Volume Title: Coordination and Information: Historical Perspectives on the Organization of Enterprise

Volume Author/Editor: Naomi R. Lamoreaux and Daniel M.G. Raff, Editors

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-46820-8

Volume URL: http://www.nber.org/books/lamo95-1

Conference Date: October 23-24, 1992

Publication Date: January 1995

Chapter Title: The Puzzling Profusion of Compensation Systems in the Interwar Automobile Industry

Chapter Author: Daniel Raff

Chapter URL: http://www.nber.org/chapters/c8747

Chapter pages in book: (p. 13 - 34)

1 The Puzzling Profusion of Compensation Systems in the Interwar Automobile Industry

Daniel M. G. Raff

1.1 Introduction

The American automobile industry employed a fantastic diversity of compensation systems to pay its blue-collar employees during the interwar period. Some employees were paid according to a linear piece rate—that is, they received a fixed fee per unit of output. Others were paid according to more complex piecewise linear systems in which the piece rate was constant at a relatively low value over an initial range of output and then increased sharply for one or even several higher ranges of output. There were also systems in which the piece rate rose continuously with output. There were nonlinear piece-rate systems in which the piece rate increased continuously with output but at a decreasing rate. There were nonlinear systems that were concave upward rather than downward, that is, in which the payment per piece increased at an increasing rate as output grew.[1] There were even more varieties of group incentive schemes. These involved the same set of formal relations between output and compensation, but the output in question was that of a group of workers. The

Daniel M. G. Raff is associate professor of management at the Wharton School and a faculty research fellow of the National Bureau of Economic Research.

The author owes thanks for stimulating conversations or comments over the years to Chris Argyris, Michael Beer, Steven Berry, Alfred Chandler, Donald Critchlow, Russell Eisenstat, Avner Grief, Naomi Lamoreaux, Margaret Levenstein, James Mirrlees, Daniel Nelson, John Sutton, Peter Temin, and, most particularly, to David Landes. He also learned from discussants and audiences at the Econometric Society and Business History Conference annual meetings, the Columbia University, University of Michigan, and Washington Area Economic History workshops, and Bengt Holmstrom's brown-bag seminar at the Yale School of Organization and Management. Naomi Lamoreaux and Walter Licht made detailed and helpful comments on the penultimate manuscript. The author's research has been supported by the Division of Research of the Harvard Business School and the National Science Foundation. The usual disclaimer applies.

1. Emerson [n.d.] surveys the basic varieties of individual compensation systems in use at the time. Helpful diagrams accompany the text.

sizes of these groups varied widely. And there was more heterogeneity still. At Ford, employees were—and had been for years—paid by the hour.

The infancy of the American automobile industry may be said to have ended in the winter of 1913–14 when the idea of mass production and the implications of Ford's $5 day burst upon the public consciousness. At the time, many journalists noted, Ford was the only firm in the industry paying its employees exclusively by time rates. Individual piece rates were by far the commonest means of remuneration. About a decade later, a study conducted by the U.S. Department of Labor's Bureau of Labor Statistics (1926) reported on compensation practices in ninety-nine establishments (whose employment was said to represent about one-third of the industry as observed in the census of manufacturers conducted two years previously). It showed nearly 40 percent of the establishments with some sort of bonus scheme in place. In some of these establishments, the bonus was based on individual performance. In some, it was based on the performance of groups. Which type of scheme predominated is not clear, but there had definitely been some movement to the group basis. A 1934 article on compensation systems by the Detroit editor of *Automotive Industries* makes it clear that by the early thirties group schemes had become dominant and even ubiquitous. The point of the article is that the whole of the assembly industry seemed to be in the midst of a shift to time rates.[2] The diversity of the midtwenties is thus striking, but it also appears as one stage in a longer sequence. By the 1920s, payment systems had evolved from very individualistic schemes to ones oriented predominantly toward medium-sized groups. In the next decade, the focus would continue to evolve toward very large groups, even entire factories.

How are we to understand these patterns? It is widely believed that the industry switched briskly over to mass-production methods when the $5 day brought reporters and photographers into the Ford factories. I argue below that this is false. Ford's production techniques actually diffused quite slowly. In the mid- and even late twenties, production technology remained heterogeneous. This is the key to understanding the contemporary diversity of compensation systems.

Compensation schemes can function as important mechanisms of control in factories in which production is carried out by many independent decision makers (that is, workers). Compensation systems offer workers incentives that help shape their decisions about how hard to work and how to allocate their effort and attention. Which compensation system is best for a given factory depends on how the work tasks of these decision makers are related to product performance and to one another, which in turn depends on the nature of the production technology. With some technologies, these tasks might be

2. Denham 1934. The author remarks, in passing, that "group bonus methods of worker compensation have never been as general in parts plants as in car factories" (703). I will come back to this remark below.

relatively independent. With others, they might be coupled together extremely tightly.

This general perspective suggests that compensation systems ought to evolve with the production technology (or, more precisely, with the production system) deployed. Similarly, the diversity of such schemes ought to be a function of the diversity of production systems. The midtwenties' heterogeneity of compensation systems was driven by heterogeneity in the organization of production. The convergence of predominant types of compensation systems over time basically reflected a convergence of approaches to organizing production in the population of automobile plants. There was relatively great variety in the production systems in place in the midtwenties. Ford-style mass production did not triumph until later.

This paper begins with a sketch of the technological history of the automobile industry and an analysis of the implications of this history for workforce control and compensation. I then show that Ford's ideas really did diffuse at a slow pace and that there was considerable variety in the production systems employed by automobile firms in the 1920s. Finally, I use anecdotal evidence and some formal tests to explore the relationship between the production system and the method of compensation employed. The test results confirm the main hypothesis, but there is some unexplained variation as well. The paper closes with a discussion of the significance of such unexplained variance in the history of economic institutions.

1.2 Mass Production and Compensation

In the early years of the industry, all cars were assembled on sawhorses in the center of a low-ceilinged room. Workers fetched parts from bins around the edges of this area. They kept their tools on or near workbenches running around the perimeter. Most of the work involving tools took place on the workbenches. The parts themselves were often irregular, requiring careful filing and fitting. Most of this filing and fitting went on away from the sawhorses. Anyone who wanted to observe the fit, worker or manager, had to be physically very close to the piece to do so.

