Marx, Machines, and Skill

PAUL S. ADLER

Recent decades have seen renewed interest in the historical effects of technology on skill requirements.[1] Marx's name figures prominently in this research as a theorist and prophet of the dehumanization and deskilling of work under capitalism. Indeed, it is now considered almost obvious that Marx, rightly or wrongly, saw capitalist development and use of machinery as tending to—and at least to some extent designed to—reduce skill requirements.[2] This article argues that distinguishing more carefully between theory and polemic in Marx's writing and between short-term processes and long-term trends in Marx's theory reveals the possibility of a quite different reading. Apart from its exegetical merits, this new reading offers a theoretically provocative and surprisingly optimistic perspective on the longer-term trend in skill requirements under capitalist conditions.

In part, my argument was prefigured by Daniel Bell, who, in reviewing previous analyses of the growth of white-collar employment, identified two schemata in Marx: first, a class polarization thesis based inter alia on deskilling, and second, a more complex picture

PROF. ADLER teaches in the Department of Industrial Engineering and Engineering Management at Stanford University. His current research focuses on the management of technology, the effect of automation on work, and the relations between design and manufacturing engineering. This article has benefited from the comments of Horst Brand, Michael Howard, Nathan Rosenberg, and the *Technology and Culture* referees.

[1]See, e.g., W. H. Lazonick, "Industrial Relations and Technical Change: The Case of the Self-acting Mule," *Cambridge Journal of Economics* 3 (1979): 231–62; H. Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York, 1974); D. F. Noble, *Forces of Production: A Social History of Industrial Automation* (New York, 1984); W. Form, "Resolving Ideological Issues on the Division of Labor," in H. M. Blalock, Jr., ed., *Sociological Theory and Research: A Critical Appraisal* (New York, 1980), pp. 140–55; M. R. Smith, *Harpers Ferry Armory and the New Technology: The Challenge of Change* (Ithaca, N.Y., 1977); L. F. Gross, "Wool Carding: A Study of Skills and Technology," *Technology and Culture* 28 (October 1987): 804–27; and the special issue of *Technology and Culture* 29 (October 1988) on "Labor History and the History of Technology," edited by Philip Scranton.

[2]See D. MacKenzie, "Marx and the Machine," *Technology and Culture* 25 (July 1984): 473–502; R. S. Rosenbloom, "Men and Machines: Some 19th-Century Analyses of Mechanization," *Technology and Culture* 5 (Fall 1964): 489–511.

0040-165X/90/3104-0001$01.00

based on capitalism's substitution of a new middle class of professionals, managers, and white-collar workers of various kinds for the traditional middle class of independent small businesses.[3] My contention is that the first, deskilling schema might be a polemical extrapolation of some short-term trends into the longer term. I shall analyze the skill component of these two schemata, attempting to draw some general lessons both for the interpretation of Marx and for some current issues in research on automation and work.

The Problem and the Argument in Outline

My starting point is the influential work of Harry Braverman, who contributed significantly to establishing the deskilling reading.[4] Braverman has been the object of so many critiques[5] that it hardly seems appropriate to attack him yet again. My critique, however, is more radical than previous ones. Others have accepted at least the broad contours of Braverman's reading of Marx but have contested that theory's adequacy. Either they have shown how various countervailing forces (such as the condition of local product or factor markets, specific ideological conditions, and the local balance of power) can blunt the underlying deskilling trend supposedly hypothesized by Marx, or they have argued that there is no single underlying skill trend because capitalists face several options in designing jobs. By contrast, I argue that Braverman's reading of Marx may be wrong: while agreeing with Braverman that Marx seems to have believed that capitalist development does embody a distinctive underlying skill trend, I argue that in Marx's theory this trend may not have been deskilling but quite the opposite—upgrading.

Let us begin with one of the most frequently cited passages in Marx and its treatment by Braverman:

> One of Marx's comments on this score has so often been subjected to a flat misreading in recent years that it is necessary to comment on it. The passage: ". . . Modern Industry . . . imposes the necessity of recognizing as a fundamental law of production, variation of work, consequently fitness of the labourer for varied work, consequently the greatest possible development of his varied aptitudes. It becomes a question of life and death for society to adapt the mode of production to the normal functioning

[3]D. Bell, *The Coming of Post-Industrial Society* (New York, 1976).

[4]Braverman (n. 1 above).

[5]See, e.g., S. Wood, ed., *The Degradation of Work?* (London, 1982); D. Knights, H. Willmott, and D. Collinson, eds., *Job Redesign: Critical Perspectives on the Labor Process* (Hampshire, 1985), and their bibliographies.

> of this law. Modern Industry, indeed, compels society, under penalty of death, to replace the detail-worker of today, crippled by life-long repetition of one and the same trivial operation, and thus reduced to the mere fragment of a man, by the fully developed individual, fit for a variety of labours, ready to face any change of production, and to whom the different social functions he performs, are but so many modes of giving free scope to his own natural and acquired powers" (*Capital* [Moscow, n.d.] 1:458). This, extracted from its context, has been understood to mean that Marx was predicting that with the further development of capitalism an "educated" and "technical" working class would be created by modern industry. In fact, that was not his thought at all, as a reading of the section in question makes clear. He saw capitalism as being in direct contradiction to the tendency of modern industry to call into being a new type of worker, a "fully developed individual," and what he is saying here is that society itself is threatened with extinction unless it rids itself of the capitalist system which, the more modern scientific industry makes it obsolete, the more tenaciously it holds on to and even deepens an outmoded division of labor. . . . Every line Marx wrote on this subject makes it clear that he did not expect from capitalism or from science and machinery as used by capitalism, no matter how complex they become, any general increase in the technical scope, scientific knowledge, or broadening of the competence of the worker, and that in fact he expected the opposite.[6]

When Marx writes that it becomes a question of life and death for society to "adapt the mode of production," does he mean, as Braverman and most of his neo-Marxist followers claim, that society must replace this capitalist mode of production by a socialist one? Or does he see the possibility of an evolution within capitalism toward a more fully developed individual?[7] In this article, I shall argue the following propositions:

> *(a)* The "evolution" reading of Marx is possible, and perhaps more plausible than Braverman's neo-Marxist "replacement" reading. It is consistent with an interesting version of Marx's model of social change, a model in which occasional manifestations of deskilling in the short term and on the local level are

[6]Braverman (n. 1 above), pp. 231–32.

[7]The new translation of *Capital* by Ben Fowkes (New York, 1977) differs in the wording, but not much in the sense. Instead of mode of production, Fowkes has "law of social production": "This possibility of varying labour must become a general law of social production, and the existing relations must be adapted to permit its realization in practice" (p. 618). See Appendix for the Fowkes translation of the full passage.

symptomatic of the power asymmetries and unplanned nature of capitalist economies, but are nevertheless eddies in the broader current of a long-term skill-upgrading trend.

(b) The possibility of this evolutionary upgrading reading has been obscured by the polemical tone of much of Marx's public writing, including *Capital.*

(c) This reading of Marx's analysis of skill trends in capitalism's "large-scale industry" period is consistent with an upgrading reading of Marx's analysis of the transitions from handicraft to manufacture and from manufacture to industry.

(d) Such a reading suggests a distinction between deskilling and a broader, more fundamental historical process—the separation of the worker from the means of production. I suggest that deskilling bears the same relation to separation as, in a more philosophical domain, alienation bears to objectification: in both pairs, both terms refer to real processes. I thus uncover an important sense in which Marx saw the destruction of craft skills as having an emancipatory significance.

(e) The critical edge of the deskilling reading has often been secured by association with the younger Marx's vision of a utopia in which work is self-realization; by contrast, the coexistence of high training requirements and job boredom in many automated jobs may point the way to an antiwork utopia more congruent with the older Marx's celebration of free time.

(f) The data available on skill trends, automation's effect on work, and work's influence on personality provide at least enough prima facie empirical plausibility for the theory I am imputing to Marx to make further discussion worthwhile.

(g) This exegesis could help contemporary research by forcing us to clarify our notions of skill and our understanding of the underlying logic of machine design.

The premise of this article is that Marx is too important and rich a theorist to leave his interpretation to the neo-Marxists. A detailed examination of the passage Braverman discussed will show that it can be read as anticipating a skill-upgrading trend under capitalism. I shall then show how this trend fits into a plausible version of Marx's overall model of social change. After discussing a second passage from *Capital* that provides further support for my reconstruction of Marx's theory, I shall highlight the tension in this version of Marx's theory between short-term and long-term pressures on skill.

