Theory and Society (2005) 34: 579–612

Electric charges: The social construction of rate systems

VALERY YAKUBOVICH, MARK GRANOVETTER
and PATRICK McGUIRE
University of Chicago, Stanford University; University of Toledo

Abstract. Price is a central analytic concept in both neoclassical and old institutional economics. Combining the social network perspective with old and new institutionalist approaches to price formation, this article examines technological, economic, institutional, and political factors that shaped the earliest pricing systems for electricity used in the United States, between 1882 and 1910. We show that certain characteristics of electricity supply led to ambiguities in how the product should be priced, which created a politics of pricing among electricity producers. In particular, we investigate why the "Wright system," arguably inferior in productive efficiency to other alternatives, was widely adopted by 1900. We argue that this outcome resulted in part from the political and organizational clout of its supporters, as well as from their particular conceptions of the boundaries and future of the industry itself. The Wright system best suited the "growth dynamic" strategy promoted by the managers of large central stations in their fierce competition with smaller and more decentralized installations. Thus, even in this apparently highly technical and mainly economic issue of how to price the product, there was ample room for social construction and political manipulation. The outcome reached was by no means inevitable and had a highly significant impact on the shape of the American industrial infrastructure.

Where do prices come from? Max Weber clearly saw the limitations of a purely economic model:

> Money prices are the product of conflicts of interest and of compromises; they thus result from power constellations. . . . [The] price system [is] a struggle of man against man . . . . and prices are expressions of the struggle; they are instruments of calculation only as estimated quantifications of relative chances in this struggle of interests (1921/1968: 108).

Whether modern economic sociology can elaborate this insight and add value to the discussion of prices is a litmus test for its ability to demonstrate the importance of distinctively social dimensions in the most conventional economic practices. In this regard, it is puzzling that the issue of pricing has attracted relatively little attention in the current literature.[1]

We examine here one interesting case: the struggle in the late 1890s over which electricity rate system to use in the U.S. central station industry. In this period before rates were set by regulatory commissions, the two major pricing alternatives debated were the Wright and Barstow systems. The Wright system did not penalize usage at peak times, in part because its proponents pursued what we call a "growth dynamic" including revenue maximization and monopoly building, while the Barstow system, with its time-varying rates, was more consistent with productive efficiency and short-term profit maximization.

The present study is part of a larger examination of the American electricity industry from its origins in the late nineteenth century to the 1920s. (See, e.g., McGuire et al., 1993; Granovetter and McGuire 1998; McGuire and Granovetter 1998; McGuire and Granovetter 2005.) In general, we have found in this project that despite the obvious importance of technical and economic aspects in the emergence of the electricity industry, overall outcomes cannot be well explained without understanding also the way key actors mobilized resources through their industry and extra-industry social, political and financial networks. In this article, we make this argument for pricing systems.

By the early twentieth century, the Wright system became dominant in the American electricity industry while the Barstow system virtually disappeared from the discourse. Although economic theory illuminates the relative strengths and weaknesses of these two systems, we believe that it does not lead to any strong prediction as to which pricing system we should expect to have been adopted. Economic theory does provide rationales for a variety of systems, depending on such factors as actors' time preferences (e.g., for short or long term advantage), but does not attempt to predict these preferences. And even if the theory were unambiguous as to the best pricing system, most economists would agree that certain institutional conditions must be met to assure that actors put the most efficient system in place.

If profit maximization was the ultimate goal, we argue that the Barstow system should have prevailed. On the other hand, theorists of industrial organization argue that revenue maximization may, under some circumstances, lead to profit maximization *in the long run* (e.g., Koch

1974: 34) and therefore the Wright system could conceivably also have been economically sound. Fifty years later, despite such ambiguities, a number of prominent economists argued (with the benefit of hindsight) that systems with time-of-day pricing were superior not only in productive but also in allocative efficiency (e.g., Houthakker 1951; Little 1953). Indeed, these authors attributed to Wright-like systems the crises that troubled the electricity industry in the first half of the twentieth century. Whether or not one accepts this position, it is quite interesting to inquire how, given the ambiguities involved, the Wright system became so dominant. In the absence of the clear-cut null hypothesis we would have if economic theory made a definite prediction, our problem is to develop a theoretical argument that can predict and explain the outcome. We propose to do so by building on the new institutionalism in the sociology of organizations, adding to it a social constructionist argument that assigns a vital role in outcomes to the network position of leading actors and their organizational affiliations.

It is important to note that when our story took place, the economic characteristics of the two rate systems were actively debated but not yet well understood. Central station managers always justified pricing schemes with the rhetoric of economic efficiency, but our analysis suggests that such justifications had little to do with actors' actual goals and that proponents did not make fully satisfactory arguments for either system. Central station companies had a well-documented pattern of acting myopically rather than strategically (cf. Granovetter and McGuire 1998), as is typical in emerging industries (see, for example, Porter 1998[1980]: 217). This makes us doubt that they were farsighted maximizers. Key figures such as Samuel Insull expressed general confidence that increasing the customer base would ultimately allow rates to be reduced (e.g. Insull, AEIC 1895: 106). We could interpret this as rational support for revenue maximization based on an expectation of economies of scale in electricity generation. But those making such comments did not justify them in detail, and in fact, the technology in place in the late 1890s, when the rate debate took place, was not consistent with economies of scale. Only with the introduction of huge steam turbine generators in the early twentieth century did such economies become feasible (cf. McDonald 1962; Hirsh 1989).

Whatever the efficiency characteristics of the Wright system, we suggest that its adoption resulted not from persuasive argument but from complex manipulations and exercises of power by leading industry actors, who mobilized support through their personal networks and domination of industry trade associations. Even this apparently highly technical and economic issue of how to price the product left there ample room for social construction and political manipulation. Central station managers constructed and re-constructed the rules of the game depending on the goals pursued and on local conditions. An apparently academic dispute among followers of different systems turned into a political fight, which one group won because of thanks to political clout. The triumphant rate system encouraged its preferred trend, consolidation and expansion in the electricity industry, despite reasonable doubts about its productive efficiency. The outcome reached was by no means inevitable, and had a highly significant impact on the shape of the American industrial infrastructure, since it disadvantaged smaller and more decentralized modes of electricity provision that were not taken seriously again until deregulation in the 1980s.

To support our argument, we analyze the proceedings of annual meetings of the two main trade associations in the fledgling electricity industry from the late 1800s and early 1900s. Our primary source of information is the Proceedings of the Association of Edison Illuminating Companies (AEIC, 1891–1910), a small, elite group, made up of firms in some way descended from the original Edison central stations or using related equipment. The Association printed only enough copies for distribution among its small number of members, in part because the Proceedings contain extremely frank debates on the most urgent and difficult issues facing the industry. Their location in corporate archives made the Proceedings generally difficult to access and thus rarely used for historical research. Our secondary source of data is the Annual Proceedings of the National Electric Light Association (NELA, 1890–1910), a larger, more inclusive group of central stations of many types, as well as individual, non-corporate actors. Because of its sheer size and openness, NELA printed many more copies of its proceedings; consequently they are now available in a number of university and public libraries. Throughout the article, references to the Proceedings include the name of a speaker, if any, an abbreviated name of an association, "AEIC" or "NELA," followed by a reference to a specific year.

Specific characteristics of electricity and its provision made pricing decisions difficult. The late nineteenth-century "marginal revolution" in economics emphasized how supply and demand determine "equilibrium prices" that govern resource allocation in a market economy. These prices were said to emerge from multiple anonymous transactions among sellers and buyers who benefit from information flowing freely through the market. Further developments expanded this basic model to cover market imperfections caused by asymmetric information, monopoly power, and externalities.