Lighting in these work spaces was often poor. Sightlines were frequently physically obscured. Because it was difficult to monitor the pace of work, material inputs spent a lot of time sitting around under this system; and labor certainly spent a lot of time walking around. The extent to which the latter was appropriate or simply a means of working less hard was quite difficult for managers to judge.

The best compensation system in such a setting is a piece rate. The early production process was a highly decoupled system. Roughly speaking, extremely small groups of people assembled each car from start to finish. For any particular assembler, then, there were very few other assemblers whose work pace could constrain his own. Put slightly differently, the outputs of most

individuals were close substitutes for one another. From the perspective of the owners of the company, more output was therefore unambiguously better, whoever it came from. Furthermore, the owners did not have much money tied up in physical capital in these factories. Most of their machinery was relatively inexpensive and general-purpose. The artisans owned many of their tools. The owners' main stake in the pace of production came from their ownership of materials and work in progress.

Ford perfected two improvements to this way of proceeding. The first of these, progressive assembly, made managing the chaos of the early shop floor much easier. Under this system, the men stayed put, and the parts and work flowed wherever they were needed. Monitoring and logistical control became much easier, and productivity increases were quite substantial. The Studebaker Corporation reorganized the layout of its automobile production facilities in 1913 to install progressive assembly. We can derive from its experience a rough rule of thumb of what shop-floor reorganization without any major capital investment might yield a competitive firm circa 1913, holding constant the degree of design complexity.[3] In this, the one example that has been documented, man-hours per car fell by about 47 percent.

This innovation coupled the work of assemblers far more tightly together. More precisely, it coupled tightly the work of all assemblers whose stations were not separated by buffer stocks. Within these groups, coordination of pace became much more valuable. This in turn increased the value of incentive systems that encouraged the workers to coordinate with one another. All other things equal, the optimal size of the group whose output should be measured would have grown.

Note, however, that this innovation by itself simply changed the layout of work. Job content remained, at least in principle, untouched. Controlling the expense of materials stocks had been rendered easier. But control over the flow of work itself remained elusive because the jobs remained highly artisanal. What more did the managers know, after all—and what more could they then control—about the work remaining? In the absence of other changes, the tasks themselves remained suitable only for highly skilled machinists working with a great deal of autonomy and exercising very great control over their time.

Ford's second essential innovation, which at Ford (but not at Studebaker and other firms) was apparently more or less simultaneous with the first, changed all this as well. Ford brought American-system production of parts—that is, production of parts standardized to such high tolerances that they were for all practical purposes interchangeable—into automobile manufacturing, and he did this on a more or less comprehensive basis. Suppliers were reluctant to dedicate their own capital equipment to making parts for a single customer

3. I have argued at length in Raff 1992 that the company did not begin to deploy American-system parts production on any substantial scale until the war years at the earliest. The shift to progressive assembly is the only important change in the production process going on during the period in question.

(see Helper 1991). The risks of holdup were too great.[4] If Ford wanted the investment, he had to do the bulk of it himself. The resources thus required from Ford for physical and organization capital were huge. But a direct consequence of committing them was that assembly, and most production jobs as well, could be completely routinized. The main effect was to allow central coordination and control of the work pace: the need for judgment, and with it the artisan's discretion, was banished from his shop floor forever.[5]

The deployment of the American system put much more shareholders' capital into the factories. Progressive assembly made the production system much more highly interconnected. Together these two changes increased the importance—to the owners of the capital—of actually keeping the equipment fully utilized and the output flowing smoothly. Workers executing their tasks in an uncoordinated fashion became potentially quite expensive, raising questions of control and compensation in an extremely salient form (Raff 1988). Ford's procedure was to pay time rates. Why precisely was this strategy wise?

The discussions of compensation systems one finds in the economics literature are not particularly helpful in resolving this question. The analyses come in two basic varieties. The first focuses on risk sharing between the firm and its employee; the other is directed toward the problem of getting differentially productive employees to identify themselves. The models in both theories are set up to focus attention on problems in the labor market and on decentralized incentives—the price system—as a solution. Firms need to undo as best they can a fundamental informational imperfection so as to get each worker to work as hard as he or she efficiently can and to enroll the most productive group of workers in the enterprise to begin with. In both cases, the basic underlying assumption is that the firm desires as much output as it can get from each and every worker. Both models put essentially all their emphasis on labor supply. In the name of analytic tractability, they ignore the imperatives of the production technology itself. Yet anyone who can visualize Charlie Chaplin on the assembly line will recognize that models such as these cannot help us understand what was going on at Ford.

The point of this intuition is that the assembly line is a setting in which all inputs and activities need to be precisely coordinated. In mass production of the assembly-line variety, uncoordinated increases in output are generally simply wasteful: they do nothing but increase work-in-process inventories and so tie up working capital. If the rate of production is high, this can be very expensive.

Theory appropriate to this setting would instead be written in the spirit of Martin Weitzman's famous paper "Prices versus Quantities" (1974). Weitzman's article is about the choice between decentralized (price-guided) systems

4. Klein, Crawford, and Alchian 1978. For the testimony of one supplier, see Sloan 1941.

5. It was this routinization and central control that allowed the efficient use of the expensive capital stock, the large-scale economies, and so forth. See Raff 1995, chap. 3.

of national resource allocation and central planning. The "peripheral units" of his article are factories. In the present setting, they would be the suppliers of effort and, through that, intermediate inputs into the automobile production process. Weitzman's central concern is the balance of costs and benefits in the peripheral units induced by two alternative schemes of telling them how to decide what to do. The first is the decision rule "expand production until marginal cost rises to some specified price," where in our case marginal cost is the marginal disutility of effort to the worker. The specified price is the piece rate he receives. Under the second decision rule, managers simply tell the effort suppliers what to do, paying them compensation based on obedience rather than on output per se. If workers keep the centrally determined pace, they are paid for their time. If not, they are fired.