First Exegesis

The first step in my exegesis is to resituate the passage Braverman cites in its context (see the Appendix). The need for a fully developed

individual is, in the logic of Marx's exposition, the positive aspect of an "absolute contradiction" between, on the one hand, the revolutionary technical basis of large-scale industry—that is, the fact that "modern industry never views or treats the existing form of the production process as the definitive one"—and, on the other hand, the form taken by this constant revolution in technology in capitalist society—that is, how, "in its capitalist form, it reproduces the old division of labour with its ossified particularities."[8] In the Hegelian model Marx is using here, a substance and its form can be in contradiction, since both substance and form are construed as having their own materiality.[9] The "old division of labour" that Marx refers to here is the specific form of the division of labor associated with the manufacturing period: "Thus although, from a technical point of view, the old system of division of labour is thrown overboard by machinery, it hangs on in the factory as a tradition handed down from manufacture, and is then systematically reproduced and fixed in a more hideous form by capital as a means of exploiting labour-power." In particular, the "lifelong specialty of handling the same tool [under manufacture] becomes the lifelong specialty of serving the same machine" under large-scale industry.[10]

If the need for a fully developed individual—the substance of industry's requirements for flexible labor—is the positive side of this contradiction, the negative side is the fact that the form in which capitalism responds to industry's flexibility requirements is to increase not so much the flexibility of each worker but rather the flexibility of the work force as a whole: "This absolute contradiction does away with all repose, all fixity and all security as far as the worker's life-situation is concerned; . . . it constantly threatens, by taking away the instruments of labour, to snatch from his hands the means of subsistence, and, by suppressing his specialized function, to make him superfluous."[11] We have then a contradiction between the revolutionary nature of a technical basis and the ossified nature of its social form. This contradiction has a positive side: the substance of industry's need for flexibility, which tends naturally toward the fully developed individual. It also has a negative side: the distorted form in which capitalism expresses industry's substantive need—namely, worker insecurity and technological unemployment. The question to

[8]Ibid., p. 617.

[9]See G. W. F. Hegel, *Hegel's Logic* (Oxford, 1975), p. 189, cited by I. I. Rubin, "Abstract Labour and Value," *Capital and Class* 5 (1978): 134.

[10]Marx (n. 7 above), p. 547.

[11]Ibid., p. 618.

be resolved is: What does it take for the positive side, a historical "need," to materialize in a form more congenial to workers' well-being? Braverman, like many commentators, argues that it would take the replacement of capitalism by socialism. I want to suggest that Marx's answer might plausibly have been quite different.

Note first, however, that Braverman's reading has a certain prima facie validity. Indeed, Marx's general argument does seem to be that, while capitalism is an effective social form (mode of production) for bringing society into the stage of large-scale industry, the full flowering of industry's potential will require a change of type of society: capitalism's difficulty in abandoning the division of labor characteristic of the manufacturing stage is construed by Marx as evidence that the capitalist form of social organization has outlived its usefulness and has become a barrier to the development of society's productivity.

But what future does Marx see for workers and their skills in the absence of social revolution? Did Marx believe that without a change of mode of production work would become progressively deskilled? If we grant that according to Marx increasing the flexibility of the individual worker is not the *primary* means by which capitalism increases production flexibility, does this imply that in his view the average worker will tend to become less flexible in the course of capitalism's development?

The answer to these questions lies perhaps in the next paragraph: "One aspect of this process of transformation, which has developed spontaneously from the foundation provided by large-scale industry, is the establishment of technical and agricultural schools. Another is the foundation of 'écoles d'enseignement professionel' [vocational schools]."[12] Even under capitalism, industry needs some more skilled workers, and this need encourages investment in worker education. Until we can calibrate the quantitative importance of this "one aspect," it is difficult to judge how strong a counterweight to deskilling tendencies this development provides. Indeed, Marx goes on to argue that these educational initiatives are not sufficient to bring about a change "in the mode of production" or fully satisfy the "needs" of large-scale industry: "Though the Factory Act, that first and meagre concession wrung from capital, is limited to combining elementary education with work in the factory, there can be no doubt that, with the inevitable conquest of political power by the working class, technological education, both theoretical and practical, will take its place in the schools of the workers."[13] The development of worker

[12]Ibid.
[13]Ibid.

education under capitalism is thus, in Marx's view, insufficient—although one is tempted to ask how he would have interpreted the tremendous expansion of the education system since his death. Moreover, this development of worker education is not spontaneously generated by industry; it is a concession "wrung from capital"—although Marx goes on to explain the role of bourgeois enlightened self-interest in supporting such initiatives.

Notwithstanding these important reservations, the punch line of his argument suggests that Marx saw capitalist large-scale industry as stimulating real, albeit limited, movement in the direction of the fully developed individual, and moreover, that such an upgrading tendency was a critical factor in social transformation: "There is also no doubt that those revolutionary ferments [educational initiatives, Factory Act], whose goal is the abolition of the old division of labour, stand in diametrical contradiction to the capitalist form of production, and the economic situation which corresponds to that form. However, the development of the contradictions of a given historical form of production is the only historical way in which it can be dissolved and then reconstructed on a new basis."[14] In other words, while the "ferment" of vocational education and the Factory Act is not *sufficient* in itself to recast the mode of production, it is a *necessary* condition for fundamental change. Phrased in philosophical shorthand, we might say that both the "substance" (revolutionizing technology and the attendant development of a more fully developed worker) and its "form" (reproduction of an ossified division of labor) are real. The latter does not subsume the former; both have their real effects; the contradiction between them is real, historically efficacious, and not merely philosophical. This interpretation can be contrasted with that offered by neo-Marxists such as David Noble, for whom the most basic contradiction is not between two real forces but between "what is" and "what ought to be."[15]

A Tentative Model

In this passage Marx is not explicit on how broader education contributes to basic social change. But it is perhaps not difficult to reconstruct the linkage. Industry's positive effect on skill requirements plays the capabilities-enhancing role discussed in the *Communist Manifesto:* It draws workers into larger plants, gives them the experience of disciplined collective action, and draws them out of "the old local and national seclusion and self-sufficiency" into an

[14]Ibid., p. 619.
[15]Noble (n. 1 above).

awareness of "universal interdependence."[16] In most exegeses—as often, but not always, in Marx's writings themselves—the motivation for social change is in the experience of work that has become so miserable that workers have "nothing to lose but their chains." But here we see another side, where the upgrading of workers' jobs and the broadening of their education contribute to workers' capabilities—as distinct from their motivation—for concerted action. For Marx, the proposition that socialist revolution was not just desirable but also inevitable reflects the conjunction of both the increased misery of the "surplus" population (the unemployed or underemployed minority) and the increased capabilities of the working class as a whole.[17]

Marx's model of social transformation seems to be based on the idea that industrial development transforms workers' experience of work and encourages the growth of their capabilities. These capabilities play two key roles. Workers' capabilities represent, first, a resource for political action. Industrial development drives an increase in skill requirements, which in turn leads to an expansion of the educational system and of the intellectual horizons of workers. Furthermore, the experience of large-scale production enhances workers' capacity for organized activity. The conjunction of this capacity and their broader horizons gives workers growing political potential. This potential becomes actual political mobilization only if there is a sufficient maturation of political organizations and ideological forms, and only if a propitious political conjuncture presents itself. The role of economics and work experience in triggering workers' political action lies not in any widespread deskilling trend but in the obviousness of the fact that every worker risks unemployment—in the cyclical large-scale unemployment generated by capitalism's recurring economic crises and in the continual smaller-scale unemployment generated by capitalism's inability to plan for the labor-force consequences of economic and technological change.

Deskilling does sometimes occur. Indeed, deskilling is of fundamental theoretical significance, since it is symptomatic of the power asymmetry of capitalist organizations and of the potential for myopic

[16]K. Marx and F. Engels, "Manifesto of the Communist Party," in L. S. Feuer, ed., *Basic Writings on Politics and Philosophy: Karl Marx and Friedrich Engels* (New York, 1959).

[17]"Along with the constant decrease in the number of capitalist magnates [through the centralization of capital] who usurp and monopolize all the advantages of this process of transformation, the mass of misery, oppression, slavery, degradation and exploitation grows; but with this there also grows the revolt of the working class, a class constantly increasing in numbers, and trained, united and organized by the very mechanism of the capitalist process of production" (Marx [n. 7 above], p. 929).

management in market economics. Moreover, deskilling is of some practical significance, since, even if only a minority of workers ever experience deskilling, other workers' sense of solidarity with these victims might help trigger action. But in the dynamics of capitalist development and supersession, these effects are secondary: at a theoretical level, workers share with managers an interest in the increased productivity usually associated with a higher-skilled work force, and at a practical level, in Marx's hypothesized movement toward the supersession of capitalism, other factors are far more significant motivators of worker mobilization.