But as economists have often noted, the simple model does not easily apply to highly capital-intensive industries like electricity. Marginal-cost pricing, which follows from the general model, is difficult to apply here and may even lead to losses because, given huge fixed expenditures, the marginal cost of a kilowatt of electricity is less than its average cost (cf. Brown and Sibley 1986: 34–37). This underlies the pricing dilemma that central station managers felt but could not clearly articulate in the industry's early years. Because of the need to cover fixed costs, most of the enormous variety of pricing solutions proposed since the late nineteenth century have in common that they do not charge equally for each unit of the product – hence the modern terminology of "nonlinear pricing".[2]

We suggest that when the economic outcomes of pricing systems are difficult to assess, actors gain freedom to mobilize resources around preferred solutions, and political, organizational, and institutional factors take on particular significance. To illuminate what transpires in such cases, we offer a sociological approach to pricing that builds on the old institutionalism in economics and sociology (cf. Williamson 1975 on the distinction between "old" and "new" economic institutionalists, and Selznick 1996 and Stinchcombe 1997 on a similar topic in sociology), and the new institutionalism in the sociological theory of organizations (cf. Powell and DiMaggio 1993). We use these ideas to explore how institutional and social structures shape transactions when a market first forms, which we suggest represents an important new direction for organization theory to explore.

The sociology of electricity pricing

We distinguish between outcomes and institutions. Prices are what Granovetter (1992) has called an "outcome," emerging from the aggregation of transactions; what is "institutional" is not the prices themselves, but the rules, norms, habits, and conventions underlying and supporting them. Berger and Luckmann saw the origins of habits in social interactions: "Objectivity of institutions emerges in the process of transition from dyadic to triadic interactions and further. The habitualizations and typifications develop from *ad hoc* conceptions of two individuals to historical institution" (1966: 58). It is just a slight extension to assert that economic institutions are the outcome of "actions taken by socially situated individuals embedded in networks of personal relations with noneconomic as well as economic aims" (Granovetter 1992: 47).

Institutional studies implicate environmental pressures towards rationalized and standardized structures and practices (Meyer and Rowan 1977; DiMaggio and Powell 1983; Powell and DiMaggio 1991; Scott 1995). Following this lead, we identify the environmental pressures that forced electricity industry executives to search for uniform pricing policies. They include the cultural expectations of fairness among central stations' customers, uncertainty caused by poor understanding of electricity pricing, and rapid professionalization of the central station business. Given such pressures, the institutional theory of organizations suggests that coercive, mimetic, and normative processes produce isomorphism in organizational structures and routines (DiMaggio and Powell 1983). And indeed, we find that informal networks of customers, Meter Inspection Companies, and legislative bodies denied legitimacy to central stations engaged in what they considered unfair pricing. The National Electric Light Association and the Association of Edison Illuminating Companies became the arenas for the mimetic dissemination of pricing methods, and the emerging profession of electrical engineers strove to reach a consensus about pricing standards and norms. Taken together, these processes explain the observed unification of pricing practices. But this does not explain why one organizational form or routine became widely accepted rather than another.

DiMaggio (1988: 13) argues that institutionalization is "a product of the political efforts of actors to accomplish their ends and that the success of an institutionalization project and the form that the resulting institution takes depend on the relative power of the actors who support, oppose, or otherwise strive to influence it." However, new institutionalists have not paid enough attention to interests and agency to transform DiMaggio's general claim into a sustained theoretical and empirical agenda. Such an agenda can be developed with some help from the "old" institutionalism, in both economics and sociology, which focuses more on "the guts of the causal process of institutional influence"

(Stinchcombe 1997: 6) in general and the issues of power and politics in particular. For instance, empirical studies of price formation by old institutionalist economists found coercion in power plays of buyers and sellers that subsequently become the standard pricing conventions. The most far-reaching empirical study of pricing within this framework was carried out by Walton Hamilton et al. (1938) who studied such diverse products as automobiles, tires, gasoline, milk, whiskey, cottonseed, and apparel.[3] Hamilton found that pricing practices are shaped by what he calls, "the politics of the industry" facilitated by the intrinsically elusive character of standards for pricing. In particular, costs and profits are not objective phenomena, but outcomes of managerial judgments grounded in accounting practices supported by "the plausible rhetoric of business enterprise" (Hamilton 1938: 538).

Old institutional sociologists did not pay much attention to pricing but explored in depth the role of power in institution formation (Selznick 1969, 1996). Following that tradition, Perrow (1986: 259) defines power "in terms of goals: there is a struggle over either the content of the output or the distribution of it." He notes that it is easier to exercise power when bounded rationality limits actors' ability to develop objective criteria for evaluating the output under dispute. Interest groups use bounded rationality to promote their own agendas that are only indirectly related at best to the substance of the dispute. Formal structure (bureaucracy) becomes a tool in an exercise of power.

In Perrow's terms, what pricing scheme to adopt was the output of a struggle in the late nineteenth-century electricity industry. The uncertainty about the efficiency and fairness of specific pricing policies limited the key actors' ability to rationally choose the optimal scheme. We argue that a particular interest group used this as an opportunity to promote its broader agenda and employed the formal structures of trade associations to implement it.

In particular, our empirical analysis will show how the more exclusive Association of Edison Illuminating Companies became an arena for controversial, politicized, and emotionally charged discussions of rates. This is where the power of concrete social networks comes into play. One group of electricity industry executives could institutionalize its preferred pricing system through its dominant position in the industry power structure, especially through its control of trade associations. In the following section, we explain the alternatives and the outcomes in more detail.

Electricity pricing 1880–1910: The main alternatives

Historians of business and technology have previously shown that the American electricity industry struggled with the issues of pricing from its inception in 1882.[4] A major player was Samuel Insull, former private secretary to Thomas Edison, who in 1892 assumed the presidency of fledgling Chicago Edison – forerunner of today's huge electric utility, Commonwealth Edison. One standard account of pricing explains that during an 1894 Christmas vacation in his native England, Insull met engineer and central station operator Arthur Wright who explained to (the supposedly naive) Insull that there are both fixed and operating costs in electricity production. Even if a customer reaches his maximum usage only a few times a year, a central station must invest in equipment to serve him at this level. Thus, Wright had invented a "demand meter" which measured the maximum demand of a customer as well as his total usage. The charge for electricity was then composed of two parts: one corresponding to maximum demand, to cover one's share of fixed costs, the other to actual usage. According to this account, Insull seized on Wright's approach and, following his model, had within a few years revolutionized electricity pricing throughout the world (McDonald 1962: 67–68, Platt 1991).[5]

However, more detailed research casts doubt on this simple story. Early rate systems were developed pragmatically rather than theoretically. In 1881, Thomas Edison himself designed the first "contract system" based on a fixed charge per lamp installed (Hughes 1983: 39). As soon as metering became possible, central station managers started charging customers for the amount of electricity actually consumed and tried to attract customers who would use it longer. But the pool of qualified candidates was small. Most important "long hour" customers, as they were called, with more than a very few lamps, usually preferred to install an isolated plant.[6] To meet this challenge, the managers turned to "special contracts," the most extreme form of price discrimination. In his first years at Chicago Edison, Insull, like other station managers, tried to expand by making whatever rate deals brought in larger customers. But despite a focused effort to keep special contracts secret, preferential treatment of large customers became public knowledge, provoking deep dissatisfaction and even judicial appeals.

Central station managers found that their attempts to offer individualized pricing ran afoul of the logic of social relationships. As one manager put it:

> In a small town . . . we cannot make special contracts. In the city you can make special contracts on the same principle that you can live next door neighbor to a man and not know him, whereas in a small town like ours we must have some basis of charge for current that is uniform to all customers. If we make a rate with a customer on a street, within twenty four hours every customer on that street will know about it, notwithstanding the customer might have made very positive promises that he would keep the price to himself. He won't do it. If he thinks he is buying current a little bit cheaper than someone else, he can't keep from telling it. In the city that probably is different (Chandler, AEIC 1898: 58).

But Arthur Williams from New York Edison doubted it was different, noting that, "The important people in New York City are linked together in various ways; I find them knowing each other most surprisingly through clubs and so forth, and they talk over the cost of electric lights rather confidentially, and often times some of the things we say personally spread over town with surprising rapidity" (Williams, AEIC 1895: 110).