The objective in Weitzman's model is to maximize the total net benefit, that is, profits. Weitzman shows that which control mode is best depends crucially upon the degree to which costs and benefits shift when output is not at just the desired level. When the level of marginal benefit is less sensitive to changes in quantities than is the level of marginal cost, it pays to focus attention on getting the cost side exactly right. The price-guided system is best for that. When the level of marginal benefit is more sensitive to changes in quantities than is the level of marginal cost, it pays to focus on the benefit side. A quantity-guided system is better for that. How was automobile production changing? The two most obvious examples may suffice to make the point. As production runs grew longer and new setups became less frequent, costs grew less sensitive. As the production process grew more tightly coupled and more employees and work in process had to stand idle whenever particular parts were, however temporarily, unavailable, benefits become more sensitive. In the progressive introduction of mass-production methods to the various production and subassembly processes and ultimately to final assembly itself at Ford, costs were becoming less sensitive and benefits were becoming more sensitive. The system was shifting in a direction favoring quantity controls.[6]

1.3 The Diffusion of Mass Production

Neither of the two central principles of the organization of mass production were original or distinctive to Ford. Progressive assembly was tried relatively early on at Studebaker, and the earliest attempts at truly interchangeable parts production in the automobile industry came well before the Model T.[7] But Ford

6. I should note that Weitzman (1974) speculates about this sort of situation without modeling it formally. But that task has been carried out in an unpublished Ph.D. thesis by one of his students, Gary Yohe. Technically, the question is what happens to the "coefficient of advantage" of, say, the price-setting mode over the quantity-setting mode when there are multiple producers of complementary goods and the degree of complementarity is rising. The answer comes down to a shift toward quantity setting. Montias 1976, 226, summarizes the argument.

7. On progressive assembly at Studebaker, see Raff 1992. The best example of interchangeable parts manufacturing is Ransom Olds' Curved Dash Oldsmobile of 1904. Raff 1992 discusses this in detail.

did innovate. Ford combined the two principles and deployed them relentlessly throughout the production system. Moreover, he used them to control centrally the pace of work so as to keep all fixed and quasi-fixed assets working at capacity.

How swiftly did the Ford system diffuse? The economist's intuition—prompted by all the attention the Highland Park plant received and by the attention paid to Henry's millions too—is probably "quickly." But an examination of the equipment in place in automobile plants during this period shows this intuition to be false.[8]

The most familiar outward sign of the system was conveyors. Moving assembly lines certainly were in place in a number of other firms by mid-1916. Articles in the trade press suggest that these were responsible for Ford-style quantity production, but there is good reason to doubt these claims.[9] Conveyors indicated only that the firm was using progressive assembly techniques, and we have seen that these could be deployed (and yield substantial savings) in the absence of American-system production. But the essence of the American system was the intensive use of purpose-built machine tools or general-purpose machine tools dedicated through the use of devices known as jigs and fixtures. Ford implemented the system through large-scale investment in precisely these sorts of machines and tools. Records from the Studebaker company, one of the handful of firms at which one might expect to find Ford methods if one could find them anywhere, indicate that Studebaker was certainly not investing in single-purpose machine tools on any serious scale.[10] Surviving records listing all major machine-tool purchases during the period 1913–16 indicate that the company was buying general-purpose tools.[11] For Studebaker to engage in American-system production, it would have to dedicate these tools using jigs

8. Confirming any sort of answer statistically is a difficult sort of exercise. There are no census statistics that could serve as even relatively unequivocal proxies. Company balance sheets of the day, when issued at all, are occasionally helpful (see below), but much more often they offer no useful information whatsoever. A single line item for "real estate, plant, and equipment" sheds little light on the particular patterns of capital investment suggested by a changeover to American-system production. The investigator is driven to articles about new developments in the trade journals and to surviving company archives for photographs, records of purchases of physical capital, and traces of discussions among knowledgeable managers.

9. For an example of the claims with some photographs and shop-floor diagrams, see "Conveyor System Aids Big Production," *Automobile*, 20 July 1916, 100–104.

10. One might expect to find Ford methods there because the Studebaker automobile operation had been run for some years by Walter Flanders, the engineering manager who came to automobile manufacturing from the Connecticut Valley gun trade (the seedbed of the American system) and who had brought progressive assembly to Ford. See Raff 1991a.

11. There are, of course, some exceptions. Page 5 of the *Studebaker News* for January 1915 gives a splendid photograph of one of them. But the records of the Finance Committee (which considered all capital investment proposals, down to $200 common machine tools) suggest that the company was investing only reluctantly in machinery. The minutes of the meeting of 2 September 1915 record that "[m]uch delay in production has occurred from old machinery breaking down. . . . The Production Department feel the importance of purchasing additional machinery to take the place of that which is antiquated, and also of adding to the present machinery new equipment as much as will be necessary from time to time to equip some of the proposed new buildings." The attitude toward investment at Ford was very different.

and fixtures. The telltale sign would therefore be substantial investment in these kinds of devices. but there is no evidence of such purchases in the records. Moreover, balance sheets for both Ford and Studebaker covering the year 1915 are sufficiently detailed to enable us to calculate the unit output per dollar of investment in such tools. The more Americanized the production, the higher this ratio should be. Ford used these tools roughly two-and-a-half times as intensively as Studebaker.

This is not to suggest that Studebaker failed to devote a good deal of time and energy to efficiency-enhancing improvements. Board and committee minutes for 1914 and 1915 are replete with references to shop-floor reorganizations (implementing, for example, progressive assembly and otherwise minimizing the excuses employees had to wander around the plant), attempts to plan plant workloads farther in advance, and the introduction of conveyor belts. But the general tenor is well summarized by the discussion concerning conveyor belts. The Finance Committee considered and approved putting in a number of them, including one for chassis. The advantages cited included eliminating five hundred men from the payroll (this was about one-seventh of their average monthly workforce in the Detroit operation that year) and lowering works and inventory expense as well as certain vaguely stated gains in flexibility. One official remarked that "[t]his runway and these conveyors will more than pay for themselves in the first year's labor savings."[12] The gains were admittedly substantial, but the point to emphasize is that this was labor saving, not labor control. It was certainly not mass production à la Ford.

Two vignettes fill in this portrait of pre–American system operations. The first concerns the reaction of Studebaker's directors to the $5 day. Finance Committee minutes describe this in considerable detail. All the members of the committee were close to their enterprise. Yet they could not fathom what Ford was up to. Minutes of the meeting of 19 January 1914, for example, include both false scents—"Ford . . . undoubtedly will have the pick of men"—and nervous reassurance—"It is believed in the city that his plan contravenes all economic laws and must in the end fail because of competition." Committee members were sure that the new measures would bring financial disaster to Ford's company. It is plain they had no idea where any increased productivity that might pay for them—and more—could come from.[13]

Indeed, when they decided later that winter that a considerable short-term increase in their own productivity was called for, centralized control was the farthest thing from their minds. The means they seized upon to increase output was to change their workers' compensation scheme to an extremely individualized incentive scheme: "In order to counteract the possibility of [labor] trouble

12. See the finance committee minutes for 19 January 1914. For shop-floor reorganization, see the minutes for 2 September. For advance planning, see 23 March.