Workers' capabilities represent not only a political potential, but also a productive resource. Indeed, a prima facie case against Braverman's deskilling reading can be made by pointing out the difficulty of reconciling this reading with Marx's repeated assertions that capitalism builds the infrastructure of productive forces for the socialist mode of production that will supersede it. The deskilling thesis implies on the contrary that a socialist society would inherit a working population composed predominantly of unskilled workers unaccustomed to the exercise of any collective autonomy.

If, therefore, the "contradiction" between the need of modern industry for well-rounded workers and the maintenance of capitalist manufacture's division of labor is an "absolute" contradiction, absolute may not mean permitting of no resolution, not even partial, so much as requiring a constantly expanding set of partial resolutions that tend to undermine the starting point. This interpretation suggests that Marx's argument is not that capitalism witnesses no evolution toward the more fully developed individual; it is rather that, by its tendency to create such individuals, industry accelerates the change from the old to a new form of society. This vision of capitalist dynamics explains perhaps why Marx leaves his formulation—"change in the mode of production"—so indeterminate: he is in fact referring to changes *within* the mode of production which over the longer term might spell a change from one mode to another.

This reconstruction of Marx's theory of historical development is congruent with Gerald A. Cohen's: the contradiction between the development of the forces of production and the maintenance of the current form of society—a contradiction expressed in class conflict—deepens over time, since over the long run, as a result of the development of the productive forces, the capabilities of the emergent class develop, and this class's potential for political action grows.[18]

[18]G. A. Cohen, *Karl Marx's Theory of History: A Defense* (Princeton, N.J., 1978).

It becomes increasingly likely that sooner or later this class will mobilize itself and its allies against the prevailing class structure. In this basic form, the argument has an undeniable element of technological determinism. Given the widespread suspicion of technological determinism as an explanatory principle in historical and sociological research, and given the powerful arguments against interpreting Marx as a technological determinist presented by scholars such as Rosenberg,[19] I need to explain why my model does not constitute a proof reductio ad absurdum that Marx did not adhere to a skill-upgrading thesis.

In defense of this reading, I submit that much of the discussion of the role of technological determinism in Marx's theory has missed at least three complicating features of his model—factors that make it more sophisticated and more robust than simpler technological determinisms would be. First, "technology" (or "forces of production") should be construed broadly, to include, besides equipment, the productive aspects of work organization[20] and perhaps even workers' skills.[21] Second, the determination by technology (even broadly construed) is not complete: other economic, political, and ideological forces clearly have a role to play in Marx's theory, and "determinism" is a way of conceptually ordering the relative roles of these forces, not of denying them any causal weight. Finally, the relative causal weight of technology appears to differ with the time horizon of Marx's analysis: Marx gives technology a predominant role in the broadest sweep of history,[22] but he seems to be more of an economic (relations of production) determinist or even a political determinist in his analysis of narrower time frames.

My reconstruction of Marx's theory suggests that, within the time frame of the historical development of capitalism, Marx saw technological change both as a dependent variable and as a powerful causal factor in its own right. As a dependent variable, technology is released from the shackles of the natural economy and from the technological

[19]N. Rosenberg, "Karl Marx on the Economic Role of Science," in *Journal of Political Economy* (1974): 713–28; see also Rosenberg's "Marx as a Student Technology," in *Inside the Black Box: Technology and Economics* (Cambridge, 1982).

[20]Cohen (n. 18 above).

[21]MacKenzie (n. 2 above).

[22]Cohen (n. 18 above). Wright initially argued against Cohen on this point, in A. Levine and E. O. Wright, "Rationality and Class Struggle," *New Left Review* 123 (1980): 47–68. But he has more recently come to support the proposition from a more game-theoretic premise: rarely does any social class have an interest in lowering social productivity. See E. O. Wright, "Gidden's Critique of Marxism," *New Left Review* 138 (1983): 11–36.

conservatism of the guilds by the diffusion of capitalist market relations and is now powerfully stimulated by capitalist competition. But as an independent variable, it plays a crucial role in shaping and reshaping skill requirements, work organization, and the resultant class capabilities.

Second Exegesis

There is a second passage in *Capital* that merits exegetical attention. It encapsulates, perhaps better than any other, the elements of Marx's analysis, even though it focuses not on the factory worker but on the white-collar, "commercial" worker:

> The commercial worker, in the strict sense of the term, belongs to the better-paid class of wage workers: to these whose labour is classed as skilled and stands above average labour. Yet the wage tends to fall, even in relation to average labour, with the advance of the capitalist mode of production. This is due partly to the division of labour in the office, implying a one-sided development of the labour capacity, the cost of which does not fall entirely on the capitalist, since the labourer's skill develops by itself through the exercise of his function, and all the more rapidly as division of labour makes it more one-sided. Secondly, because the necessary training, knowledge of commercial practices, languages, etc., is more and more rapidly, easily, universally and cheaply reproduced with the progress of science and public education the more the capitalist mode of productions directs teaching methods, etc., towards practical purposes. The universality of public education enables capitalists to recruit such labourers from classes that formerly had no access to such trades and were accustomed to a lower standard of living. Moreover, this increases supply, and hence competition. With few exceptions, the labour-power of these people is therefore devaluated with the progress of capitalist production.[23]

This passage identifies several forces that reduce commercial workers' wages; but closer examination reveals that, while one of these factors might lead to some sort of deskilling, the others lead either to upgrading or else to lower wages without deskilling. Let us analyze this passage more closely.

First, skill requirements are lower than they would otherwise be because of the effects of the division of labor. This is clearly a deskilling factor, at least in the sense of reducing skills compared to the hypothetical requirements of the job in the absence of any division

[23]K. Marx, *Capital* (London, 1974), 3:300.

of labor. Second, the socially necessary labor time required to train workers to a given skill level is reduced by greater instructional efficiency. This is less clearly a deskilling factor: it does not imply any reduction in real capabilities, but only a change in the market economy's yardstick for measuring them, since shorter instruction times would reduce the "human capital" claim for higher wage rates. Third, the same skill levels can be paid at lower rates if workers accustomed to lower living standards are recruited. This factor does not affect skills; it only creates a possible source of disjunction between the underlying value of those skills (as measured by training time) and their current price (as measured by the prevailing wage rates). Fourth, workers' competition in this labor market increases as more workers receive general education. But this factor too identifies a value/price disparity rather than a skill shift.

Of all these factors, therefore, only the division of labor implies that capabilities are in any sense reduced. But this reduction is only relative to skill requirements in the hypothetical absence of any division of labor; it does not imply a continual decline over time in actual skill requirements. Indeed, such a continual decline seems extremely unlikely, since there is a limit to the subdivision of any given task and since economic development is constantly creating new tasks.

Against this single, somewhat limited deskilling factor, Marx's analysis poses a major upgrading force: the spread of education. The overall effect is clear, as the passage concludes: "Their wages fall, while their ability increases."[24] Marx's somber diagnosis of labor power's depreciation is thus crucially modified by the conclusion that this depreciation is only in money terms, while real capabilities tend to increase. The upgrading conclusion would be further reinforced if Marx had discussed the emergence of new white-collar tasks requiring greater skills. And even his prognosis of lower wages would be mitigated or reversed if, as seems plausible, capitalism's demand for white-collar skills led rather than lagged the access to education of new population categories.

Short-Term Processes versus Long-Term Trends

The argument of my exegesis of two key passages in *Capital* has thus been that it is possible to interpret Marx, Braverman notwithstanding, as predicting a general skill-upgrading trend under capitalism. A critical feature of this reading of Marx's argument—a feature that Braverman and others have overlooked—is that such an upgrading prognosis would not necessarily contradict Marx's critique of the

[24]Ibid.

short-term dynamics by which capitalism "muddles through" along this long-term upgrading path.

Marx's own exposition highlights two key features of these short-term dynamics. First, capitalists, because of the cost pressures they experience in competition and the corporate and class interests that often put them at loggerheads with workers, frequently attempt to reduce skill levels, often myopically ignorant of the loss of operations efficiency and future profitability that usually ensues. In other words, the short-term dynamics of skill are profoundly marked by the social form of capitalism: decision-making power is asymmetrically distributed, class interests often diverge, decisions are based on profits rather than social welfare, and decentralized decision making allows for myopia.

Second, the market mode of economic coordination characteristic of capitalism leads firms to underinvest in worker training. The fear that workers might leave discourages firms from funding worker training at the socially optimal level. But this does not mean that firms refuse to make any investment in training. Moreover, the political economy of capitalism includes a key causal chain leading from this "market failure" to increased pressure on government, both from workers and from enlightened capitalists, to fill the training gap. It is characteristic of capitalism as a social form that this causal chain passes along the uncertain pathways of a relatively autonomous political process.