Thus, customers' influence on electricity prices came initially from their ability and willingness to exchange price information with those in their personal networks. This jeopardized central stations' capacity to practice special contracts and became one of the major factors that forced them to search for a consistent system of rates. Indeed, consumer activism in the electricity market was soon to become institutionalized. In the early 1900s, informal arrangements were supplemented by Meter Inspection Companies, which collected relevant information and represented customers in their disputes with central stations (AEIC 1904: 233–245).

The economics literature focuses on arbitrage as the main obstacle to price discrimination, "since demanders who can buy from the monopoly at lower prices will be more attractive sources of the good for those who must pay high prices than is the monopoly itself" (Nicholson 1995: 620). Resale of electricity by consumers was technically implausible in the industry's early years. Distribution was controlled by central stations and vertically integrated with production; moreover, electricity could not be stored effectively. Thus customers had no practical way to re-sell the product. But despite the absence of arbitrage, consumer concerns and mobilization about fairness sharply limited and shaped what kinds of price discrimination were possible, and special contracts had to be abolished. The explanation lies in the social organization of the demand side of the market: customers were not atoms but were in social contact with one another, and resented unequal treatment. Social comparisons and a sense of fairness made special contracts illegitimate; in general, we suggest that the social structure of the customer base will be a central matter for whether and in what form price discrimination can be sustained. In particular, two aspects of that structure are relevant: (a) information imperfections (in more sociological language, social network decoupling) that keep some consumers from knowing what prices are offered to others, and (b) the capacity of these networks for collective action when aggrieved. We suggest that these insights usefully complement economic arguments on price discrimination.

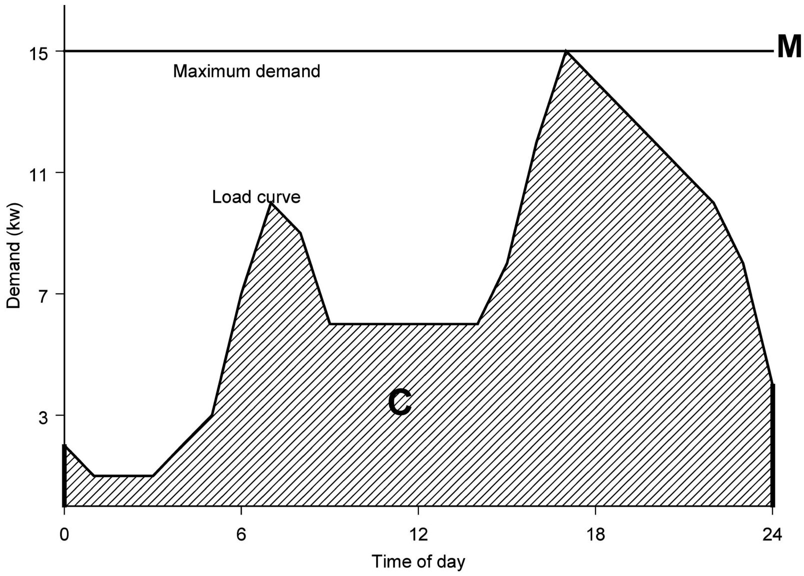
There were other sources of pressure for uniform rates. One was that legislative inquiries raised the specter of forcible imposition of rate systems. As one prominent participant put it at the 1895 meeting of the AEIC: "Now, gentlemen, you may formulate these intricate systems of discount, but I will tell you within a short time the Legislatures of your various States are going to come in and simplify it for you very materially. And you are driving them to it" (Beggs, AEIC 1895: 103). Another impetus toward uniformity was an industry crisis in the early to mid-1890s that provoked a massive wave of consolidation; this pressured utility executives to create common practices in order to facilitate mergers.

The first clear published account of a uniform and sophisticated rate system was provided by British engineer John Hopkinson in 1892, who articulated the distinction between fixed and operating costs two years before its supposed revelation to Insull in England. He explicitly stated that the customer must pay for both his share of fixed costs and for the actual consumption. The fixed charges are justified by the fact that electricity could not be stored and therefore the station has to produce and supply, at any time, what the customer wants without prior notice. Charges for fixed costs (which he and others in this period called "standing" or "standing-by" costs), in his scheme, were assessed according to "connected load" – the amount of equipment that the customer had connected.[7] In effect, he argued that service starts as soon as this equipment is ready to operate, not when the actual consumption begins. *Running costs* refers to the variable expenses incurred when the station is actually providing electricity to the customer. Although Hopkinson appears to be the first to have published an account of pricing that divides costs into standing and running costs, further investigation shows that such pricing systems were already in use during the 1880s, making it highly implausible that they could be new to Insull in 1894.[8]

But Hopkinson's definition of the maximum demand as the *connected load* discouraged customers from installing more lamps than absolutely necessary, since they would be forced to pay for this load even if using it rarely. Therefore, central station managers turned their attention to Arthur Wright, whose 1894 encounter with Insull we have recounted above. Wright's system redefines maximum demand as the *actual* maximum during the billing period, rather than Hopkinson's connected load, and provides a special meter to measure this maximum. The Wright system removed the disincentive for customers to purchase new equipment.

But both systems had another drawback, whose explanation requires a brief account of the economics of electricity provision. Most important is the idea of "load factor," defined as $L = C/(M * T)$, where L is load factor, C is the total amount of electricity supplied by a station during some time period T, and M is the maximum aggregate demand observed by that station at any one moment during T. The "load curve" of Figure 1 shows electricity demanded at every moment; the shaded area under the curve is the total amount in kilowatt hours actually supplied by the station over a 24-hour period; this is C. The top horizontal line represents the maximum load M, which in this case is equal to 15 kw and is reached at about 5 P.M. If a central station invests in just enough equipment to supply 15 kw at any given moment, the area of the rectangle formed by this line and a vertical line drawn from $T = 24$ hours is the maximum supply which can be generated by the station within one day, $M * T$.

Central stations had to invest in at least enough equipment to supply M, even if this load occurred only once in a day. The "load factor" indicates the degree to which this investment is utilized rather than idle during the period measured. The fixed or "standing" costs imposed on customers had to be higher for lower load factors to compensate the central stations for their unused investment – financed by loans on which they were constantly paying interest. Thus, the lower the load factor, the higher the proportion that fixed costs would be of customers' total costs, and the higher the cost of capital per unit of electricity produced. The most efficient utilization of equipment comes at a load factor of one. Improving (i.e., increasing) the load factor was frequently discussed in terms of "balancing the load" or "flattening the load curve," because a perfectly flat load curve would yield the optimal load factor of one. The improvement of efficiency achieved by raising the load factor refers to "productive efficiency" – making more efficient use of all productive



The "load curve" shows electricity demanded at every moment; the shaded area under it, marked as C, is the total amount in kilowatt hours actually supplied by the station over a 24-hour period. The top horizontal line represents the maximum load M equal to 15 kw and is reached at about 5 P.M. If a central station invests in just enough equipment to supply 15 kw at any given moment, the area of the rectangle formed by this line and a vertical line drawn from T=24 hours is the maximum supply which can be generated by the station within one day, M*T=360kwh.

Figure 1. Aggregate load curve of hypothetical consumers.

inputs, so as to produce at minimum cost. It is a commonplace of economic argument that rational firms would want to achieve such efficiency.

Neither the Wright nor the Hopkinson system considers the *time* when the customer demands her maximum load. Whether you turn on the lights in the evening when everyone else does, or use electricity to produce ice at 3:00 A.M. when the demand is very low, you pay the same fixed charges per unit of maximum demand. But the latter usage improves the efficiency of capital utilization, by increasing the load factor, whereas the former reduces it. William Barstow of Brooklyn Edison addressed this problem by designing an alternative rate system that differentiated standing charges depending on the time of consumption. His "two rate" system is based on a study of the central station's overall load curve; it takes the highest points of the load curve as indicating the time periods when consumers should pay higher rates for standing costs, to encourage shifting of usage to times that would even out the load and reduce the central stations' need to invest in new equipment. Like Wright, Barstow promoted a meter – the Kapp meter – which could capture not only the maximum load, as did Wright's, but also the time of the day when this maximum is reached (Barstow, AEIC 1897). This was available even before Wright's meter was widely used.

