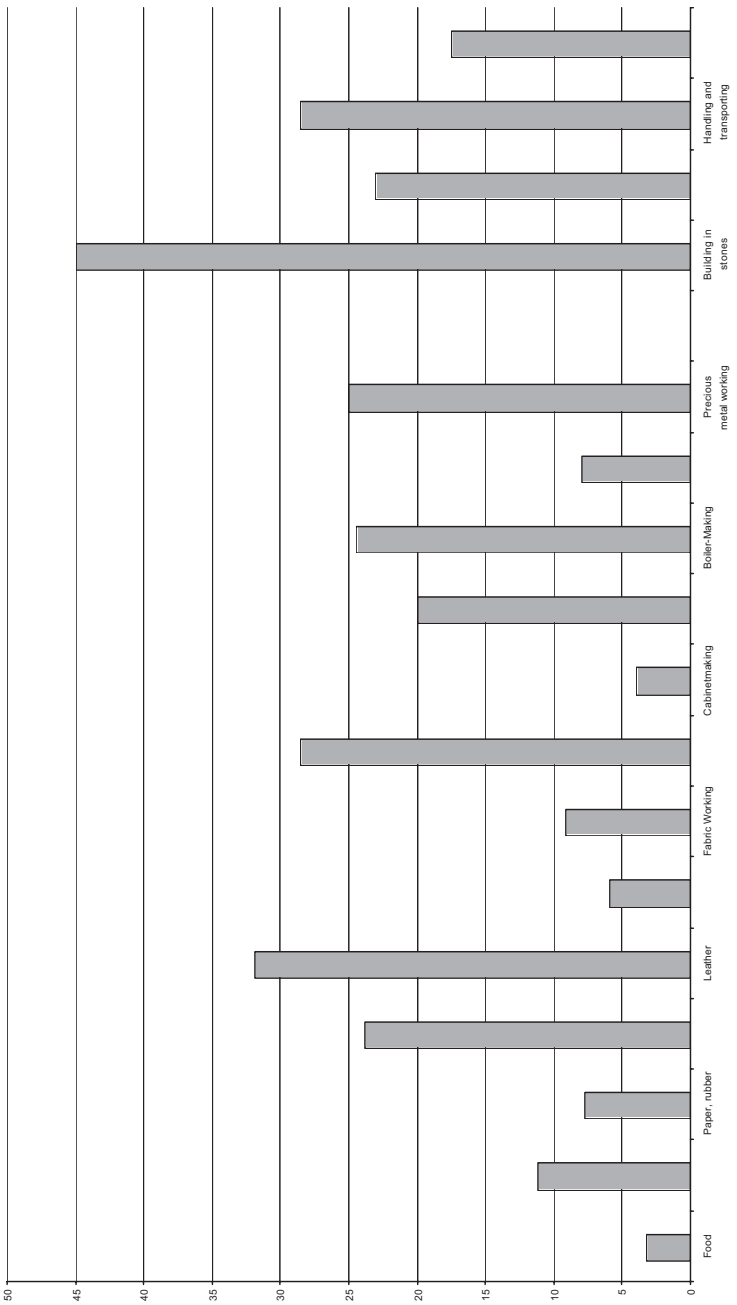

Figure 3 Percentage of firms where overtime hours are paid at an increased rate (Paris areas, 1894) (Office du Travail, 1894–1897).