13. Raff 1995, chap. 6, reconstructs the calculations Ford management seems to have done for itself on this point.

in our factory, and at the same time increase the production of the intervening months so that we will be best prepared for trouble if it comes, [our managers] feel it would be desirable to change our wage method to a piece rate system so that our men can make more money and at the same time turn out more product."[14] The vice president in charge of construction and engineering reported to the board of directors the following August that the company had "always believed an incentive wage system to be a very important factor in promoting efficiency."[15] The context makes plain that he was using the phrase "promoting efficiency" here to mean maximizing each individual's output. He went on to say that, having received the approval of the Finance Committee, he and his colleagues had instituted a piecework system in the production departments earlier in the fiscal year. He then devoted most of a page to statistics demonstrating how helpful this has been: one department's output had grown 66 percent, another's 141, another's 223. "The resulting condition," he concluded, "is one highly satisfactory to both employer and employee." This was not a factory in which the central principle was coordination.

David Hounshell suggests that the first large-scale implementation of Ford-style mass production came in the Chevrolet Division of the General Motors Corporation circa 1923 (1984, chap. 7; on the economics of this, see Raff 1991a). With the end of the war and the postwar depression, business prospects again looked expansive. GM had hired away Ford's senior production manager, William Knudsen. His first post was on the corporate staff. As Alfred P. Sloan's overall competitive plans became clear, however, Knudsen was given command of Chevrolet and told to start competing seriously with Ford.

Until this point, to judge from the trade journals and the researches of Alfred D. Chandler, Jr., there had been only two attempts at standardization at GM. When the Du Pont interests came in, they had attempted to integrate the accounting and control systems (Chandler and Salsbury 1971, 17). There had also been a direct effort after the war to cut down on the variety of screws and nuts on order, an exercise primarily in inventory control.[16] Now, however, GM began to focus on assembly.

Writing retrospectively in 1927, Knudsen detailed his steps (65–68). The company purchased new machine tools. "Sequence lines" were established to pave the way for the conveyors that were to follow. Gauges and indicators (to measure tolerances) were devised for all operations of importance. A decision was made simply to abandon all scrap work rather than redo it. Only then could volumes seriously be increased.[17]

14. Finance committee meeting of 9 February 1914. The labor trouble they feared was a return of the Wobblies, whose agitation had shut down their plants the previous spring for a period.

15. "Report of the Vice-President in Charge of Construction and Engineering," Secretary of the Corporation files, Supporting Matter for Minutes, Directors Meeting of 4 August 1914.

16. Baird 1923, 334–37. The two efforts were not unrelated, of course.

17. Indeed, we know that the interdependence went even further than these actions suggest. Raff 1991a gives the details. GM introduced a new model called the Pontiac in 1926. It was for

GM led the charge, but the rest of the industry ultimately followed. Perusal of the pages of the *American Machinist* for the decade of the twenties leaves a much more vivid impression of diffusion than does the analogous exercise a decade earlier. The installation of major conveyor operations is still news. But it is now nested among news of extraordinarily dedicated machine tools and complaints from machine-tool builders that the balance of demand ought to swing back in the other direction.[18] Chrysler's new Plymouth model in 1929 was obviously aimed at the economies as well as the markets pioneered by Ford and by Knudsen's Chevrolet.[19] The manuscript returns to the 1929 manufacturing census show the growing strength of the mass producers: the Big Three firms made two-thirds of the vehicles (Bresnahan and Raff 1991). On the other hand, the returns show signs of considerable and persistent heterogeneity as well: the Big Three may have made most of the output, but they operated only 26 percent of the establishments. The model product in 1929 was manufactured by mass-production methods, but the model factory did not use them. It took the Depression to kill off the artisanal enterprises and to establish the hegemony of mass production (Bresnahan and Raff 1993).

What happened to skill, autonomy and judgment, and the general idiosyncrasy of work tasks in automobile production as mass-production methods diffused? The number of firms manufacturing à la Ford had grown. Jobs in them were overwhelmingly routinized.[20] So too were the products, superficial differences and distinctions notwithstanding. Yet other enterprises operated, even opened, and flourished; and those establishments seem to have sold products that were often genuinely differentiated and that seem to have had a much higher skill content. The production runs were all much, and sometimes very much, shorter. Many of these firms produced for a clientele that valued handwork.[21] The rest had a clientele with needs sufficiently special that they had no choice.[22] The artisanal producers thus had a market niche. Elasticities of

practical purposes some odds and ends of new body panels, an Oldsmobile engine, and otherwise entirely parts from the current Chevrolet. The basic purpose of this strategy was to sell Chevrolet parts to persons who would not buy Chevrolet cars and by so doing enlist even these reluctant soldiers in the campaign to drive down Chevy unit costs. This enabled all the main Chevrolet supply plants to support even more corporate revenue.

18. On this latter point, see especially Heidey 1925 (a paper presented to a production meeting of the Society of Automotive Engineers). On the (postwar) timing of the great burst of machine-tool investment, see Pletz 1926.

19. The Pontiac strategy was also on Chrysler's mind. The company had one central engineering and design staff, not one for each brand as at GM. The next attempt at large-scale entry, Studebaker's unsuccessful one, had a similar strategy of common use of resources across product lines.

20. Babson's study focuses on the beliefs, attitudes, and actions of the remnant in the toolrooms.

21. Some of this handwork was visible, as in the body and interior. Some was invisible but could be felt: careful balancing of rotating parts was taken to great extremes at Packard, for example, and even today old-car buffs say of Packard engines that nickels can be balanced on them.

22. Thus, if the mass-production firms employed most of the people, then the typical employee in the industry could have a highly routinized job without the typical factory's doing highly routinized work.

substitution were low. At the margin, Ford and Chevy were not going to drive them out of business.

But the business cycle could. The change the Great Depression wrought on this heterogeneous population of firms and product/production strategies was a striking one. The cycle winnowed out the relatively artisanal producers, leaving the mass-production firms and those tending in that direction intact (Bresnahan and Raff 1993). Economists might be tempted to speculate that the mass-production firms survived because they had the lowest long-run average costs. Competition would drive out the less "efficient" competitors. But Bresnahan and Raff (1993) demonstrate that this was not in fact the selection mechanism at work. Jobs were simple at mass-production plants; training costs per worker were low; and abrupt scaling back in the face of slack demand was relatively easy. The artisanally organized cohort, in contrast, had major sunk costs in the indentification of personnel and the organization of production that it could not lightly reincur. It seems to have hung on to its workforce like grim death, ever hoping demand was about to return, until closure was the only alternative. Average practice changed through change in the population of firms as well as through changes in the practice of representative agents.