The long-term upgrading trend that I have argued Marx predicts is thus achieved only ex post, as the result of myriad incoherent local economic decisions and uncertain political processes. That the outcome should sometimes leave workers dispossessed of their skills is, for Marx, a scandal, and for Marx it remains a scandal even if the deskilling outcomes are only a small proportion of all the outcomes and the overall trend is upgrading. The question arises, however: If Marx did foresee such a positive long-term trend, why did he not discuss it more explicitly? In the following section, I will suggest that Marx may have avoided discussing such possibilities for polemical reasons.

The Role of Polemic in Marx

An excellent example of polemic at work in Marx's writing is found in his discussion of workers' living standards. In earlier writings, in particular in the *Manifesto* (written 1847–49), it appears that Marx did in fact believe that workers' living standards would tend to fall under capitalism. By the time he wrote *Wages, Price and Profit,*

however, he had clearly recognized that, while the *relative* share of total wealth going to workers might decline as capitalism developed, it was perfectly possible for the average *absolute* standard of living of workers to improve.[25] In *Capital,* Marx focused on relative share but did little to clarify the distinction because relative impoverishment is a much less powerful rhetorical position than absolute impoverishment.[26]

In many ways, Marx's discussion of skill trends parallels his discussion of wage trends—the standard deskilling proposition corresponds to a kind of absolute impoverishment of the worker's role in the labor process.[27] The corresponding "relative skill impoverishment" thesis could take several possible forms: *(a)* industry needs even more skill upgrading than capitalism will permit, *(b)* workers' educational levels and skills are rising but they are underutilized, and/or *(c)* while the working class as a whole experiences a gradual skill upgrading, a segment of the working population—perhaps a growing segment—is confined to the lowest-skill positions and experiences no upgrading. Any or all of these forms of relative skill impoverishment are empirically plausible and theoretically interesting propositions, but they make less effective revolutionary rhetoric than the argument of absolute general decline.

Marx's hopes, indeed his expectations, that fundamental social change was imminent also color his discourse. If the forces that might encourage the upgrading and broadening of workers' skills operate primarily over longer periods, and if Marx expected basic social change before these trends had much effect, it is understandable that he did not spend much time developing an argument about this upgrading future. The role of polemic is heightened by the fact that Marx saw himself as an active participant in the political and ideological struggle for change, and highlighting the injustices of the present was one of his ways of playing a political role. Showing that over the recent period and into the immediate future "things are bad and may even be getting worse" is a powerful rhetorical device for crystallizing opposition. But this call for revolt does not fit easily with long-term theoretical argument for the inevitability of revolution based on the

[25]Written 1865, available in K. Marx and F. Engels, *Selected Works in Three Volumes* (Moscow, 1969). On the evolution of Marx's thinking on wages, see B. Rowthorn, *Capitalism, Conflict and Inflation* (London, 1980), chap. 7.

[26]Marx (n. 23 above), pp. 765 ff. The passages on p. 798 are quite explicit that growing pauperization is not the lot of the working class as a whole, but of its "reserve army"; p. 799, however, leaves much greater ambiguity.

[27]Braverman (n. 1 above), p. 129, writes of a "secular trend toward the incessant lowering of the working class as a whole below its previous conditions of skill and labor."

inescapable laws of evolution. (Recall Marx's proposed dedication of *Capital* to Charles Darwin.) These three levels of analysis—revolt, revolution, and evolution—can be combined, but only at the cost of a constant differentiation of short term and the long term, and such attention to theoretical nuance is a common victim of polemic. It is important, too, to recall that Marx expended much effort in trying to formulate *Capital*'s argument in accessible terms.[28] His success on this score is hardly obvious, but his intention might help explain the role of polemic in it.

Marx on Skill before Large-Scale Industry

If we distinguish between short and long term and between theory and polemic, other parts of Marx's analysis appear in a different light. In particular, if Marx did leave room in his model for a globally positive influence of capitalist industry on skill requirements, it is important to look backward and ask whether such an upgrading trend would constitute a reversal or a continuation of previous historical trends. The conventional reading is that Marx saw both the transition from handicraft to manufacture and that of manufacture to large-scale industry as attacks on craft and thus as attacks on workers' skill requirements. I submit that the attack on craft may in Marx's model be associated with an increase in skill requirements.

Take first the passage from handicraft to manufacture. At first reading, the deskilling interpretation appears self-evident, since Marx emphasizes that apprenticeships are reduced or eliminated.[29] But he also mentions the emergence of "new and comprehensive" functions and offers neither empirical evidence nor theoretical rationale for assuming that these exceptions will not counterbalance or even outweigh the effects of work simplification.[30]

[28]Writing to Maurice La Châtre in the preface to the French edition: "Dear Citizen, I applaud your idea of publishing the translation of *Capital* as a serial. In this form the book will be more accessible to the working class, a consideration which to me outweighs everything else" (Marx [n. 7 above], p. 104).

[29]"Hence in every craft it seizes, manufacture creates a class of so-called unskilled labourers, a class strictly excluded by the nature of handicraft industry. If it develops a one-sided specialty to perfection at the expense of the whole of a man's working capacity, it also begins to make a specialty of the absence of all development. Alongside the gradations of the hierarchy, there appears the simple separation of the workers into skilled and unskilled. For the latter, the cost of apprenticeship vanishes; for the former, it diminishes, compared with that required of the craftsman, owing to the simplification of the functions" (ibid., p. 470).

[30]"An exception to this law occurs whenever the decomposition of the labour process gives rise to new and comprehensive functions, which either did not appear at all in handicrafts or not to the same extent" (ibid.).

If we take now Marx's analysis of the passage from manufacture to large-scale industry, we find the same ambiguity. At first reading, capitalist industry appears a deskilling force, reducing manufacture's specialized workers to the role of machine minders.[31] But two factors complicate the issue and leave considerable doubt about the overall skill direction. First, the tendency to reduce all kinds of work to an identical level is at least in part counterbalanced by the creation of a new hierarchy in industry, distinguishing machine operators, machine feeders, and a "numerically unimportant group whose occupation it is to look after the whole of the machinery and repair it from time to time."[32] Again, Marx offers no prognosis for the subsequent evolution of the relative sizes of these groups. Second, and more critically, we need to understand how the skill requirements of each of the three groups in this new hierarchy of jobs compare with those of the manufacture period, and on this subject, Marx has little to say.

That Marx does not assess these aggregate effects probably results from his desire to insist on the proposition that under capitalist conditions all this deskilling and upgrading—whatever the resultant trend in average skill level or in skill distribution—happens at the expense of the individual workers' economic security. Marx appears to be arguing that, even if the global statistical effect is an upgrading one, society should be able to achieve the same effect without hurting so many in the process. This critique of the "anarchy" of capitalist development is, however, quite different from one based on a diagnosis of aggregate deskilling. What is clear is that the new skills in manufacture are not craft skills. But as we shall see, Marx does not conflate skill and craft—craft is only one form of skill.

The Underlying and Ambivalent Process: Separating Workers from the Conditions of Production

I have argued that the impression of many readers that Marx saw capitalist industry as entailing a deskilling derives from *(a)* Marx's focus on the peculiar manner in which capitalism muddles through on what may have been in Marx's view an upgrading trend, *(b)* Marx's polemical style, and *(c)* the confusion of wage levels and skill levels. My discussion of the handicraft-manufacture-industry sequence allows us to identify a final, more deep-seated source of confusion in the

[31]"Along with the tool, the skill of the worker in handling it passes over to the machine. . . . Hence, in place of the hierarchy of specialized workers that characterizes manufacture, there appears in the automatic factory a tendency to equalize and reduce to an identical level every kind work that has to be done by the minders of the machines" (ibid., p. 545).

[32]Ibid.

ambivalence Marx attaches to the long-run process of social and technological development.