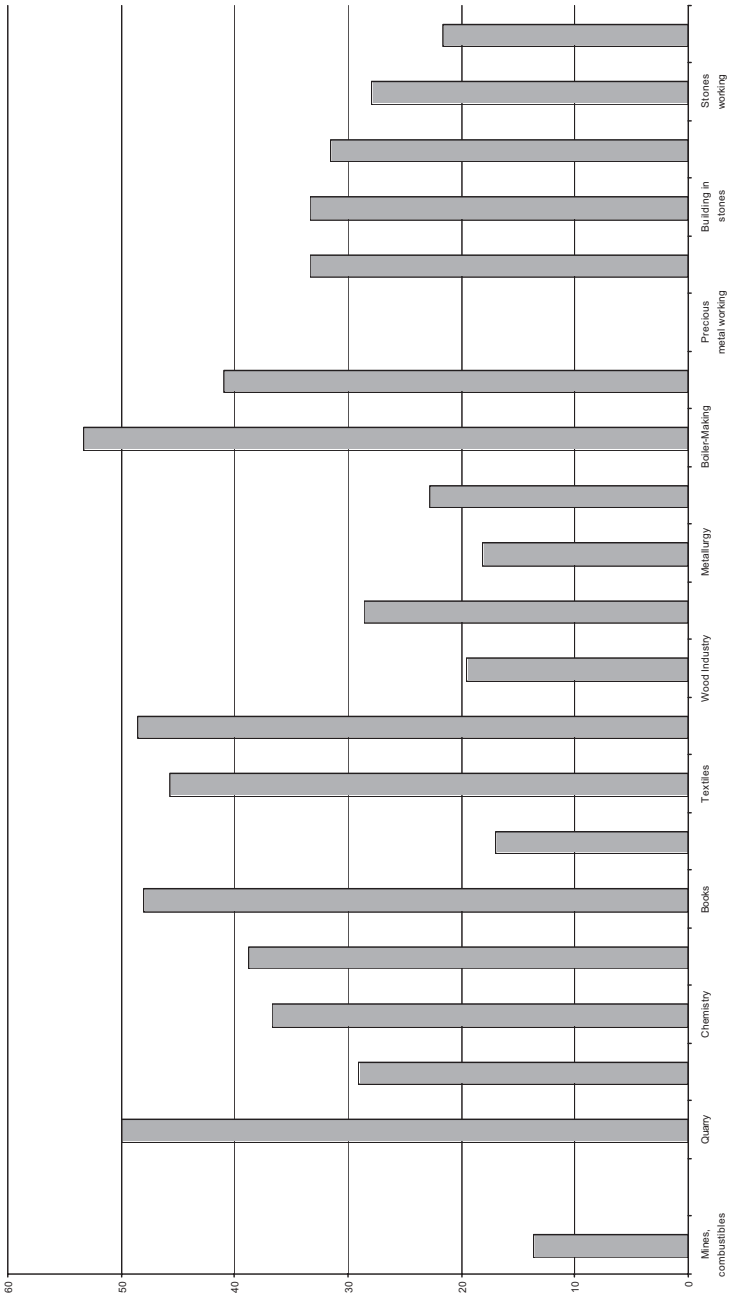

Figure 4 Percentage of firms where overtime hours are paid at an increased rate (Provincial areas, 1894) (Office du Travail, 1894–1897).

'the misleading nature of the concept of subsistence as Malthus originally used it and as it still widely used today. Subsistence is not located at the edge of nutritional cliff, beyond which lies demographic disaster. The evidence outlined in the paper implies that, rather than one level of subsistence, there are numerous levels at which a population and a food supply can be in equilibrium, in the sense that they can be indefinitely sustained'.

4. The conditions for reduction of working time

4.1 Inter-firm competition and the extension of employers' time horizons

If workers were unable to internalize the effects of very long working days on their health, employers, who both determined their working conditions and suffered the consequences these of, might well have been concerned to look after their employees' health, to protect their own interests.

The nub of the argument deployed by some liberal economists of the period who were favourable to working time reductions was that it was in the employers' interests to cut working hours. In fact, it was only at the very end of the period under scrutiny that economists brought up the idea that firms had an interest in keeping their workers healthy and that there was, therefore, a benefit to be gained from enduring the supplementary cost of better working conditions and shorter hours. This might have happened because the deterioration of working conditions, in a broad sense, had been large enough to diminish productivity in the short run (and not because of the high mortality rate of workers who already had left the factory). Before 1890, managers perceived any improvement of working conditions in a firm, and any shortening of the working day, as a loss in competitiveness. This was not compatible with the firm's survival. Certain managers in eastern France from the 1820s, argued for a paternalistic approach to the worker, the prohibition of child labour and a complete patronage of workers' lives in an environment organized by the firm, comprising better working conditions and shorter working days; they were, however, exception. Fohlen (1956) estimated that in the textile factories run by Schlumberger, working time was about 1.5 h shorter than elsewhere.

Rae (1894) in England and Rist (1897) in France were the most systematic advocates of this position. In their view, employers had to internalize some of the effects of excessively long working days on their workers' productivity and hence on their profits (without explicitly saying so, Rae invented the notion of the efficient working day, which is the counterpart of the current notion of efficiency wages). The notion that productivity declined, as a result of worker fatigue, when working days were too long was widely debated throughout the nineteenth century. Thus, any reduction in working hours at that time was the

result of a learning process by which employers became more aware of their own long-term interests, and better informed about the prevailing modes of production. In any event, this hypothesis is credible. Indeed, the empirical analyses of reductions in working time mention the existence of private, voluntary experiments with shorter working hours, generally in the most modern factories (Rae, 1894; Rist, 1897). In these factories, employers made explicit reference to considerations of efficiency to justify their decision not only to cut working time but also to reorganize the working day (for example by abolishing the first morning break). However, such practices were rare and internalized only a small part of the external effects, which a limited number of employers suffered (they could always get rid of prematurely exhausted workers at little cost to themselves).