1.4 Production Methods and the Puzzling Profusion

We can now return to the subject of compensation systems and hope to test this technological explanation of their incidence. There are two sets of facts that require explication. The first is the heterogeneity of compensation schemes employed by auto manufacturers during the midtwenties cross-section. The second is the stylized time series, that is, the trend over time away from individual piece rates to group incentives to time rates.

There is certainly suggestive anecdotal evidence in support of the theory. Speeches by factory managers and their technical support staff to the annual production meetings of the Society of Automotive Engineers show actual decision makers addressing their colleagues on the subject of compensation systems and articulating precisely the germ of the logic advanced here. In the 1923 meetings, for example, the supervisor of time study at the Chandler Motor Car Company of Cleveland said straight out that manufacturing conditions, as well as the manufacturing processes in the departments of a large plant, vary considerably and cause entirely different problems to arise (Bouton 1923, 380–81). A single wage-incentive plan that would fit all departments in an automobile plant satisfactorily had yet, he asserted, to be evolved. Chandler had adopted the group piecework plan for the major assembly units and machining departments and straight individual piecework for small parts that involved one, two, or at most three steps to complete.

The following year an industrial engineer from Maxwell discussed imposing a particular group bonus scheme across many departments (Perkins 1924). He analyzed in detail one brilliant success and indicated that there had been crash-

ing failures as well. He attributed the difference to a series of factors, the first in the list of which was (in the language of this paper) the organization of the production processes and the interrelationships between the work tasks in question.

Are these merely isolated instances? The firms are, of course, unknown today. One would like to test statistically whether compensation schemes varied systematically across departments or at least across firms using broadly different production techniques. Unfortunately, the Bureau of Labor Statistics reports cited above cannot be used for this purpose: the reports' authors guarded the identities of the plants and firms they described extremely carefully. Without knowing which was which, there is no hope of associating compensation systems with production strategies. This defect is worse in the widely cited studies of the National Industrial Conference Board, which provide even less detail about firms and their industries.[23] There is in fact no really satisfactory broadly based source of data. But the trade journal literature is of some use here.

An article in *Automotive Industries* for 1925 gives a small cross-sectional sample of the sort required (Shidle 1925). Twenty-one firms were included—some relatively large, some small, some parts suppliers, some solely assembly firms, and only three withholding their names. The article details the wage system used most extensively by each firm and lists other systems in place where applicable. Matching firms with systems reveals that relatively unintegrated and relatively artisanally organized firms (i.e., those making specialist parts or entire cars substantially by hand) employed relatively individualized compensation schemes. Other firms used more group-oriented schemes. The relationship is not without exceptions and the sample is small, but the basic pattern does seem clear.[24] The contingency table analysis summarized in table 1.1 indicates, moreover, that the pattern is statistically significant.[25]

This impression is strengthened by two glimpses of compensation practices within GM in 1927. At that time, GM used a variety of production systems in its plants. The first glimpse emerges from a survey of methods of payments and wage-setting protocols conducted for the members of the Special Conference Committee by its secretary, E. S. Cowdrick.[26] Cowdrick reported that hourly

23. The best of these is National Industrial Conference Board 1930. For a typical citation, see Nelson 1991.

24. This thrust is clearer once one understands that Packard, one of the exceptions, made efforts to routinize at least part of its production processes beginning in 1922, its advertising notwithstanding. See Parker 1949.

25. This is, strictly speaking, a test of the joint proposition that the claim is true and that the categories are the appropriate ones. The categories seem appropriate to me. But the test statistic should be interpreted cautiously. (Even if the test statistic were decisive, there still would remain the question of why the table shows any off-diagonal elements at all. This question of why there might be noise in the pattern is important and is discussed in section 1.5.)

26. For more on this extraordinary but shadowy organization, see Gitelman 1990 and the sources cited therein. A copy of "Methods of Wage Payments" can be seen at the Hagley Museum. Page citations are not given below, since the eccentric organization of the manuscript deprives them of any real usefulness.

Table 1.1 Cross-Section of Motor-Vehicle-Industry Plants, 1925

	Individualized Compensation Systems	Group-Based Systems
Relatively unintegrated production process	1	2
Relatively integrated	4	11

Note: The test statistic for this distribution is 45.64 >> 5% critical *F*.

rates, individual piece rates, group and pool piece rates, and group bonuses were all being deployed somewhere in the company. Those responsible for choosing the schemes were relatively low level but themselves received performance-related pay, thus providing an incentive favoring the adoption of the most efficient schemes. The trend, Cowdrick wrote, was toward group bonuses.[27]

The rationale for group schemes was clearly stated by one of the interviewees: they "lessen the need for supervision, since it is in the interest of every man in a group to have every other man working at his maximum efficiency" while enabling management to set the standards so that the well-managed factory with satisfactory employees "can reach an average efficiency of from 108–110 percent [of a technical standard]. The actual average efficiency of the General Motors Corporation is not far from this figure." So the corporation was able to plan production relatively precisely and get the employees to monitor straightforward shirking as an extra. This was clearly an advantageous outcome in situations in which coordination was valuable.

Only one fragment of data on particular GM plants and systems survives, and it is strongly consistent with the analysis of this paper. Again, individualized compensation systems are coupled with relatively unintegrated production processes, and group-based compensation systems are coupled with relatively integrated processes. Table 1.2 gives the numbers. The pattern is statistically significant well beyond conventional confidence intervals.

The time-series pattern then runs as follows. Production organization within surviving firms shows a progressive tendency toward integration. Compensation practices show a progressive tendency away from individualized compensation schemes. The movement to straight time rates is a lurch, and it comes under the shadow of the National Industrial Recovery Act and the New Deal labor legislation—a regime change as sure and deep as Ford's once new idea, and in its implications quite similar.[28] The legislation made it much easier to organize assembly and parts plants, thus giving small groups greater ability to

27. It would be particularly interesting to know the history of compensation systems at Chevrolet. Research has not turned up any time-series evidence concerning this during the period of transition in the Chevrolet production system.