In his general analysis of the succession of modes of production, Marx argued that capitalist development was based on and furthered a millennial process of separating the worker from the conditions of production—the natural, human, and man-made means of production and consumption.[33] Clearly, there is something tragic in the disruption of earlier societies' "organic" unity. But in Marx's view, this multifaceted dissolution/separation also has a fundamentally emancipatory significance, since it brings with it a "universality and comprehensiveness" of "relations and capacities."[34] Thus, under capitalist

[33]". . . the relation of labour to capital, or to the objective conditions of labour as capital, presupposes a process of history which dissolves the various forms in which the worker is a proprietor, or in which the proprietor works. Thus above all (1) *Dissolution* of the relation to the earth—land and soil—as natural condition of production—to which he relates as to his own inorganic being, the workshop of his forces, and the domain of his will. All forms in which this property appears presuppose a *community*, whose members, although there may be formal distinctions between them, are, as members of it, *proprietors*. . . . (2) *Dissolution of the relations* in which he appears as *proprietor of the instrument*. Just as the above form of landed property presupposes a *real community*, so does this property of the worker in the instrument presuppose a particular form of the development of manufactures, namely *craft, artisan work;* bound up with it, the guild-corporation system etc. . . . Here labour itself still half artistic, half end-in-itself etc. Mastery. Capitalist himself still master-journeyman. Attainment of particular skill in the work also secures possession of instrument etc. etc. Inheritability then to a certain extent of the mode of work together with the organization of work and the instrument of work. Medieval cities. Labour still as his own; definite self-sufficient development of one-sided abilities etc. (3) Included in both is the fact that he has the means of consumption in his possession before production, which are necessary for him to live as producer—i.e. during production, *before* its completion. . . . (4) *Dissolution* likewise at the same time of the relations in which the *workers themselves*, the *living labour capacities* themselves, still belong *directly among the objective conditions of production*, and are appropriated as such—i.e. are slaves or serfs. For capital, the worker is not a condition of production, only work is. If it can make machines do it, or even water, air, so much the better. And it does not appropriate the worker, but his labour—not directly, but mediated through exchange. These are, now, on one side, historic presuppositions needed before the worker can be found as a free worker, as objectless, purely subjective labour capacity confronting the objective conditions of production as his *not-property*, as *alien property*, as *value* for-itself, as capital." K. Marx, *Grundrisse* (Harmondsworth, 1973), pp. 495–96.

[34]"Universally developed individuals, whose social relations, as their own communal [*gemeinschaftlich*] relations, are hence also subordinated to their own communal control, are no product of nature, but of history. The degree and the universality of the development of wealth where this individuality becomes possible supposes production on the basis of exchange values as a prior condition, whose universality produces not only the alienation of the individual from himself and from others, but also the universality and the comprehensiveness of his relations and capacities. In earlier stages

conditions the process of separation appears in two contradictory lights: on the one hand, in its capitalist form, it is employment insecurity and the fragmentation and deskilling of craft work; on the other, in its substance, it is the premise of what Marx presents as a new degree of socialization of the forces of production.[35]

I believe we can establish a parallel between the relationship of separation to deskilling and a more philosophical couple whose relationship has been more extensively discussed, namely, the relationship of objectification to alienation. In Marx's analysis, mechanization is a form of objectification of human capabilities, and the form taken by this objectification in capitalist contexts is alienation. The human capabilities objectified in technology confront the worker as an alien force since they have become the property of the capitalist.

Some commentators conflate objectification and alienation: they would no doubt also conflate separation and deskilling. This clearly misses an interesting aspect of Marx's analysis. Other commentators would want to maintain the conceptual difference between objectification and alienation and between separation and deskilling but argue that under capitalism the first term in each pair manifests itself only in the form of the second. This approach misses, I believe, the thrust of Marx's argument as we saw it earlier—that "the development of the contradictions of a given historical form of production is the only historical [as opposed to philosophical] way in which it can be dissolved and then reconstructed on a new basis."[36] It is because the positive effects of separation are real, as opposed to only virtual, potential, or philosophical, that they can shape the historical process.

The negative side of the separation of the worker from the conditions of production is not primarily the loss of craft immediacy; the key negative aspects lie rather outside the labor process, in separation of workers and owners and in the separation of productive

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of development the single individual seems to be developed more fully, because he has not yet worked out his relationships in their fullness, or erected them as independent social powers and relations opposite himself. It is as ridiculous to yearn for a return to that original fullness as it is to believe that with this complete emptiness history has come to a standstill" (ibid., p. 162).

[35]"This process of separation starts in simple cooperation, where the capitalist represents to the individual workers the unity and will of the whole body of social labour. It is developed in manufacture, which mutilates the worker, turning him into a fragment of himself. It is completed in large-scale industry, which makes science a potentiality for production which is distinct from labour and presses it into the service of capital" (Marx [n. 7 above], p. 482).

[36]Ibid., p. 619.

units into independent firms competing on the market. This double separation creates the fundamental economic insecurity of the worker, whose employment, and therefore whose access to the means of consumption, is dependent on the intrinsically uncertain market fortunes of his or her employer.

On the positive side, Marx saw the separation of workers from the conditions of production as the driving force behind two key forms of real socialization. In identifying these forms of socialization, we shall see that where many commentators have found in Marx a deskilling diagnosis and prognosis, we may more fruitfully see a thesis highlighting fundamentally progressive effects: the form poses real problems, but the progressive import of the substance is no less real. Indeed, the substance progressively imposes itself on the form.

At the macro (interfirm) level, socialization appears in Marx's analysis in the form of the growing interdependence of branches of industry. One of the key dimensions of this interdependence is the increasingly differentiated relationship between the production of means of production (Department I) and the production of consumption goods (Department II). More generally, new branches of industry are continually emerging, and the international interindustry input-output table becomes progressively more complex and dense. This process of specialization-interdependency-socialization is key to capitalism's ability to sustain a historically unprecedented rate of productivity growth.

At the micro (intrafirm) level, socialization appears as cooperative labor.[37] It is true, argues Marx, that under capitalist conditions this collectivity is "merely objective" since it is controlled by the capitalist. But it nevertheless provides workers with an important experience of disciplined coordinated activity, thus providing a necessary if not sufficient condition for this objectively "collective laborer" to become a subjective political reality of a united class-for-itself. Where authors like Braverman see destruction of the craftsman's individual autonomy, Marx would thus in many instances presumably see a progressive tendency toward technical interdependence within a collective laborer. Moreover, it is also true that this interdependence is based on a task specialization that destroys the craftsman's breadth of expertise, and that specialization will ceteris paribus reduce skill requirements.

[37]Machinery, with a few exceptions, "operates only by means of associated labour, or labour in common. Hence the cooperative character of the labour process is in this case a technical necessity dictated by the very nature of the instrument of labour" (ibid., p. 508).

This is the essence of the Babbage principle.[38] But if specialization occurs in a context of ongoing mechanization/automation, then such specialization will often require greater depth of expertise—and this greater depth can, and often does, outweigh the deskilling effects of the narrowing of breadth. The *Grundrisse*'s analysis of automation is particularly revealing of Marx's image of the resulting trends in work. Here Marx argues that the craft form is replaced by a collective laborer composed of *(a)* "general scientific labour,"[39] that is, technicians, engineers, and scientists required for the development of new technology, and *(b)* machine supervision—a form of labor in which the worker's experience-based "art" has been replaced by an education-based "understanding of nature."[40]

These macro- and micro-level transformations are labeled "socialization" because they draw workers out of the isolation of self-contained jobs and industries. This is the essence of Marx's critique of rural "idiocy" in the *Communist Manifesto*. As Hal Draper has pointed out, the German *Idiotismus* does not mean "idiocy" but refers to the Greek *idiotes:* a private person, withdrawn from public or communal concerns.[41] This etymology clarifies Marx's critique of "craft idiocy" and Proudhon.[42] Marx would agree that the separation process attacks the status of craft—a concern, however, proper to that small minority of the working population which may have ever claimed the status of

[38]"The master manufacturer, by dividing the work to be performed into different processes each requiring different degrees of skill and force, can purchase exactly that precise quantity necessary for each process; whereas, if the entire work is executed by one workman, that person must possess sufficient skill to perform the most difficult, and sufficient strength to carry out the most labourious of the operations into which the art divided." C. Babbage, *On the Economics of Machinery and Manufactures* (London, 1832), pp. 137–38.

[39]Marx (n. 33 above), p. 700.

[40]The operator of the automatic system "steps to the side of the production process instead of being its chief actor. In this transformation, it is neither the direct human labour he himself performs, nor the time during which he works, but rather the appropriation of his own general productive power, his understanding of nature and his mastery over it by virtue of his presence as a social body—it is, in a word, the development of the social individual which appears as the great foundation stone of production and wealth" (ibid., p. 705).

[41]H. Draper, *The Annotated Communist Manifesto* (Berkeley, Calif., Center for Social History, 1984). I am grateful to Michael Howard for drawing my attention to this point.