Only organizations exercising complete control over the workforce could have had an interest in taking better account of the long-term effects of their decisions. The most frequently cited examples of more humane working conditions do indeed relate to factories that were organized in such a way as to ensure a very long-term involvement with the workforce.[13] The 'paternalist' employers of eastern France are one such example. Thus, Fohlen (1956, p. 88) showed how in 1852 Jean Dolfus, an employer in the textile industry, 'launched the idea of workers' housing estates, the aim of which was to enable workers to own their own homes after twenty years'. Other institutions were organized around the principle of employer-organized assistance, and in Mulhouse a pension fund and retirement home were set up in 1851, followed in 1852 by a mutual aid fund for sickness and a society promoting savings.

Even at a time when such social institutions were still underdeveloped, the costs of exhaustion through work were being socialized in practice. Thus, when workers fell ill, as one consequence of working conditions, they had to be cared for by their families or by the community, in one way or another (charities or public assistance). The very long working days did indeed constitute a negative external effect that diminished collective well-being. Since they were only bearing a very small part of these costs, employers (who could always pay money to charitable organizations) were not internalizing the effects of long working hours.

4.2 The collective construction of measurements of externalities

The idea of campaigning against excessive working hours did not develop until the social actors had at their disposal a shared knowledge of working conditions and hours, and this required the production and interpretation of the relevant

[13] This reasoning does not apply over the short term, because the reorganization of the workforce contains a fixed cost, which offsets the advantages of long-term involvement in the workforce.

information. What we wish to analyse here, therefore, are the circumstances under which abnormal exhaustion through work became socially recognized. In France and in England, the 1830s saw the emergence of the social issue, the outlines of which were sketched by Castel (1995). However, Michelle Perrot (1973) highlighted the influence of the medical profession on the creation of 'moral' statistics. 'Population censuses (. . .) should not consist simply of an enumeration of all inhabitants by gender, age and marital status but also, as far as possible, of an enumeration by profession and social conditions', wrote Villermé, a member of the Academy of Medicine, in 1834 (Perrot, 1973, p. 15). While the *Journal of Public Health and Forensic Medicine* (*Revue d'hygiène publique et de médecine légale*), set up by Villermé in 1824, was an instrument for the diffusion of the latest knowledge in the sphere of industrial health and of the measures required to improve that knowledge, another institution also played an important role. This was the Academy of Moral and Political Sciences,[14] which adopted a moral, 'hygienicist' (i.e. public health) position that had developed from the 1830s onwards out of research on worsening poverty, a point which Michelle Perrot highlighted (1973, p. 15–35). It was against this background that the Academy commissioned two reports on the condition of the working classes: Villermé and Buret in 1840. Surveys on poverty proliferated between 1830 and 1850.[15] From an international point of view, Engels's (1845) study attracted attention, since it had a considerable impact on the development of class-consciousness, particularly through the widespread international diffusion of *Capital*. Moreover, there were considerable similarities between these surveys, so much so that some experts have wondered whether Engels might have plagiarized Buret's work (Rigaudias-Weiss, 1936). It is true that the two surveys were both based on a report compiled by the English physician James Kay. Finally, Buret acted as Villermé's referee to the Academy of Moral and Political Sciences.

These surveys highlighted three points. First, they contained information on actual working conditions that was not available before. Second, they raised the question of why these reports were socially effective. Third, they were an incentive to explain the mechanisms by which awareness of excessive working hours developed. Their legitimacy helped to make the reports effective, but was not in itself a sufficient condition.[16]

[14] Set up by the National Convention in 1795, abolished in 1803 and re-established after the revolution of 1832. Villermé was head of the Academy's economic policy and statistics department (cf. Villermé, 1840, p. 21).

[15] A list of them can be found in Francis Démier's introduction to Villermé's *Tableau*, pp. 77–9.

[16] There are conditions for the effectiveness of legitimacy, which are beyond the scope of the present analysis (see Fridenson, P. and Reynaud, B., 2004).

Our hypothesis is that the medical profession played an essential role in the development of this social awareness. Indeed, physicians translated a diffuse social malaise—'the question of poverty'—into a naturalistic and statistical depiction of the destitution of the working classes.