28. See "Johnson Warns Industry of Impending Wave of Strikes," *Automotive Industries,* 10 March 1934, 321, and, for example, "Drive to Unionize All Automotive Workers Seen in New Council Setup," *Automotive Industries,* 30 June 1934, 790.

Table 1.2 Cross-Section of GM Plants, 1927

	Individualized Compensation Systems	Group-Based Systems
Relatively unintegrated production process	6	2
Relatively integrated	0	20

Note: The test statistic for this distribution is 1266.03 >> 5% critical *F*.

shut down the whole and so increasing management's incentive to view the whole system in unitary terms. While all this was going on, the Depression was, roughly speaking, wiping out the plants with relatively less routinized production systems (Bresnahan and Raff 1993). For both reasons, the attractions of decentralized motivation systems were markedly on the wane.

1.5 Patterns in Organizations and the Meaning of Unexplained Variance

The main conclusions I draw from this story and evidence are as follows. First, there was a microeconomic logic to these historical decisions and events. As the opportunity costs of particular ways of organizing production grew, manufacturers adopted new techniques. Mass-production methods changed the opportunity costs of uncoordinated workforce activity. They changed the structure of measurement and supervision costs. It should not be surprising to discover that administration methods in general, and compensation systems in particular, evolved and adapted to fit the circumstances in roughly the ways these changes would favor.[29] The data available to test this hypothesis are far sparser than is usual in empirical microeconomics late in the twentieth century. But they do support the story.

Second, the tools required to do very microeconomic history such as this need not be confined to models of black-box firms, perfect competition, complete and symmetric information, and continuous equilibrium, blown up from the textbook's page to the scale of historic plants and firms. The sort of history this paper develops is not rooted in any mystical a priori belief in the pervasiveness of markets and competition. This microhistory is nothing but a study of the evolution of microlevel facts, seen in a particularly orderly way. Efficiency—in the usual sense of the survival of only facilities and methods that minimize long-run average costs—is certainly not the only tale being told here. Artisanal firms continued to fill an important market niche long after Ford introduced mass production. They disappeared during the Great Depression

29. For an interindustry cross-section of data in the mid-1920s covering more than 500,000 employees, in which the incidence of time and piece rates can be statistically explained in this spirit, see Malcolmson 1992 and Lytle 1942, 57. For a more recent econometric exercise in this general spirit (though with a quite different model), see Goldin 1986.

not because they were inefficient but because the costs associated with holding together their skilled labor forces were too great to withstand the downturn in demand. Thus bottom-up labor history and marketing history as well probably have as much of a role to play as bare-bones neoclassical microeconomics in explaining why industries and production methods evolve as they do.

My third conclusion concerns that which thus far has been passed over in silence: the unexplained variance in regressions or in regressionlike tests and stories. Cross-sectional tests never, as a practical matter, end up explaining everything. More concretely, the explanation I have sketched above leaves unexplained why innovations in methods and administration diffuse slowly.[30] Such a gap in the argument might undermine its appeal. So I should say something about this in closing.[31]

Economists have traditionally identified firms with production possibilities—that is, with possible outputs.[32] Economists take the market for granted. This would strike any businessman as bizarrely abstracted. Businessmen organize production. They take finding "markets" to be a big part of their job. So they identify their enterprises not with outputs but with needs and with the resources and capabilities to meet them distinctively well. Businessmen thus identify the firm not with what they could purchase, turnkey, in competitive factor markets, but rather with what is either unique or developed through (collective) experience within their firms.

The relationship between these capabilities and the institutions and routines of organizational life is a close one. Firms and their employees make huge investments in these. (Some are firmwide rules, some are individual- or job-specific. Generally speaking, they could not be replicated through a manual, since an important part of them concerns what individuals should do when the manual does not say or is not to be believed.) These investments are in effect sunk costs. Aside from situations of crisis or true watershed opportunity, it is often easiest for individuals to continue to operate in the way they are used to than to undergo the sunk costs of learning a new way. This induces conservatism even in the face of opportunities that might be quite attractive were there no other alternatives.

Where the traditional economist's vision of organizational life makes one wonder why the take-up of innovations is slow, this vision suggests, if anything, the opposite problem. It has economic rationality at its core, but the composition overall is well leavened with culture, meanings, and the heavy

30. This paper has even presented a clear example, namely the compensation systems at Studebaker discussed in section 1.3 above.

31. See Raff 1991b for a (somewhat) better-worked-out version of these ideas. Nelson and Winter 1982 is in a similar spirit.

32. In recent years, real progress has been made in developing a deeper analysis that might explain actual organizational institution within firms. The key development was the recognition of how commonly economic actors even within an enterprise will be less well informed than the traditional theory allowed. See Raff and Temin 1992 for a nontechnical introduction and Holmstrom and Tirole 1989 for a lucid guide to the technical literature.

hand of history. Firms are not the sort of entities brought turnkey in competitive markets. They are complex organizations that develop over time as people in them respond to perceived needs and opportunities. That process often gives firms distinctive capabilities that can be a source of sustained abnormal profits. It also has a darker side. It can create resistance to change and adaptation as the firm may come to be, to its employees, a commitment to certain ways of doing things.

This being so, it is entirely possible that the evolving incidence of within-the-firm institutions one observes owes less to radically innovative ("heroic") managers than to the relatively mundane optimizing of operations, given the slow evolution of firm-specific resource bases and competences and given the evolution of competitive conditions in product markets. Economics thus has a role in illuminating the history of business. History has an equally central role in useful economics.

References

Baird, D. G. 1923. Eliminating Needless Cost and Confusion. *Industrial Management* 65:334–37.

Bouton, D. C. 1923. Wage-Incentive Systems. *Journal of the Society of Automotive Engineers* 13:380–83.

Bresnahan, T. F., and D. M. G. Raff. 1991. Intra-Industry Heterogeneity and the Great Depression: The American Motor Vehicle Industry, 1929–1935. *Journal of Economic History* 51:317–31.

———. 1993. Technological Heterogeneity, Adjustment Costs, and the Dynamics of Firm Shut-down Behavior: The American Motor Vehicle Industry in the Time of the Great Depression. Working Paper no. FB-93-09. New York: Columbia University Graduate School of Business.

Chandler, A. D., Jr., and S. Salsbury. 1971. *Pierre S. Dupont and the Making of the Modern Corporation.* New York: Harper and Row.

Denham, A. F. 1934. Day Rates Supplant Group Bonus. *Automotive Industries* 71:702–3.