[42]"What characterizes the division of labour in the automatic workshop is that labour has there completely lost its specialized character. But the moment every special development stops, the need for universality, the tendency towards an integral development of the individual begins to be felt. The automatic workshop wipes out specialists and craft-idiocy." K. Marx, *The Poverty of Philosophy* (Moscow, 1963), p. 138.

craftsman.[43] Moreover, Marx would agree that in its capitalist form the skill-upgrading effect experienced by the majority is too often "merely statistical." But in his less polemic moments, Marx was, I submit, arguing that this separation is a fundamentally progressive process: not only is it the only way that socialization of production and growth of social productivity can proceed,[44] but even its direct influence on the experience of work is positive—certainly for the large number of previously totally unskilled laborers whose positions are upgraded to semiskilled, and quite plausibly even for the elite of craft workers whose role progressively shifts toward that of technicians, with a corresponding broadening of their intellectual and social horizons.[45]

Two Utopias in Marx

There is one final hurdle to surmount if we are to accept an upgrading reading as tenable and if we are to fully appreciate the provocative nature of Marx's views on machines and skill: the question of the significance of work per se. On the one hand, we have the conventional reading based on the Marx of the *1844 Manuscripts:* work should be a self-actualizing activity.[46] From this point of view, the fact that the task of machine supervision—which is all that remains for the shop-floor production worker—seems doomed to boredom under capitalist conditions is interpreted as a scathing critique of capitalism.[47] Emptied of all tangible content and significance, the work of the machine supervisor has been reduced to a mere "abstraction."[48] While there may be opportunities for more satisfying work for engineers and technicians, the operator's lot seems hopeless.

[43]Form (n. 1 above).

[44]Rosenberg, both works (n. 19 above).

[45]P. Zarifian, "Crise de la production et tendances du mouvement historique," *La Pensée* (October 1979): 3–18; L. Hirschhorn, *Beyond Mechanization* (Cambridge, Mass., 1984), pp. 97–98.

[46]K. Marx, *Economic and Philosophical Manuscripts of 1844* (Moscow, 1964).

[47]"Factory work exhausts the nervous system to the uttermost; at the same time, it does away with the many-sided play of the muscles and confiscates every atom of freedom, both in bodily and in intellectual activity. Even the lightening of the labour becomes an instrument of torture, since the machine does not free the worker from the work, but rather deprives the work itself of all content" (Marx [n. 7 above], p. 548).

[48]"This economic relation—the character which capitalist and worker have as the extremes of a single relation of production—therefore develops more purely and adequately in proportion as labour loses all the characteristics of art; as its particular skill becomes something more and more abstract and irrelevant, and as it becomes more and more a purely *abstract activity*, a purely mechanical activity, hence indifferent to its particular form" (Marx [n. 33 above], p. 297).

On the other hand, in his critique of Proudhon and craft idiocy, Marx seems to reject out of hand the idea of restoring some more tangible content to the worker's job. He caricatures the pinmaking craftsman as reduced to "the consciousness of the pin."[49] Why is Marx so scornful of the value of the pinmaker's craft? The underlying logic of Marx's position has, I submit, three elements. First, as already mentioned, Marx saw no turning back. He saw the economic pressures flowing from the superiority of the new technology as sufficient to ensure the obsolescence of the craft form. Second, as discussed earlier, the craft form itself was, in Marx's view, too "narrow" and privatizing. There is, however, a third element to Marx's position: Marx seems to have believed that under any social conditions most work would have a fundamentally mundane objective and as such could not be anything other than basically boring. Clearly changes in social relations in the workplace and in the property regime and changes that give workers some control in the design of the labor process and in the determination of production objectives could mitigate the trend toward abstraction and the boredom of machine supervision. But when the production of material necessities is contrasted with the free exercise of human creativity, it becomes obvious that the former necessarily lacks the spiritual value of the latter. In a different mode of production, labor might be more consciously directed to social needs, and such a transformation could restore to work some of its higher, altruistic meaning. But even a change of the mode of production cannot restore to work the central role that it played in the formation of worker self-identity under the craft regime, when the worker was absorbed by his or her task and when social identity was based on, and largely circumscribed by, work roles. Automation, therefore, plays a profoundly progressive role by highlighting this contrast—not by deskilling work, but by stripping it of its romance. The worker is no longer absorbed in the complexities of producing widgets: the worker simply controls the operation of an automatic widget plant. Even if work becomes more skilled, it may lose its intrinsic meaning.

Such appears to be the logic of Marx's second utopia, expressed in *Capital,* in which freedom and self-actualization lie beyond the realm of necessity, in the realm of creative activity proper to truly free time.[50]

[49]"The automatic workshop wipes out specialists and craft idiocy. Mr. Proudhon, not having understood even this one revolutionary side of the automatic workshop, takes a step backward and proposes to the worker that he make not only the twelfth part of a pin, but successively all twelve parts of it. The worker would thus arrive at the knowledge and the consciousness of the pin" (Marx [n. 44 above], p. 138).

[50]Marx (n. 23 above), p. 820.

In this utopia, work time is reduced to a minimum by virtue of automation and a transformation of social priorities. To the extent that the romance of labor is eliminated by capitalist automation, capitalism is, Marx seems to suggest, confronting humanity with our higher spiritual needs. Marx seems to be saying: if the postmodern workers at the control panel of a chemical plant find their work boring despite its high training and responsibility requirements, if they have a "merely instrumental" attitude toward their work, so much the better; such is the fruit of civilization—that workers can find their free time more important to their self-identity than work, even skilled work. This utopia's vision of quantitative reduction competes with the earlier vision of qualitative enhancement for preeminence in Marx's vision of the ideal future.

Is This Upgrading Thesis Empirically Tenable?

It is not the task of this article to assess the validity of the theory I have attributed to Marx. But the reader is entitled to some indication as to whether this theory has any prima facie empirical support. Since others have already collected the available data, it would seem excessively niggardly not to summarize what is known about skill trends, automation's effect on work, and the effect of work on attitudes.

Spenner reviews the available larger-scale and longer-term statistical studies of skill trends.[51] He concludes *(a)* that the skill content of the jobs in each occupation has, on average, slightly increased or remained stable, and *(b)* that the skill profile of the labor force as a whole has been substantially upgraded by compositional shifts. It is noteworthy that none of these studies shows deskilling in either job content or occupational composition. Only one of the studies, that of Dubnoff, addresses the secular time frame that has been the object of this essay.[52] Dubnoff analyzes the U.S. occupational structure from 1900 to 1970, and Spenner summarizes the study as showing "little net change."[53] Spenner's presentation is, however, based on his own reanalysis of the data, which highlight the lack of upgrading in each specific cell in a matrix distinguishing male from female workers and blue-collar from white-collar employees.[54] But it is precisely through the elimination of domestic help positions and of laborer positions in farms and factories and

[51]K. Spenner, "Deciphering Prometheus: Temporal Changes in the Skill Levels of Work," *American Sociological Review* 48 (1983): 824–37.

[52]S. Dubnoff, "Interoccupational Shifts and Changes on the Quality of Work in the American Economy," paper presented at the annual meeting of the Society for the Study of Social Problems, San Francisco, 1978.

[53]Spenner (n. 51 above), p. 832.

[54]K. Spenner, "Temporal Changes in the Skill Level of Work: Issues of Concept,

through the growth of professional and technical positions that much of the compositional upgrading has operated (see table 1).

We can use the U.S. Employment Service's Dictionary of Occupational Titles to estimate the average skill level of the 1900 and 1970 work forces. Using the 1950 scores of "general skill requirements" to rate occupational categories in both 1900 and 1970, we find that the index of average skill level increases from the equivalent of 10.3 years of schooling required in 1900 to 11.2 in 1970.[55] Thus, the effect of the changing occupational structure—as distinct from the effect of changes in the component individual jobs—is probably an upgrading one. Under these conditions, the plausibility of the deskilling hypothesis can be sustained only if we believe that skill requirements for individual jobs within each occupation have undergone a systematic downgrading sufficient to more than compensate for this compositional upgrading effect. Again, Spenner's review found not one study showing a long-run deskilling trend of individual occupations; in fact, most show a small but clear net upgrading of the average occupation, and all show a considerable upgrading of the labor force as a whole.

In contrast to this statistical approach, Flynn analyzes 197 case studies published between 1940 and 1985 and finds that some support and others contradict Braverman's thesis.[56] The distinction drawn earlier between short-term, localized effects and longer-term, aggregate effects might help reconcile apparently contradictory findings of the statistical and the case-study research: the vast majority of Flynn's studies do not focus on the longer-term evolution of skills and highlight instead the prevalence of management's deskilling intentions.

If we look for skill-trend data going back further than 1900, perhaps the strongest case has been argued by Form.[57] His compilation of twelve historical studies reaching back into the 18th and 19th centuries concludes that, while skill levels may have diminished in specific instances, the historical record is unambiguous in contradicting the aggregate deskilling thesis. Craftsmen have never been more than a small minority of the work force.

These skill-trend studies do not, however, address the more specific question of the role of automation in changing work. The only

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Method and Comparison," paper presented at the Tenth World Congress of Sociology, Mexico City, 1982.

[55]I have calculated these results from the data in R. Rumberger, "The Changing Skill Requirements of Jobs in the U.S. Economy," *Industrial and Labor Relations Review* 34 (1981): 578–95.