Villermé was certainly the most famous of the physicians, despite the influence of other physicians on him. First, in 1826, the Mulhouse physician Achille Penot published a report on Alsatian cotton factories. This publication became an important source for Villermé. W. Coleman (1982, p. 253) wrote 'The academy had, in fact, only translated to the national level the pointed investigations whose design and execution by the physician had already been tested by the physician Achille Penot and others at Mulhouse'. Second, the work of the English physician James Kay had been a model for Villermé. Moreover, according to Rigaudias-Weiss (1936, p. 30), the title of Villermé's book is the same as Kay's (1832) publication: 'The Moral and Physical Condition of the Working classes, employed in the Cotton Manufacture in Manchester'. In turn, Villermé influenced other French physicians. For example, Frederic Bérard, Professor of private and public Hygiene in Montpellier, referred in his opening speech in 1826 to Villermé's work on mortality in Paris, which demonstrated the relation between poverty and disease (E. Ackerknecht, 1848, p. 127).

In addition to Villermé, other physicians were also preoccupied by the health of the working class. In 1835, for example, the physician C. Saucerotte published his 'Advice for the Hygiene of the Working Classes' (E. Ackerknecht, 1848, p. 132). The physician Thouvenin published an article on the influence of the industry on the workers' wealth in the *Annales d'hygiène publique et de médecine légale* (Villermé's review) (Moriceau, 2002, p. 28). In 1850, for the physician Chapelle, it was obvious that child labour was one reason for the weakness of the French population and for the Army's recruitment difficulties (Moriceau, 2002, p. 51).

Although the importance of Villermé's report is now universally recognized, we believe that the reasons for its social effectiveness have gone largely unrecognized. Why did the medical profession expose the situation? What exactly did Villermé do?

Villermé took care to establish the facts. He went into factories, carried out his own investigations, observed and noted down what he saw. His investigations took no fewer than 4 years to complete. For the first time, it was proved that the working classes endured very long working days and lived in extreme poverty. It was in that sense that Villermé converted a partial and somewhat vague awareness of the condition of the working classes into a naturalistic depiction. In the conclusions to his report, Villermé called for a reduction in working time for children only, judging, the liberal that he was, that the condition of adult workers had improved (Villermé, 1840, p. 565). The influence of Villermé's *Tableau* on

the promulgation of the law in 1841 was undeniable. During the debates in the two Chambers, Villerme's book was a reference. The statistical method was the key to his success. Dupin, the Secretary of the Chamber of Peers, referred to 'Villermé's book written by a statistician'.[17] G. de Beaumont, a member of the Chamber of Deputies, insisted on the 'serious statistics of Villermé's book'.[18] The State passed the first piece of legislation seeking to limit children's working hours in 1841, immediately following the report's publication. This clearly demonstrates the ineffectiveness even of obvious facts when an expert witness does not mediate them. Conversely, such an expert witness does not necessarily have any influence over the political authorities.

However, one of the strengths of Villermé's *Tableau* is that its author was able to develop a more scientific analysis of the condition of the working classes by drawing on new tools, namely statistics applied to demographic and social data, in which Quetelet's work had made considerable advances during the first third of the nineteenth century.[19] Villermé (1840, Ch. VIII) compiled mortality tables by occupation, which had never been carried out before. He measured the volume of air per person in factories.

In our view, the other main strength of Villermé's *Tableau* is that he drew on his medical expertise in order to examine a problem, which, strictly speaking, lay outside the scope of medicine. The logic that underpinned the medical world meant that physicians inevitably came up against the questions of public health raised by the very nature of industrial work in the nineteenth century. The more medicine developed as an autonomous field with its own value system, the more inevitable it was that it would involve itself in every domain where it had the legitimacy to do so. The independence of medicine meant that the suspicion of biased expertise was unthinkable. The reason lies in the fact that physicians, unlike politicians, did not have interests in the economic sphere itself. Thus, the physicians' position as 'outsiders' is an essential characteristic that accounts for the weight of influence of the position they adopted.[20]

[17] Chamber of Peers, 23 February 1840, quoted by H. Defalvard (2001), p. 23.

[18] Chambers of Deputies, 27 December 1840, quoted by H. Defalvard (2001), p. 23.

[19] On this point, we follow H. Rigaudias-Weiss (1936) and F. Demier (1989).

[20] This analysis certainly needs to be refined. It is necessary, in particular, to ascertain the position medicine occupied in the scientific 'space'—it is in a sense the most moral of the 'hard' sciences—and also the position within medicine occupied by those physicians who took a stance.