The Wright and Barstow systems of pricing electricity became the basic alternatives debated within the emerging American electricity industry in the mid-1890s. Both accepted standing and running costs as necessary elements and had similar approaches to metering the running costs. Both were supported by innovative devices for metering standing costs. The points of disagreement were the way in which the standing costs were measured and practicability and reliability of the meters used. Both promoted interests of the "long hour customer" but did so differently. While Wright's rates promoted consumption by exacting no penalty for prolonged use of electricity within the peak period, Barstow specifically encouraged greater consumption at the time of low demand. This is a difference between an emphasis on growth (Wright) and on productive efficiency (Barstow), as the Barstow system discouraged growth that did not contribute to a more balanced load.[9]

Some students of industrial organization suggest that an emphasis on revenue maximization, (such as characterizes the Wright system) may reflect not non-economic goals but rather a preference for profit maximization over the long run versus the short run (cf. Koch: 34). Although this may look plausible for our case, we note that this claim was never made during the debate we are analyzing. On the contrary, the evidence suggests that the proponents of Wright's system acted myopically, while Barstow in part justified his views with references to future developments in electric appliances that could create new opportunities for balancing the load.

The Wright system prevailed after heated debates at the 1898 meeting of the AEIC. Developments after 1898 led to the rapid institutionalization of pricing within the Hopkinson-Wright framework, which was later locked in under regulation as the baseline pricing model. In the following section, we apply the social-constructionist version of institutional analysis we have sketched above to understand the interplay of economic, political, and social factors that produced this outcome.

Political economy and social networks in rate system adoption

Institutionalization mechanisms are often subtle and implicit and thus difficult to capture in empirical research; it is rare to find an arena where the relevant issues are openly and frankly discussed. In the early years of the electricity industry, the two national trade associations, AEIC and NELA, were the only national forums in which sustained discussion of central station issues and problems took place. As such, they played a crucial role in setting industry trends. Both had been founded in 1885, the NELA mainly composed of sellers of current *without* ties to Thomas Edison, and the AEIC, true to its name, including Edison's friends and collaborators who had branched out to form central station companies in many cities. With Edison's departure from the electricity industry in 1892 (cf. McGuire, Granovetter, and Schwartz 1993), Samuel Insull became the *de facto* leader of the Edison circle, whose members dominated the AEIC through the 1890s, but not the entire industry, since the NELA was a larger association that brought together many smaller firms. The main AEIC firms, however, began to join the NELA early in the 1890s, and by 1897 had become a major bloc. In 1898, Samuel Insull was elected President of both associations, and while not as completely dominant in the NELA as in the AEIC, his circle had become by far the most influential (for a fuller account see Granovetter and McGuire 1998; Chung and Granovetter 2001).

We argue that if the Insull circle had not succeeded politically in dominating both trade groups, the industry would have developed in much less homogeneous ways over the following ten to fifteen years, and that among the practices that would have varied more was pricing. Insull's consolidation of power within the trade associations coincided with the rate debate, which became a snapshot of the distribution of power within the industry. This gives us a unique chance to understand the institutionalization of pricing systems and, in particular, the role of concrete social networks in this process.

In this section, we recount the debate over rate systems as it unfolded in the trade associations in the late 1890s, which led to acceptance of the Wright system, and rejection of William S. Barstow's alternative, which entailed time-of-day pricing and an attempt to increase load factors and thus the efficiency of resource allocation. The crucial evidence for an exercise of power comes from the minutes of the influential 1898 AEIC symposium on rates. In this debate, the main support for Barstow's system came from the equipment company, General Electric, and those utility executives who still identified closely with it. In the period preceding this debate, central stations' relationship with General Electric had been in turmoil. Equipment suppliers became less influential over the central station companies as the 1890s wore on. From an original position in the 1880s of holding the majority of stock in such companies and dictating policy, GE and Westinghouse became defined as heading a separate industry, and gave up their dominant ownership role (see McGuire 1986: Ch. 7; Granovetter and McGuire 1998; McGuire, Granovetter and Schwartz 1993). Most important, station managers felt betrayed by their parent company,[10] which aggressively marketed its equipment to the direct competition represented by isolated stations. Insull's circle took shape at Edison's labs and manufacturing plants, predecessors of General Electric. Insull himself led Edison General Electric in 1889–1892 and in that role represented the manufacturing interests at the AEIC. Therefore, when the relationship soured, each member of Insull's circle had to reaffirm his loyalty to central stations.

With regard to the substance of the rate issue, equipment companies would be less concerned about the rapid growth of customers for central station companies than executives of those companies themselves, who worried about competition from isolated stations or public power. Equipment suppliers benefited no matter how the demand for electricity was divided among different providers. The 1898 AEIC debate started when Mr. Haskins, a manager of Meter and Instrument Sales at General Electric, noted that any incentives to consume more electricity during the peak periods increase a station's maximum load without flattening the load curve. Haskins thought that the Wright system had this effect by going too far in rewarding a long hour customer at the expense of a short hour customer who burns electricity in off-peak periods: "There is certainly a large money earning power in the short burning customer, using lots of times when lots of apparatus is idle, and it seems to me that that man is a man that is not reached at all [by the Wright system]" (Haskins, AEIC 1898: 122).

Alex Dow of Detroit Edison argued that there was insufficient evidence to answer Haskins's questions; Mr. Bowker from New York Edison, who had previously made a number of favorable statements regarding the Barstow system, used this opportunity to claim that, unlike Wright, Barstow took care of the short hour off-peak customer. Barstow himself intervened immediately to clarify Bowker and compare directly his and Wright's systems in this respect, saying that "On the maximum demand [Wright] system we seem to discourage the raising of peaks during the minimum period. . . the long hour burner should be recognized when he comes in the minimum period more than if he comes in the maximum period (Barstow, AEIC 1898: 124)".

Barstow might have expected strong support from Louis Ferguson, one of the industry's heavyweights and Insull's closest ally, because when Wright presented his method at the previous 1897 NELA meeting, it was Ferguson who suggested – in line with Barstow's approach – that stations should vary the price for the readiness to serve depending on when the maximum load is demanded (NELA 1897: 200–201). However, at the 1898 AEIC meeting, Ferguson suddenly completely reversed his position, unambiguously supported the Wright system, and openly recognized his previous "misjudgment" about it:

> When Mr. Wright came over here . . . and read his paper . . ., I brought up the point, that Mr. Haskins and Mr. Barstow are now enlarging upon, and I thought I had an awfully strong point. I thought I had a hole in the Wright demand system, and I set up the claim at that time that a customer who used the service at a time other than the period of maximum load ought to have a lower rate.[11] While it might appear to some people that he ought to have it theoretically, yet if you come to analyze the amount of business that occurs at that time you will find that it is a very, very small percentage of your total business, and that you are simply discrediting your system, because you can find a very, very small theoretical point. The number of customers who use current at times other than the maximum load solely is very, very small (Ferguson, AEIC 1898: 125).

Ferguson did not stop here. He unexpectedly invoked a letter from Arthur Wright written as a reply to Barstow's paper in the trade journal *Electrical World*. Ferguson notes that the letter is addressed to him personally, but believes Wright would not object to making it public. The letter aggressively supported Ferguson's claim and caught Barstow off guard; he acknowledged that he "was not quite prepared for the criticism" (AEIC 1898: 129).[12] Barstow hastily made some points in his defense while securing his right to read the letter carefully and prepare a more comprehensive response later. However, this did not take the pressure off Barstow and Haskins who found themselves deadlocked in a hot debate with Insull's allies, Ferguson, Edgar, and Scovil. Neither side could find a comprehensive theoretical argument or empirical evidence to support its position; Bowker's attempts to reconcile the two different methods failed as well.