[56]P. Flynn, *Facilitating Technological Change* (Cambridge, 1988).

[57]Form (n. 1 above).

TABLE 1
OCCUPATIONAL STRUCTURE

Employed Population over Sixteen Years Old (%)	1900	1970
White-collar workers:		
Professional, technical	4.3	14.5
Managers, officials, proprietors	5.8	8.1
Clerical	3.0	17.8
Sales	4.5	7.1
Manual and service workers:		
Craftsmen, foremen	10.6	13.9
Operatives	12.8	18.0
Laborers (excluding farms, mines)	12.5	4.7
Private household workers	5.4	1.5
Other service workers	3.6	11.3
Farm workers:		
Farmers, farm managers	19.9	1.8
Farm laborers, foremen	17.7	1.3

SOURCE.—*Historical Statistics of the United States* (U.S. Department of Commerce, Bureau of the Census, 1975), Series D182-232.

systematic job content data that give some sense of the influence of automation are presented by Mueller.[58] On the basis of a representative sample (N 2,662) of men and women in the 1967 U.S. labor force, Mueller and her colleagues found that of those workers who had been in the same job for the previous five years and had experienced a machine change during that time, 53 percent felt their job now required more skill, 36 percent felt it required about the same degree of skill, and only 7 percent felt it required less skill.[59] (See table 2.)

Finally, what about the thesis that the experience of skilled work builds workers' capabilities for political action? Here the research program of Kohn and his associates has provided powerful empirical support for the proposition that "self-directed work leads to ideational flexibility and to a self-directed orientation to self and society; oppressive working conditions lead to distress."[60]

[58]E. Mueller, *Technology Advance in an Expanding Economy* (Ann Arbor, Mich., 1969).

[59]These data may suffer from respondent bias. They probably further overstate the upgrading effect because, if a job is deskilled, the incumbents are likely to be replaced, while if it is upgraded, incumbents are more likely to be retrained or stretched. I am grateful to Sam Cohn for pointing this out to me.

[60]M. L. Kohn and C. Schooler, "Job Conditions and Personality: A Longitudinal Assessment of Their Reciprocal Effects," *American Journal of Sociology* 87 (1982):1257. See also Kohn and Schooler, *Work and Personality: An Inquiry into the Impact of Social Stratification* (Norwood, N.J., 1983).

Naturally, these brief notes do not prove that the theory I have attributed to Marx is correct. But they do demonstrate that such a theory may hold some interest beyond the archaeology of ideas.

Implications for Research: What Is Skill?

Marx observed on numerous occasions that artificial skill distinctions are often maintained by active worker resistance in specific market conditions. One might imagine pushing this line of reflection further, to ask whether there can be any significance at all to the comparison of such extremely different skill sets as those required by a craftsman in one century and by an engineer in the next century, let alone by an agricultural laborer in the previous century. Indeed, one might wonder whether "skill" had any real significance beyond serving as an ideological label for codifying relative prestige and status. Marx's approach offers one way to clarify a complex theoretical issue.

Let us begin with the technical-economic determinations of skill. In Marx's economic theory, skill refers to the value of a given quality of labor power relative to the baseline quality of simple labor.[61] In a

TABLE 2

IMPACT OF MACHINE CHANGE ON WORK FOR THOSE IN THE SAME JOB FOR THE PAST FIVE YEARS AND HAVING EXPERIENCED MACHINE CHANGE

(N = 170, in percentages)

Automation and Work Requirements	More	Same	Less	Not Ascertained
Speed required	48	44	5	3
Physical effort required	15	34	47	4
Interest	60	31	5	4
Skill required	53	36	7	4
Opportunity to learn	49	42	3	6
Planning, judgment, initiative required	49	42	3	6
Own influence on work	48	43	5	4
Seriousness of errors	31	53	11	5
Influence on quality (production workers only)	29	37	10	24
Pleasantness of physical surrounding	20	66	10	4
Danger of personal injury	15	56	25	4
Chance to talk	20	64	12	4

SOURCE.—E. Mueller, *Technology Advance in an Economy* (Ann Arbor, Mich., 1969), pp. 120–21.

[61]Skill is therefore not a dichotomous category, but one permitting graduations. The appearance of such a continuous category is relatively recent. Marx describes (n. 32 above) how the early factory fairly unambiguously trichotomized workers as skilled, worker apprentices, and common laborers.

market system in which labor power is treated as a commodity, the determination of the relative values of different qualities of labor power works the same way as the determination of the relative values of other commodities: by the scarce resources required for the (re-)production of that labor power's specific qualities (and for Marx, the only truly scarce resource is labor time). In Marx's economic model, prices fluctuate around values: the wage differential between skilled and unskilled workers would thus fluctuate around the value determined by this socially necessary training time. From a technical (use value) point of view, skill is a set of capabilities whose magnitude can in principle be measured by the required training time (formal and informal, but socially recognized), and deskilling is brought about by simplifying previously more complex (i.e., training-intensive) labor. If training technology improves, workers' capabilities—skill viewed technically—do not change, but their economic (exchange value) yardstick does. If general education raises the capabilities of simple labor, again the capabilities of the more skilled worker are unchanged, but their relative economic value is reduced. Both these economic effects can be mitigated or even outweighed if workers maintain their share of total value added, since the total pie will expand with the resulting (technical) productivity increase. Marx's analysis of the commercial workers shows this approach at work.

There are, of course, good reasons to think that labor power is not easily treated as a commodity,[62] and that there are many other determinants of both education and wages: the social recognition of training time is an extremely tenuous procedure; diplomas give rise to rents; and market fluctuations and the market power of different categories of workers intervene. Apart from these factors, it is important to note that the value determination of wages is itself a fragile process (but then labor power is certainly not the only commodity for which this is true): in the case of labor power, the lag between the production and sale of skills is particularly long, and therefore the disjunction of individual (expected) value and social (realized) value is more frequent. But none of this vitiates the theoretical usefulness of the economic model: it merely reminds us that it does not exhaust the analysis.

At least one crucial dimension is missing from this analysis. Over time, not only does this quantitative value determination change, but

[62]S. Bowles and H. Gintis, in "Structure and Practice in the Labor Theory of Value," *Review of Radical Political Economy* 12 (1981): 1–26, argue that labor power is not a commodity in any sense because it is not the product of a capitalist production process. But this ignores petty commodity production as a possible model of training in which workers are like individual producers, developing their own skills for sale.

also the qualities for which the worker is trained—in other words, the qualitative determinations of labor. It is these qualities that authors like Braverman attempt to encapsulate in the notions of autonomy and control. But we have already seen that the craft model of autonomy and control is inadequate because increasingly obsolete. In another article, I have proposed an alternative approach in which a dimensionalization of these qualitative factors is grounded in three key conditions of existence of the market form of society: the split between the private ownership of productive units and social nature of demand, the distinction between concrete forms of labor and abstract, commensurable labor time, and the contrast between the collective nature of most productive activity and the individual form of the wage. These can be related to three dimensions of work, respectively: whether the worker is responsible only for providing "a fair day's work for a fair day's pay" or is expected to take some personal responsibility for the integrity of the operation and the product; the manual or mental nature of expertise and the concrete or less tangible nature of goals; and the degree of independence versus interdependence of workers, work groups, and functions.[63]

Further, one might see a "superstructure" of skill concepts built on this quantitative and qualitative "technical-economic base." Beyond its technical-economic determinations, skill, as a socially significant category, usually has political determinations, reflecting the power of different actors (workers, managers, specific categories of workers or managers, state agencies) to influence skill assessments and the wage levels attached to skill levels. It also has ideological determinations, reflecting the influence of inherited biases such as those that privilege mental over manual work, men's work over women's, and so forth. These other levels of determination merit close attention. Research might be advanced, however, if the efficacy of the underlying technical-economic determinations, especially over the longer term, were kept in view.

Implications for Research: Technology as Cause and as Effect

This article has focused on mechanization's effect on skill. Other writers, however, have argued that the more useful approach may be to reverse the question and ask whether machine design is itself determined by capitalists' drive to deskill and control workers—as distinct from an objective of increasing profits and reducing overall

[63]P. S. Adler, "Technology, Skill and the Future of Capitalism," *Berkeley Journal of Sociology* 33 (1988): 1–36.

unit costs.[64] In part, this reversal of the research question is motivated by concerns stemming from the assumption that mechanization has been accompanied by deskilling. If, despite the data cited earlier, there is a deskilling trend, then it is natural to ask whether this deskilling is due to the nature of the equipment being used or to the way in which it is used; and, if deskilling is due to equipment design, it is natural to ask whether this reflects inescapable technical requirements or capitalist influence on machine design/selection. Researchers who believe the deskilling thesis thus understandably find the subject of capitalist influences on machine design particularly important, because the alternative is a nihilism of the kind Marcuse expressed when he described automation as "a catastrophe of the human essence."[65]

The research into capitalist influence on machine design works with a handicap, however. It is very easy to show *some* capitalist influence. But demonstrating the strong version of the thesis means showing that deskilling and control intentions are the *dominant* factor—and that is exceedingly difficult. Even Noble's analysis of the well-circumscribed case of the transition from conventional to numerically controlled machine tools fails to show that performance characteristics did not weigh more than the deskilling intentions he manages to document.[66] Building the evidence for a general argument along entire technological trajectories, let alone for a broad sample of such trajectories, would be even more difficult.