We can also observe this phenomenon of the exteriority of expert medical knowledge in other countries. In Belgium and England, for example, the various academies and colleges of medicine compiled reports on child labour. In Belgium, members of the Royal Academy of Medicine (1848) carried out the *Survey on the condition of the working classes and on child labour* (quoted by Lecoq, 1906, pp. 45–8) on behalf of the Ministry of the Interior. For several reasons, the excessive duration of child labour is criticized. First, children were too tired to attend evening classes and second, they had to be out after dark, which was dangerous. The Belgian Royal Academy of Medicine noted that 'night schools have serious disadvantages from the moral point of view, particularly in winter' (Lecoq, 1906, p. 47). In England, Marx (*Capital*, Appendix 8) referred to the reports of the Child Employment Commission, the first of which dates from 1829, in his denunciations of child labour. We have already mentioned James Kay's and Edwin Chadwick's influence. The physician Casper in Berlin was an important contributor to the *Revue d'Annales d'Hygiène et de Santé Publique* (Lecuyer, 1977, p. 454, note 54). All these facts support our claim that the link between work and health was a European preoccupation.

It seems to us impossible to understand the processes leading to the reduction of working time without factoring into the analysis the existence of the Academies of Medicine. In other words, the reduction of working time is due in part to autonomous social worlds such as the medical profession. Furthermore, we contend that changes inside the economic field may come from agents who are not strictly speaking economic agents.

The social order that the physicians were challenging was in no way a natural order, but a social order that would have to react, according to its own lights, by putting its own institutions in motion. Rabinbach (1992) showed how the scientific discourse on fatigue and the physiology of effort developed independently at the end of the nineteenth century. Nevertheless, he claimed that neutral expertise encountered resistance from both employers and workers. The medical and physiological observation—people are unwell, they are engaged in excessive physical activity associated with their work—served historically as the vehicle for a challenge to a mode of economic regulation that was incapable of providing workers with a satisfactory standard of living. Once again, this identification of deficiencies in the mode of regulation applied not only at the collective level, as an average outcome or as an abstract idea, but also at the individual level, influencing the notions each individual had about their situation in the world of work. It was out of the crisis arising out this set of representations that the reduction in working time emerged. Medical knowledge was an efficient way of incorporating the question of public health into peoples' thinking about work.

5. Concluding remarks

Since the concept of externality normally denotes a technical interaction in the absence of an economic transaction, it would—at first sight—seem difficult to apply the notion to the employment contract, which consists of a voluntary agreement between free individuals. However, we draw on the analyses developed by Steinfeld and Engerman (1991) and by Engerman (1973, 1992), according to which the distinction to be made between 'free labour' and 'coerced labour' has no sense because, in Hegelian terms, formal freedom in law does not ensure real freedom of choice. Thus, employees are obliged to work; they are not free to choose the time they devote to it. Furthermore, they are not in a position to defend their long-term interests and in particular their health. Consequently, the notion of externality is applicable, despite the fact that an employment contract entails a monetary transaction. We have established how the working conditions and factory discipline imposed by employers could give rise to negative external effects. The first contribution of our analysis consists in analysing health at work as an externality. The idea that people converted growth and productivity gains into free time, in an idealized trade-off between consumption and leisure, does not tell us at what rate and in what way the actual reduction in working time took place. The second contribution of our paper consists in identifying two conditions for the reduction of externalities. On the employers' side, only a change in the time horizon of their decision-making could bring them round to the view that a reduction in working time would not inevitably undermine their competitive position *vis-à-vis* other firms: the efficiency principle dictated that, in the long term, a healthier workforce would enable productivity gains to be realized. On the other hand, it was necessary to obtain information to stimulate new thinking about work. Moreover, a change in employers' time horizons from the short term to the long term has been a determinant condition in the reduction of externalities. Economists such as Rae and Rist played a decisive role in that change. The example of certain employers in the textile industry of eastern France, such as Dolfus, made their arguments more convincing. A third condition not examined in this paper was the mobilization of the working classes themselves in support of a reduction in working time, which led eventually to the establishment of the right to strike in 1864 and the recognition of trade unions in 1884.

Our thesis leads to a research agenda focused on a more general hypothesis about the conditions of any economic change. In the case studied in this paper, physicians are not, strictly speaking, economic agents whose economic interests are embedded in the actual world. Further research must deal with the following hypothesis. Economic change depends on the involvement of forces generated in the social sphere rather than the economic one. These forces act

on the economic sphere when they are able to provide the representations that the latter recognizes. In order to do so, they have to manifest themselves in real effects on behaviour, institutional arrangements and the rules governing social relations.

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