The sudden appearance of Wright's letter, which criticized Barstow's paper in a journal, but was addressed privately to Ferguson rather than to Barstow or the journal, suggests that Ferguson resorted to its public presentation at the critical moment when all other means had failed to win strong support for the Wright system. Our conclusion is further supported by the fact that the letter was not brought up during the main rate debate. Instead, it showed up the next day after remarks by Haskins who insisted on being heard after being mysteriously omitted by Insull from the major discussion (AEIC 1898: 122).[13] Moreover, Insull himself acknowledged that he decided to enter the debate only "for the fact that Mr. Haskins thought he could contribute something to the discussion, and raised the question a second time" (AEIC 1898: 133).

Events after 1898 support the claim that the Barstow system was eliminated by force rather than argument. Although Barstow's name and meter vanished from the rate debate, arguments about time-of-day pricing broke out occasionally, as in the 1904 meeting of the AEIC (AEIC 1904: 245–247). The proponents of the Wright system addressed this issue with growing impatience. Mr. Knight from Boston Edison, for example, responded to a series of questions:

> The one which seems to be the most important is . . . in regard to the effect of the time of use on cost. It seems to me there is a great deal of misunderstanding on that question, and that it is one about which we should have much clearer views than appears to be the case, considering the number of years we have been discussing rates. Personally, I do not think the time of day when a customer's maximum comes on ought to have anything to do with his cost; the only just and equitable way of proportioning the company's charges among all classes of customers is directly in proportion to the maximum which any individual customer happens to have, entirely irrespective of the time of day (Knight, AEIC 1904: 251).

It became increasingly difficult to raise this issue when discourse was dominated by the symbolism of the "Wright system"; after Barstow's exit from the debate, we do not find discussion of a "Barstow system" or "Kapp system"; time-of-day pricing did not capture enough imaginations to crystallize a recognizable symbolic expression, and this was in part because powerful actors did all they could to push this idea off the stage.[14] But the repeated discussion of the same basic issues underscores the cost of coercive institutionalization; it has to be constantly reinforced by networks of actors.

While hot debates about the Wright system took place at AEIC meetings, Wright himself was invited to lecture at the 1897 meeting of the NELA. We hypothesize that the organizers of Wright's visit targeted as large an audience as possible and NELA, with its broad membership, suited this purpose much better. The lecture provoked substantial interest but stayed free of political fighting and arm-twisting. Thus, the mimetic mechanism of institutionalization was more explicit within NELA than AEIC at that time. Only the victory of Wright's supporters at the 1898 AEIC meeting shifted the focus of that association from the theoretical debate toward the system's implementation and thereby enhanced the mimetic component there as well.

Although in practice, central stations subsequently identified the systems of charging that they adopted in a variety of different ways, the defeat of the Barstow system was decisive. All "Wright-system" variants avoided time-of-day pricing, either for maximum demand or overall usage, because, as we argue below, this would achieve productive efficiency *at the expense* of growth.

Barstow's defeat at the AEIC rate symposium in 1898 demoralized his supporters and led to the rapid formalization of rates. Barstow sold the rights to his meter to General Electric and left the battlefield completely. We do not see his name in subsequent manuals and textbooks on rates. The AEIC's Committee on Meters, established in 1898, included Dow, Ferguson, and Lieb, i.e., the winners in the rate debate. Between 1898 and 1910, departing members of this committee were regularly replaced by others from their same firm (cf. Granovetter and McGuire 1998). Chicago Edison and Edison Electric Illuminating Company of New York kept representatives on the committee continuously until 1910. Detroit kept its seat for another two years after Dow quit in 1905 (AEIC 1898–1910). The relevant NELA committees on Rates and Schedules and on Meters were initiated in 1905 and 1908 respectively by Insull supporters Dow, Edgar, Ferguson, Hale, and Scovil (NELA 1905–1910) all of whom are familiar to us from the rate debate.

The question remains why Barstow himself, a long-time central station executive and associate of Insull and his circle, stood out as the prominent supporter of a rate system that other central station officials opposed so strenuously. We believe that the explanation lies in Barstow's continuing close relationship to equipment supply companies, including General Electric and Westinghouse, which had purchased the rights to produce his meter. But despite Barstow's economic interest in the matter, his social networks were so closely linked to the Insull circle that he was unable to create an independent power base to promote his argument. In the midst of the consolidation of power within the industry, Insull's followers felt a need to sacrifice any internal policy difference for the group's overall goals, which we describe more fully in the next section.

Managerial motives and the drive for growth

We have offered an account of why various actors chose the allies that they did in the rate debate, and why it was so difficult for Insull's opponents to mobilize resources. But the puzzle remains why, given the ambiguities involved in evaluating these systems, Insull and his associates would *define* their side by support for the Wright system, and fight so ferociously for it that their counterparts angrily noticed that "the strongest point about the Wright demand system is the able backers it has in this country. . . . The ability of its backers exceeds the merits of the system" (Doherty 1900: 335). We see two major factors.

One concerns vested interests in the meters that went with specific rate systems. Insull held a financial stake in Wright's meter,[15] and Barstow was a patented inventor of his system, which also included a metering device and therefore promised substantial business if his system were recognized as superior. The first presentation of the Wright system at an AEIC convention was given in 1896 by R.S. Hale from Boston who was a seller of Wright's meter. Haskins, Barstow's staunch supporter, led the Meter and Instruments Sales Department in General Electric, which bought the right to produce the meter from Barstow (Doherty 1900). Finally, Barstow left Brooklyn Edison and the central station industry in about 1899–1900 to become an independent consultant, maintaining his ties to equipment firms.

These interests vested in specific metering devices were well known within the industry, and probably had some role in determining actors' positions on rates. In fact, Insull claimed to participate only reluctantly in the entire discussion, given his stake in the Wright meter (AEIC 1898: 133). In response, Barstow hesitated to acknowledge his financial interest and instead promoted himself as a true disinterested believer: "This two-rate system is original with Gispert Kapp and it is quite an old system. I became interested [financially] in it simply because I believed in it and long after we had the system in operation on a small scale in Brooklyn" (Barstow, AEIC 1898: 135).[16]

But we consider a second motive more central for Wright system supporters: the priorities of Insull's circle for the central station industry.

Insull assigned the first priority to acquiring new customers and growing revenues even if they were achieved at the high cost of an unbalanced load. He and his circle were devoted to what can be called the "growth dynamic" approach to central station provision of electricity (see Granovetter and McGuire 1998, and cf. Hirsh 1989). This approach emphasized large-scale provision, vertical integration of generation, transmission and distribution and continuous expansion of the customer base, and actively combated alternatives based on decentralized, smaller-scale provision with separation of functions by company, of which isolated generation was a special case.

By contrast, Neufeld argues that under competitive pressure from isolated plants, central stations adopted the Wright system "as a sophisticated mechanism which institutionalized profit-maximizing price discrimination" (Neufeld 1987: 693). He suggests that the mechanism worked because it took into account the only two factors that determined the costs of isolated plants: total energy production and maximum energy production. But this argument does not consider that isolated plants frequently accepted external customers to balance their load and it was only regulation that later made this impossible.[17] The Barstow system did address this factor as well as the two mentioned by Neufeld, and could have brought additional profits from productive efficiency by creating incentives for customers to shift their maximum demand away from the central station's peak load. This did not happen because, as we show above, the Barstow system was dead, for reasons unrelated to profit maximization, long before the institutionalization of the price mechanism was completed under the dictate of state regulatory commissions.