One source of confusion in this literature lies in a common misconception about machine design, namely, that machines in some sense "embody" workers' skills, that mechanization consists essentially of the "expropriation" by capitalists of workers' skills and the transfer of these skills from worker to machine. But Marx makes a telling criticism of precisely this premise when he writes that "it is not labour, but the instrument of labour, that serves as the starting point of the machine."[67] The vector of mechanization is less determined by desires to remodel work requirements than by opportunities and constraints created by the accumulation of scientific and technological know-how. Indeed, this generalization becomes progressively more valid as technology develops and frees itself from the limiting base of artisanal

[64]MacKenzie (n. 2 above); D. MacKenzie and J. Wajcman, *The Social Shaping of Technology* (Milton Keynes, 1985).

[65]H. Marcuse, "Neue Quellen zur Grundlegung des Historischen Materialismus," in *Philosophie und Revolution: Aufsatze von Herbert Marcuse* (Berlin, 1967), cited by Braverman (n. 1 above), p. 182.

[66]Noble (n. 1 above).

[67]Marx (n. 7 above), p. 500.

know-how.[68] A corollary of the embodiment thesis is widely held too: many observers still believe that job simplification is the normal precondition for automation. This is even less true today than it was when Marx wrote, since, once the productive forces reach a certain level, technology can "resolve [the production process] into its constituent elements without looking first at the ability of the human hand to perform the new processes."[69] Despite some rhetorical flourishes,[70] Marx seemed therefore to believe that while capitalist economic pressures accelerated the rate of technological change, the overall direction of mechanization was primarily shaped by technical and scientific factors rather than the sociopolitical forces that Noble argues lead capitalists to deskill work.

This technological-determinist view of the evolution of mechanization also suggests two potentially fruitful lines of research into a difficult question: granting that capitalists have no systematic need to deskill, why should productivity growth require workers who have, on average, higher levels of skill? Why cannot productivity growth be sustained by ever-more-powerful machines designed by a small number of increasingly skilled engineers but operated by a much larger number of workers with stable or declining skill levels? First, even a constant rate of technological growth implies that the absolute amount or frequency of change faced by the worker over (say) a year's work will increase from year to year. Absorbing such an acceleration of change might plausibly require a deeper and broader knowledge base. Cognitive science research into the learning process might be useful in exploring this issue.[71] Second, the intrinsic technical difficulty of machine design might help explain the upgrading bias of mechanization. We would expect that engineers designing automation would first tackle the simpler problems—transformation and material-handling functions in particular—leaving the worker with the functions such as control that are more technically difficult to automate.[72] It seems, therefore, reasonable to hypothesize that there

[68]Rosenberg (n. 19 above).

[69]Marx (n. 7 above), p. 616.

[70]"It would be possible to write a whole history of the inventions made since 1830 for the sole purpose of providing capital with weapons against working-class revolt." Marx, *Capital* (Harmondsworth, 1976), 1:563, as quoted by MacKenzie (n. 2 above). Note the qualifiers characteristic of the polemical rhetoric—Marx promises only a whole history, and not the whole history, and he doesn't propose to go back very far.

[71]L. Resnick, *Education and Learning to Think* (Washington, D.C., 1987).

[72]R. M. Bell, *Changing Technology and Manpower Requirements in the Engineering Industry* (Brighton, 1972). See also R. B. Gordon, "Who Turned the Mechanical Ideal into

is an approximate but felicitous correlation between technical difficulty (for the automation engineer) and human complexity (for the machine operator). This correlation is only approximate: handling nonrigid materials and visual pattern recognition are two counterexamples of functions that are relatively simple for humans but very difficult to automate. Such counterexamples help explain the persistence of low-skill jobs such as machine feeding and data entry that are often left at the interstices of automated systems. But the correlation remains remarkably strong: the intellectual, social, and creative functions that account for the complexity of highly skilled work are as yet well beyond the reach of even the most advanced technologies.[73]

The upgrading effect of automation might thus be rooted in technological opportunities and constraints, even though this conceptual strategy requires that we restore to technology some of the causal weight that many neo-Marxist and other "social constructionists" have worked so hard to eliminate.

Conclusion

This article has been largely an exercise in exegesis. Its question has been "what did Marx think?" The answer I have suggested rests primarily on distinguishing Marx's critique of the short-term skill-change process—which Marx denounced as proceeding in typically capitalist manner, that is, too often at the expense of the individual worker—from the longer-term skill trends. I have suggested a reading according to which Marx saw this latter trend as an upgrading one. The underlying motive of this discussion has been to identify some new research directions by clarifying the substance of Marx's theory and distinguishing it from its polemical form. The field of research on automation and work was given a powerful impetus by Braverman. Ensuing debates have been lively; but the intellectual vigor of the underlying research has not kept pace. A clearer understanding of Marx's theory, whether or not one agrees with this theory, might help renew and reinvigorate the field.

Appendix

Excerpt from K. Marx, Capital *(New York, 1977), 1:617–19*

Modern industry never views or treats the existing form of a production process as the definitive one. Its technical basis is there-

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Mechanical Reality?" *Technology and Culture* 29 (October 1988): 744–78, on the critical and increasing role of workers' skills in 19th-century firearms manufacturing.

[73]See H. Dreyfus and S. Dreyfus, *Mind over Machine* (New York, 1986).

fore revolutionary, whereas all earlier modes of production were essentially conservative. By means of machinery, chemical processes and other methods, it is continually transforming not only the technical basis of production but also the functions of the worker and the social combinations of the labour process. At the same time, it thereby also revolutionizes the division of labour within society, and incessantly throws masses of capital and of workers from one branch of production to another. Thus large-scale industry, by its very nature, necessitates variation of labour, fluidity of functions, and mobility of the worker in all directions. But on the other hand, in its capitalist form it reproduces the old division of labour with its ossified particularities. We have seen how this absolute contradiction does away with all repose, all fixity and all security as far as the worker's life-situation is concerned; how it constantly threatens, by taking away the instruments of labour, to snatch from his hands the means of subsistence, and, by suppressing his specialized function, to make him superfluous. We have seen, too, how this contradiction bursts forth without restraint in the ceaseless human sacrifices required from the working class, in the reckless squandering of labour-powers, and in the devastating effects of social anarchy. This is the negative side. But if, at present, variation of labour imposes itself after the manner of an overpowering natural law that meets with obstacles everywhere, large-scale industry, through its very catastrophes, makes the recognition of variation of labour and hence of the fitness of the worker for the maximum number of different kinds of labour into a question of life and death. This possibility of varying labour must become a general law of social production, and the existing relations must be adapted to permit its realization in practice. That monstrosity, the disposable working population held in reserve, in misery, for the changing requirements of capitalist exploitation, must be replaced by the individual man who is absolutely available for the different kinds of labour required of him; the partially developed individual, who is merely the bearer of one specialized social function, must be replaced by the totally developed individual, for whom the different social functions are different modes of activity he takes up in turn.

One aspect of this process of transformation, which has developed spontaneously from the foundation provided by large-scale industry, is the establishment of technical and agricultural schools. Another is the foundation of *écoles d'enseignement professionel,* in which the children of the workers receive a certain amount of instruction in technology and in the practical handling of the various implements of labour. Though the Factory Act, that first and meagre concession wrung from capital, is limited to combining elementary education with work in the factory, there can be no doubt that, with the inevitable conquest of political power by the working class, technological education, both theoretical and practical, will take its proper place in the schools of the workers. There is also no doubt that those

revolutionary ferments whose goal is the abolition of the old division of labour stand in diametrical contradiction with the capitalist form of production, and the economic situation of the workers which corresponds to that form. However, the development of the contradictions of a given historical form of production is the only historical way in which it can be dissolved and then reconstructed on a new basis. "Ne sutor ultra crepidam" ("let the cobbler stick to his last"), a phrase which was the absolute summit of handicraft wisdom, became sheer nonsense from the moment the watchmaker Watt invented the steam engine, the barber Arkwright the throstle, and the jeweller Fulton the steamship.