Emerson, H. N.d. *A Comparative Study of Wage and Bonus Systems.* New York: Emerson Company.

Gitelman, H. M. 1990. The Special Conference Committee: Reality and Illusion in the Industrial Relations of the 1920s. Manuscript.

Goldin, C. D. 1986. Monitoring Costs, and Occupational Segregation by Sex. *Journal of Labor Economics* 4:1–27.

Heidey, R. M. 1925. The Machine Tool Needs of the Automobile Industry. *American Machinist* 63:533–35.

Helper, S. 1991. Strategies and Irreversibility in Supplier Relations: The Case of the U.S. Automobile Industry. *Business History Review* 64(4):781–824.

Holmstrom, B., and J. Tirole. 1989. The Theory of the Firm. In *Handbook of Industrial Organization,* ed. R. Schmalansee and R. Willig, 61–133. Amsterdam: North-Holland.

Hounshell, D. A. 1984. *From the American System to Mass Production: The Development of Manufacturing Technology in the United States.* Baltimore: Johns Hopkins University Press.

Klein, B., R. A. Crawford, and A. A. Alchian. 1978. Vertical Integration, Appropriable Rents, and the Competitive Contracting Process. *Journal of Law and Economics* 21:297–326.

Knudsen, W. S. 1927. For Economical Transportation. *Industrial Management* 76:6–68.

Lytle, C. W. 1942. *Wage Incentive Methods.* New York: Ronald Press.

Malcolmson, J. M. 1992. Contract Inefficiency, Wages, and Employment: An Assessment. Manuscript.

Montias, J. M. 1976. *The Structure of Economic Systems.* New Haven: Yale University Press.

National Industrial Conference Board. 1930. *Systems of Wage Payment.* New York: National Industrial Conference Board.

Nelson, D. 1991. *Masters to Managers: Historical and Comparative Perspectives on American Employers,* ed. S. M. Jacoby. New York: Columbia University Press.

Nelson, R. R., and S. Winter. 1982. *An Evolutionary Theory of Economic Change.* Cambridge: Harvard University Press.

Parker, J. 1949. A History of the Packard Motor Car Company. M.A. thesis, Wayne State University.

Perkins, H. G. 1924. The Group Wage-Payment Plan. *Journal of the Society of Automotive Engineers* 15:464–66.

Pletz, A. C. 1926. The Effect of Mass Production on Machine Tool Design. *American Machinist* 64:854.

Raff, D. M. G. 1988. Wage Determination Theory and the Five-dollar Day at Ford. *Journal of Economic History* 48(2):387–99.

———. 1991a. Making Cars and Making Money in the Interwar Period: Economies of Scale, Economies of Scope, and the Manufacturing That Stood behind the Marketing. *Business History Review* 65:721–53.

———. 1991b. Sunk Costs inside the Black Box: Why Organization Change Takes So Long and Is So Hard. Manuscript.

———. 1992. Studebaker and the Idea of Mass Production: Close Encounters of the First Kind and Their Quantitative Contribution to Productivity Growth. Manuscript.

———. 1995. *Buying the Peace: Wage Determination Theory, Mass Production, and the Five-Dollar Day at Ford.* Princeton: Princeton University Press.

Raff, D. M. G., and P. Temin. 1992. Business History and Recent Economic Theory: Imperfect Information, Incentives, and the Internal Organization of Firms. In *Inside the Business Enterprise: Historical Perspectives on the Use of Information,* ed. P. Temin, 7–35. Chicago: University of Chicago Press.

Shidle, N. G. 1925. How Industry Is Approaching the Wage Payment Problem. *Automotive Industries* 53:495–502.

Sloan, Alfred P., with Boyden Sparks. 1941. *Adventures of a White-Collar Man.* New York: Doubleday Doran.

U.S. Department of Labor. Bureau of Labor Statistics. 1926. *Wages and Hours of Labor in the Motor Vehicle Industry, 1925.* Bureau of Labor Statistics Bulletin no. 438. Washington, DC: GPO.

Weitzman, M. L. 1974. Prices versus Quantities. *Review of Economic Studies* 41:477–91.

Comment Walter Licht

Daniel Raff's paper appeals to my historian's instincts. There is a simple message here: life is complicated, appreciate the details; or, more specifically, business is complicated, appreciate the details. Raff shows that the introduction of mass-production techniques in the American automobile industry in the first decades of the twentieth century formed a slow and staggered process. The implementation of systems to assemble cars on moving conveyors with highly standardized components that were also fashioned on an assembly-line basis occurred only in fits and starts. Car factories into the late 1920s remained complex entities with a variety of manufacturing regimes, and as a result, a vast array of worker compensation schemes prevailed.

Raff's paper makes many contributions. First, his essay accords with and supplements an expanding economic history literature that places great emphasis on the unevenness of American industrial development. Fully integrated, bureaucratically managed firms represented but one path toward industrial growth. Small-to-medium-sized, family-owned and -operated custom producers persisted alongside the new behemoths and added greatly to employment and the prosperity of the nation. There was money to be made through specialization, as well as through the achieving of economies of scale (and scope).

Similarly, scholars recently have shown that the vaunted American system of manufacturing was more myth than reality. True standardization in parts production—and the elimination of skilled-work assembly—did not occur in gun manufacturing in the 1810s, in the sewing machine industry in the 1870s, or, as Raff argues, in automobiles in the 1910s. Some have suggested that the technological wherewithal for precision-parts making had not yet been achieved; others, that there was insufficient demand for standardized products in a still parochialized American marketplace and thus there existed little pressure for greater technical development. Whatever slowed history, Raff succeeds, I believe, in bringing this story into the 1920s.

He also succeeds in raising an issue that, as far as I can tell, has received practically no attention from scholars—and that is the bizarre mix of formulas that existed to calculate the earnings of workers in American manufactories. Scholars have too glibly taken published wage or income data and assumed that they are straightforward reflections of labor supply, demand, and marginal productivity. Forays into company archives and perusal of payroll accounts reveal complicated, shifting, confusing, and unfortunately, too often, nonannotated calculations at work. Raff has made a contribution in bringing this to our attention, and I hope that his research stimulates investigation into the subject for other trades and time periods.