In our attempt to understand what drove the debates on pricing, we follow the old economic institutionalist literature, which depicts the price maker's interest as not confined to price or even profit making *per se*. She often pursues, instead, a diverse agenda in which price is just a means to another end (for reviews, see Hodgson 1998, Tool 1991). The more specific hypothesis that economic actors may pursue maximization of revenues rather than profits has been a commonplace at least since economist William Baumol's 1959 treatment, though we still have little systematic investigation of the theme.[18] (See also Cyert and March 1963; Kaplan, Dirlam, and Lanzillotti 1958).

We have considerable evidence that revenue maximization was the principal goal of central station managers, and that it was pursued myopically, with little regard for profit in the short or long run (see e.g. Granovetter and McGuire 1998, McGuire, Granovetter and Schwartz 1993).[19] The Barstow rate system was inconsistent with this growth dynamic approach, because it highly rewarded off-peak customers who were in a relative minority in the early period of industry development, even though it was superior to the Wright system from the point of view of load balancing and productive efficiency. Barstow was not unmindful of the need for growth, but his strategy was to encourage developments within the industry that would drastically increase the consumption of electricity during the day while the Wright system, by treating all uses equally, threatened to unbalance the load further by leading to a wider use of lighting, the night-time use that already dominated the load curve. Barstow's expectations that new electric appliances for daytime use would soon spread rapidly were in fact well-founded. The electric drill was being manufactured by 1885, the sewing machine by 1886, and ceiling fan by 1887; their massive proliferation was underway by the beginning of the 1900s (NEMA 1946: 55–59). Thus, arguments against Barstow, such as Ferguson's, that demand at off-peak hours was unlikely to develop sufficiently to merit encouragement in rate systems, were shortsighted. We note that this difference suggests that Barstow, more than Wright system proponents, was looking beyond the short-term. As detailed in the concluding section of this paper, we believe that had the Barstow system prevailed, electricity provision might have been dramatically different over the course of the next century in the United States.

But the Barstow approach did not satisfy Insull and his supporters who, in a fierce competition with gas and isolated electric plants (including those of urban electric railways which could sell off excess current to balance their own load) wanted more customers and revenues immediately, regardless of efficiency or load-balance: "The object of any system is to get business... What you are running your plant for is to increase its revenue, so that we must have a system that will do that" (Ferguson, AEIC 1898: 125). Arthur Wright added that "Barstow practically says he will not modify his tariff for lighting until the use of electricity for other purposes equals in volume the demand for electricity for lighting, which is like telling profitable lighting consumers to wait until the millennium before they can hope for electricity as cheap as gas" (Wright, AEIC 1898: 128). Insull chimed in that "It is that class of business, it is the average business, that I think a central station company wants. I do not think Mr. Barstow can get that on his scheme. He explains that the business of his company this year will improve his conditions so that he can curtail the period of high price next year. But we meet the situation right now" (Insull, AEIC 1898: 134).

These statements confirm that Insull subordinated the issue of rate systems to his major interest in expanding the central station business in the short run at almost any cost. Evidence suggests that the economic motives for this were the fear of competition from gas lighting, not-for-profit electric systems and isolated generation, and the perceived need to pre-empt the market that these threatening competitors might otherwise serve. Central station companies took such threats quite seriously, and became adept in subsequent years at combating such sources, using both economic methods such as pricing systems, and political methods such as manipulation of apparently neutral "blue-ribbon" commissions investigating related issues (cf. McGuire and Granovetter 1998). To the extent that this explains the motives of Wright-system proponents, it may be quite consistent with economic rationality, and we do not claim otherwise.

But we also believe that there were other reasons to put revenues ahead of profits. One is that revenues are comparatively easy to observe, whereas profits, especially in a capital-intensive business, depend heavily on accounting systems, which, as social constructions, are disputable and thus more difficult to use in setting goals (see e.g. Carruthers and Espeland 1993). Insull, in fact, was ruined in the late 1920s in large part by the charge that his use of "balloon depreciation" for his companies' extensive holdings of equipment – i.e., writing off the cost of the equipment all at once at the end of its useful life, rather than gradually as in "straight-line depreciation" – created a false appearance of profits over many years, and that his companies could therefore only be kept afloat by new loans. In effect, the accusers, including the Morgan interests in New York, accused Insull of managing a massive "Ponzi scheme" (see McDonald 1962).

Another very general and non-economic motive for revenue maximization is concern for status and power in a firm or community, which often rests on the *size* of operations one coordinates. There is ample evidence that Samuel Insull relished his uniquely exalted position in Chicago during the first thirty years of the twentieth century (cf. McDonald 1962). Although Insull's near-iconic local status was not matched by other utility executives, similar motives seem plausible for them as well. Beyond individual executives' desires for status, we note that as emphasized by the new institutionalism in sociology, there are substantial pressures for organizations to adopt whatever form appears modern and rational, (cf. Meyer and Rowan 1977), and that in many periods the sheer scale of an economic operation is taken by many as such an indicator. This "halo effect" of size can be documented for business organizations (e.g. Granovetter 1995: 104–106), and even for individual engineering projects such as dams (cf. Espeland 1998).

We believe that some combination of all these motives explains why proponents of the Wright system worked so vigorously on its behalf. Together with the evidence presented in the previous section, this suggests that Insull's powerful circle took advantage of the uncertainty about the most appropriate pricing scheme to promote its larger vision of the electricity industry. This is consistent with the power mechanism described by followers of the old institutionalist tradition in sociology.

Discussion

We conclude by clarifying the theoretical significance of our arguments for theory in economic and organizational sociology. We stress that our main concern is not to make a theoretical economic analysis of what would have been the optimum pricing scheme in the early electricity industry. Instead, we draw here on the work of economists who, over the last century, have made substantial progress in explicating meaningful optimization criteria and their rationales (for an up-to-date treatment, see Wilson 1993). Using that work in conjunction with our empirical data as a point of departure, we identify the relative merits of the two basic pricing schemes that were actually debated in the American electricity industry of the late nineteenth century. The Barstow system is superior in productive efficiency while the Wright system aligns customers' incentives with the logic of growth maximization. The growth maximization strategy undermined short-term profitability of private central stations but may have helped them drive out competition from isolated generation, public companies, and gas lighting. Our account of the debate over rates provides rare direct evidence of growth maximization as an economic goal.

Under what circumstances maximization of growth is compatible with that of profits over the long run has long been a hotly debated issue within economics. Neoclassical economists who have considered electricity pricing typically favor systems which, like Barstow's, take time of use into account. Houthakker (1951) argued that a time-of-day tariff would be more appropriate than the "two-part tariff" (similar to the Wright system we have described) on the ground of allocative efficiency, but that a serious obstacle to this was the "mistaken belief in the electricity industry that its task is to sell as many kwh [kilowatt hours] as possible. . . .the two-part tariff is an effective instrument for this expansionist form of monopoly" (1951: 24).

We do not consider how the different pricing schemes might impact the welfare of different classes of consumers because our argument principally concerns the actions of producers and because this subject is well beyond our ability to assess with the available data. However, since productive efficiency is a prerequisite for allocative efficiency according to general equilibrium theory in economics (e.g. Milgrom and Roberts 1992: 23), Houthhakker's comments entail a preference for productive efficiency over growth maximization in this case, and he explicitly argues for the greater allocative efficiency of time-of-day pricing. The observation that a focus on maximizing electricity revenues leads to pricing schemes that depart from productive efficiency was a source of exasperation for prominent economist I.M.D. Little who testily refuted the arguments for the maximum-demand system offered in 1953 by a representative of the British Electricity Authority, complaining that they betrayed a "complete misunderstanding of the function of the price mechanism" (1953: 61).[20]

The historical issue is muddied by the fact that the discussion of rate systems by late nineteenth- and early twentieth-century industry participants was virtually innocent of the concerns of theoretical economics. It was not until the 1920s that the general subject of "overhead costs," vital to electricity pricing, began to receive systematic treatment by economists (e.g., Clark 1923).[21] Because the period we analyze predates public rate regulation, the systems discussed were devised, analyzed, and justified by engineers, on behalf of privately owned central station companies. Although some participants showed a surprising degree of sophistication, the number of options discussed in a theoretical way was quite small compared to the vast array of rate systems that emerge from more abstract arguments such as those offered in modern treatments like Sibley and Brown (1986) or Wilson (1993). Yet those immersed in the practical world of electricity provision were compelled, with or without theoretical guidance, to deal with even the most complex problems in some fashion. One of the most vexing was how to address the fact that the sum of individual maximum demands (loads) might be substantially more than the maximum load on the system at any given moment, because different customers have their maxima at different times of day.[22] This divergence between individual and aggregate maxima makes it difficult to assess the need for system capacity, and remains a challenge even with modern analytic techniques. Wilson, for example, in his account of quite sophisticated models for "capacity pricing" schemes to help utilities deal with peak loads, mentions that all the models he considers assume synchronized peak loads across customers. But he notes that in practice, "customers' loads are substantially asynchronous and therefore equipment that is idle for one customer can be used to serve another; thus, the total capacity requirement is less than the sum of the customers' peak loads. An examination of this more complicated topic is outside the scope of the present exposition" (1993: 261).

The industry had to resolve these confusions somehow, because of the pressures towards the standardization of pricing methods. The new sociological institutionalists' principle of isomorphism helps us to explicate the coercive and mimetic mechanisms behind these pressures. One important theoretical contribution that we make here to the sociology of pricing is to show that the choice among pricing schemes is not confined to the level of firms; institutional pressures towards standardization turn it into an industry-level process. At the same time, the new institutionalism does not explain why one method rather than another becomes standard. Invoking a social constructionist argument, we assert that the structure of the network that generates and transmits institutional pressures is a key determinant of outcomes, and in this case led to the dominance of the Wright system over that of Barstow. Our joining of new institutional and social constructionist arguments brings agency into the institutional framework and explains the social organization of the price debate and its outcome. Instead of yielding an unconditional prediction of outcomes based on the details of rate systems alone, along with some assumption of utility maximizing individuals and firms, this argument yields a prediction that also depends on contingencies and social institutions. It proposes that to the extent the logic of economic argument is ambiguous, those interests that can best mobilize resources through organizational networks on behalf of an economic policy that they favor are most likely to prevail. Politics, networks, and agency become key concepts.

A number of other details in our account further justify our emphasis on institutions beyond individual actors as determinants of prices.

When consumers objected to rates, this opened the way for Meter Inspection Companies, which represented customers in their disputes with central stations. When interest groups within the central station industry wanted to forward their own agenda on rates, they found it indispensable to do so through their control of national trade associations, which cohesive groups of these individuals had founded for their own purposes. This political power achieved through the mobilization of resources through social networks can be recast in more abstract form as constituting the informal origins of formal institutions. Such origins blur the boundaries between the formal and informal spheres of economic activities. The ongoing interaction between formal and informal institutional arrangements emerges as the motor of institutional change.

The change in pricing systems caused by such a mechanism in the early electricity industry turned out to be substantial, long lasting, and highly significant for the American industrial infrastructure during the twentieth century. The "growth dynamic" strategy of the large utility companies headed by Samuel Insull and his circle led to a century of hegemony by large vertically integrated companies, generating, transmitting, and distributing huge amounts of power over very long distances, and protected by a complex regulatory apparatus (see Hughes 1983; Granovetter and McGuire 1998; McGuire and Granovetter 1998; and Hirsh 1989). We do not claim that pricing was the only or even the single most important part of this strategy, and we recognize that it is hard to assign a specific amount of variance in outcomes that results from pricing. But we do argue that pricing was a key element of the growth dynamic, and a necessary condition for it to succeed.

The dominance of Wright-like systems, however, was not inevitable. Such systems were also adopted in Wright's native England, but as Houthakker notes, time-of-day tariffs were common in some countries such as France and the Netherlands (1951: 24n). It would be of interest to investigate whether pressures for a "growth dynamic" were weaker in these countries, and if so, why.

Had the Barstow system prevailed in the U.S., the organization of the electricity industry would have been substantially different. An emphasis on productive efficiency at the expense of growth, which would have been encouraged in that case, would almost certainly have left more market niches and investment capital for a variety of smaller-scale electricity production systems. The smallest of these would be what was referred to in this period as "isolated generation," where power is generated on-site by factories, commercial establishments, or residences, including hotels, apartment houses and even single-family homes – the outcome that prevailed for heating. Because both generators and furnaces produce waste heat, it was highly efficient for electricity and heating to be linked so that the waste from one could be fed into the other, dramatically reducing costs by co-generation. The efficiency of this co-generation made isolated systems a difficult competitor for central station utilities, and utilities were still deeply concerned by this issue until the 1920s; such isolated systems will likely become important once again in the twenty-first century under electricity deregulation. By 1892 almost every textile plant in New England had an isolated plant (Hammond 1941: 64). By 1899 isolated plants accounted for 55% of all generators and distributed 50% of all electricity in the U.S. (Duboff 1979: 39, 41, 218). And by 1907, 65,000 manufacturing plants had isolated generators (USDCL 1910: 14).

When isolated generating systems were sufficiently large, as for an apartment house, a substantial factory, or an urban electric railway, there was likely to be additional electricity that could be sold off to nearby customers, in order to balance load, or co-generation products such as hot water, that could be sold off to provide heating. Early in the twentieth century, such systems were common in the United States, and were known as "neighborhood" or "district" systems. Such systems developed much more systematically in Europe during the twentieth century, but in the United States were ultimately confined to universities, military bases, and other well-defined and autonomous communities. Had district systems become more common, they might have become highly efficient, since it is relatively easier to control load factors over small territories where consumption patterns are steady and predictable.[23]

Indeed, some of the greatest threats to central stations came from suppliers to the largest district systems, namely urban electric railways and municipal utilities. The electric railways in the early twentieth century generated their own electricity, using very large installations. During the first decade of the century, such railways accounted for more than 40% of all electrical equipment purchased (USDCL: 1910). Because such railways had a large day load, but not the night-time load of lighting that they needed to balance their load curve and better amortize their equipment costs, central stations feared that they would compete with them for this load. This fear was exacerbated by the possibility in numerous cities, such as Chicago, that the railways would be taken over by the city and thus become part of a municipal electric power movement that seemed highly threatening in this period. Indeed, one of the major elements of the growth dynamic strategy, in addition to pricing for growth, was a successful political effort to encourage state regulation in a way that would hamper otherwise highly efficient municipal systems (see McGuire and Granovetter 1998).

Moving to more speculative ground, we note that full attention to productive efficiency would have presented incentives to businesses to move operations into times of day normally not utilized. This suggests that the "frontier" of nighttime activity, as Melbin (1987) has called it, might have been breached much sooner than in fact occurred, with more active use of multiple shifts earlier in the twentieth century. Instead, Melbin does not note a shifting of production to evenings as a response to differential electric rates until the 1970s (1987: 20). Yet, Lieb had already predicted such a development in response to time-of-day rates at the 1897 AEIC meeting (1897: 64).

Recent events have provoked substantially increased interest in time-of-day pricing such as featured in the Barstow system. This is in part because deregulation of the electricity industry was sparked by concern about inefficiencies in production and pricing under the regulation of vertically integrated utility companies (see e.g., Joskow and Schmalensee 1983: 82–90), and consequently has brought increased attention to issues of productive efficiency. But the new interest in time-of-day pricing usually proceeds without awareness of how old an issue it is.[24] Our account shows that the merits and fate of new schemes will not be decided exclusively by economists and industry executives but will ultimately involve political mobilization and public relations.