Raff's paper does raise a number of questions. The first concerns the Ford Motor Company. Ford figures strongly in the opening pages of the paper and

Walter Licht is professor of history at the University of Pennsylvania.

then disappears from view, with attention turned toward Studebaker and General Motors. Ford appears as an odd case here (actually, for business and labor historians, Ford for a variety of reasons has always been somewhat exceptional). Early in the paper, Raff notes that in 1913 the firm was the only one in the automobile industry compensating its workers through time rates (piece rates represented the norm). Later, he provides a quote that indicates that fifteen years later the company still paid by the hour and eschewed piece-rate systems (of any kind). This raises some questions for me. Because Ford still had a complex production regime, why did it not use varied compensation programs? Why was it exceptional? Ford remained heavily reliant on outside contractors for parts; purchased components represented more than 80 percent of the value of materials in Ford cars built in 1913 (Lewchuk 1989, 27). Does this or anything else help to explain the firm's uniform system of compensation?

A second issue relates to the main subject of the paper, that is, accounting for the varied compensation programs that existed in the automobile industry at least into the late 1920s (Raff does not deal with the entire interwar years as implied in the title). Raff rejects a number of possible answers and opts for diversity in production, and here I find myself entirely in agreement but desirous of greater specification. First, though, some thoughts about rejected explanations.

Raff rejects the notion that different kinds of firm endowments could be responsible for variations in payment schemes; that makes sense to me because variations within firms are as important as variations between firms. Second, he rejects emulation. A small army of industrial consultants were peddling their ideas at the time; although there was a great deal of dialogue and experimentation with labor arrangements because of this salesmanship—and I would not totally deny an influence—too many studies have convinced me that Frederick Winslow Taylor, his loyal and lapsed disciples, and his competitors rarely succeeded in getting their schemes accepted on a comprehensive or sustained basis. Practice was fashioned on the shop floor with and without fashionable ideas.

Raff, too, rejects agency on the part of a highly politicized workforce, but I would leave that possibility open for further research. Studies of the Ford Motor Company in England, for example, have found that piece rates were instituted largely at the behest of organized and militant workers who hoped to gain a modicum of shop-floor autonomy (Lewchuk 1989, 28–29). (This and the above statements on Taylor do raise a question about the implementation of payment schemes. Who were the chief architects? Top, middle, or lower-level managers? And were there inputs from below?)

Finally, although not explicitly stated, Raff does reject the role of whim in the profusion of compensation arrangements. There is a rationale for him in the profusion. If the "imperatives of the production system" is the key, however, I believe greater details should have been provided. If this was a rational process,

one might expect different compensation systems to have emerged from different sites in the overall production process. Were pattern makers, core makers, and molders in foundry areas, for example, paid by time because of the uncertainties in the casting process? Were drill-press and lathe operators, on the other hand, paid by the piece (with or without bonus incentives)? Were axle assemblers paid on a group piece rate and magneto assemblers on a group or individual-time basis? Were all final assemblers compensated by group piece or time rates? A host of examples can be rendered. If, in fact, diversity of unroutinized tasks led to diversity in compensation programs, then the actual links should be drawn (of course, if documentation permits).

Raff's paper raises for me another set of questions regarding events after the 1920s. Raff actually isolates two developments: the move toward group-based systems of compensation and the shift toward time-rate payments (although Ford remained consistent here).

On the emergence of group-based compensation, Raff argues that the true implementation of mass-production techniques allowed for this, that is, the institution of progressive assembly in all aspects of production (parts manufacture as well as sub- and final assembly) and the use of highly standardized components (made with single-purpose tools and machines). Greater routinization then leads away from individualized compensation schemes. I accept Raff's tables showing a relationship between integration and group-based compensation systems, but I am not convinced of the explanation. The new General Motors' plants of the late 1920s may have approached the ideal of mass production, for example, but they remained, and actually became more, complex entities. The diversified product lines pushed by Alfred Sloan led to frequent shifts in production, and as a result the firm moved away from single-purpose tools not quite to full all-purpose ones, but to what were termed "semispecial" (Meyer 1989, 75–76, 82–83). I do not necessarily see a more homogeneous situation appearing and would expect continued diversity of compensation schemes. Are there other developments at work here leading to unified group-based systems of compensation? What of the role ultimately of unionization?

As to the general move to time-rate methods of payment, the explanation rendered by Raff also seems cloudy. He mentions that New Deal legislation and regulations played a part. But how important a role? Greater elaboration was necessary here. This aspect of the story might force qualification of Raff's overall argument.

I would like to conclude with a few comments on thoughts expressed by Raff at the end of his paper on the tense relationship that exists between economists and historians. I am one of a small group of historians who have taken as their subject of inquiry the organization of work and labor markets in the past. We have tried to bridge gaps that prevail between labor, business, and economic historians, labor economists, and students of industrial relations.

To date there has been a mixed dialogue between those scholars who share a common interest in what can broadly be labeled the labor process. There has been no cross-fertilization between labor historians and business historians, for example; for reasons I do not quite understand, business historians have shown little interest in the so-called personnel function. Dialogue between labor historians and students of industrial relations has always existed—John Commons is a common discipline-founding father—and there has been some and remains great potential for exchange between labor historians and labor economists. Labor historians can use all the help they can get with theory and methods to aid in the interpretation of their findings. And I am struck by the number of economic historians and labor economists who have moved toward historical labor study (Claudia Goldin, Gavin Wright, Richard Sutch, and Michael Piore, to mention a few).

I believe, though, that if a wider exchange is to occur, tolerance will be in order, and here I can circle back to Raff's paper. He has focused on some messy details—the stuff of history—and specifically, the complex compensation systems that existed in the automobile industry. That complexity should give pause to easy theorizing about wages. Raff does theorize, though, about developments, but developments that are not readily translated into supply and demand models or regression equations (I will note here the simple contingency tables that he provides).

Good relations between scholars can occur if (labor) historians open themselves to unfamiliar language and ways of conceptualizing and economists leave themselves open to be excited by the particulars (or the "heavy hand of history" as Raff calls it). While I have criticized Raff here for not providing ample specifics, I will conclude by applauding his great respect and appreciation for the details.

References

Lewchuk, W. 1989. Fordism and the Moving Assembly Line: The British and American Experience, 1895–1930. In *On the Line: Essays in the History of Auto Work,* ed. N. Lichtenstein and S. Meyer. Urbana: University of Illinois Press.

Meyer, S. 1989. The Persistence of Fordism: Workers and Technology in the American Automobile Industry, 1900–1960. In *On the Line: Essays in the History of Auto Work,* ed. N. Lichtenstein and S. Meyer. Urbana: University of Illinois Press.

This Page Intentionally Left Blank