Our analysis brings together economic, institutional, and social constructionist arguments in a complementary fashion. The economic argument clarifies alternative merits of pricing schemes that were discussed in this period. The neo-institutional reasoning specifies the pressures toward uniformity and the tools that actors could use to enforce a single outcome. Our particular contribution to theory is twofold. First, we identify the differences between old and new institutionalism regarding their conceptions of power and, in particular, the role of broader agendas in institutionalization processes. Second, we join to institutional arguments in organizational sociology an emphasis on social construction, in particular, a focus on the position of the key actors' networks within the industry's power structure as the crucial determinant of their ability to institutionalize their preferred pricing methods. This approach allows us to generalize to the macro-level Weber's insight on the origins of prices with which we introduced the article. For Weber, prices are "quantifications" of "power constellations" and the "struggle of interests." We show that the same ingredients, power and interests, embedded in concrete networks, not only determine individual prices, but shape the pricing schemes that underlie them into full-fledged institutions.

Acknowledgments

Direct all correspondence to Valery Yakubovich, the University of Chicago, Graduate School of Business, 1101 E 58th Street, Chicago, IL 60637, valery@ChicagoGSB.edu. Earlier versions of the article were presented at the Economic Sociology workshop at Stanford University and the 1998 Annual Meeting of the American Sociological Association in San Francisco. We are thankful to James Evans, John Meyer, and Mark Zbaracki for their insightful comments.

Notes

1. Some major exceptions, which form the basis for what may become a more sustained stream of sociological argument on price, are Baker (1984), Zelizer (1985), Smith (1989), Carruthers (1996), Zuckerman (1999), Velthuis (2003), Zbaracki (2003), Uzzi and Lancaster (2004). Not explicitly couched in terms of sociological argument, but certainly of unusual interest, is Cronon's pathbreaking work on flow and pricing of the various commodities that made Chicago so dominant in nineteenth-century America (Cronon 1991)
2. A recent account of the great variety of schemes available, and their relative merits, is given in Wilson 1993.
3. Walton Hale Hamilton (1881–1958), like John Commons and other influential figures in the "old" institutional economics, was a professor of law (at Yale University), and one of the most prominent institutionalists of the interwar period (cf. Yonay 1998: 53). He also taught and greatly influenced the young Talcott Parsons in the course of his undergraduate education at Amherst College (Camic 1987).
4. For general accounts of the development of the electricity provision industry in the United States, see Hughes 1983 and Granovetter and McGuire 1998.
5. Sicilia (1991: 138) also praises the Wright system as "an equitable compromise between producer and consumer, one that rewarded the efficient utilization of resources on both sides; but unlike McDonald and Platt, he attributes discovery of the system to Boston Edison's Charles Edgar.

6. In the late nineteenth and early twentieth centuries, private electrical generating equipment, installed in homes, commercial buildings or industrial establishments, were called "isolated" plants or stations.
7. In electricity, as in some other industries, the demand from consumers at any given moment is referred to as the "load" that the system of provision is trying to meet.
8. Such systems were already in use in 1885-1886 at the Italian Edison Company in Milan (Lieb, AEIC 1897: 67). As Edison's chief assistant, Insull would almost certainly have known of procedures at Italian Edison, thus making his supposed ignorance of these basic principles ten years later, in 1894, highly unlikely. Indeed, Insull himself, as far as we know, made no claim for the novelty of the system in the 1890s; this idea comes instead from sources like Insull's biographer, McDonald (1962).
9. Economics distinguishes several kinds of efficiency. "Productive efficiency" refers only to that use of inputs that results in producing the product at minimum cost. Broader concepts of efficiency, including "allocative efficiency," consider the impact of a set of prices on general consumer welfare, including tradeoffs within the whole spectrum of goods and services that consumers want. Here we merely claim that the Barstow system was superior to the Wright system in productive efficiency. Its impact on allocative efficiency is beyond our ability to gauge with the available evidence, and in any case not necessary for our argument.
10. As a result of equipment-for-shares transactions, General Electric owned substantial stakes in central stations.
11. Ironically, not only Ferguson himself had thought that he made a contribution to the Wright system. Future historians of the electricity industry also praised his insight (cf. Platt 1991: 86).
12. Ferguson's fervent presentation of his argument was not an isolated incident. At the 1902 NELA convention, he wrestled utility magnate Henry Doherty for control of a chalkboard in order to advance his position and minimize the exposition of an alternative view (Doherty 1923, II:125; III:74–78, 136–137).
13. The omission of alternative ideas was a common practice in the AEIC and NELA controlled by Insull and his supporters (see Granovetter and McGuire 1998).
14. Gisbert Kapp, whose meter the Barstow system used, was a prominent electrical engineer in Germany and England. Though he was a prolific inventor and consultant, the only biographical material on him that we know of (Tucker 1973) does not even mention his work on a time-of-day meter and rate system.
15. See Schenectady (NY) Museum, General Electric Hall of History, General Electric Archives: C-534, Hammond Papers.
16. This particular encounter nicely demonstrates the advantage Insull enjoyed as head of the AEIC and NELA at this crucial point in the rate conflict. This status allowed him to control debates and to decide for himself when to enter a fight.
17. For example, the laws in Massachusetts and New York did not allow electric lines to cross a street unless the provider was a regulated independently owned utility, and imposed complex and expensive requirements and accounting systems if an isolated station were to become a utility. (See Sicilia 1991: 284; Ripley 1909).
18. Baumol acknowledged that a desire for high revenues may serve the goal of profit maximization to a certain extent, and also that few actors would make revenue maximization an unconstrained goal, since some minimal level of profit must be achieved to satisfy various stakeholders. Nevertheless, he argued that at least for the businessmen with whom he was familiar, "sales have become an end in and

of themselves," and that "almost every time I have come across a case of conflict between profits and sales the businessmen with whom I worked left little doubt as to where their hearts lay" (1959: 47–48).

19. Hausman and Neufeld indirectly support this argument when they suggest that "the economists were more concerned with social welfare and less concerned with the growth of electric utilities than were the engineers and executives within the industry" (Hausman and Neufeld 1984: 123).
20. In his more understated way, W. Arthur Lewis noted that the importance of time of electricity consumption in relation to the station peak was "now generally accepted among the better writers on the subject, but it is not yet fully realised in tariff making" (1949: 51). Ironically, in the latter part of the twentieth century, the more sophisticated rate schemes that came into use and made complex time-of-day adjustments to achieve productive and allocative efficiency, became known as "Wright tariffs" (Wilson 1993).
21. The level of confusion about rate systems in this period was so high, in fact, that even key industry participants had trouble with the concepts. Samuel Insull, for example in his address "Some Advantages of Monopoly" given at the meeting of the Engineers' Club of Dayton (Proceedings of the Engineers' Club of Dayton 1914), in which he touted the advantages of large central stations, miscomputed the load factor of the Chicago Edison system, thus misleading the audience (21–26).
22. This is just the difficulty that tripped up Samuel Insull in his erroneous exposition of the virtues of central station provision, as detailed in the previous footnote.
23. The example of district systems illustrates that the distinction between "isolated" and "central" is relative. Thus "central heating" in homes came to mean that one energy source heated the entire house, rather than a separate one for each room.
24. For example, a 2000 *New York Times* account of electricity pricing included the following sub-headline: "U.S. Companies Varying Fees Based on Supply, Demand and Even Time of Day" (Wald 2000).

References

Arthur, W. Brian, *Increasing Returns and Path Dependence in the Economy.* Ann Arbor: The University of Michigan Press, 1994.

Association of Edison Illuminating Companies (AEIC), *Proceedings of Annual Meetings*, 1891–1910.

Baker, Wayne E, "The Social Structure of the National Securities Market," *American Journal of Sociology*, 89/4(1984): 775–811.

Baumol, William, *Business Behavior, Value and Growth*. New York: Macmillan, 1959.

Baumol, William and David Bradford, "Optimal Departures from Marginal Cost Pricing," *American Economic Review* 60/3(1970): 265–283.

Beale, Joseph H. and Wyman, Bruce, *Cases on Public Service Companies.* Cambridge: The Harvard Law Review Publishing Association, 1902.

Beggs, John I., Papers, 1869–1924. Milwaukee Manuscript Collection 182. Wisconsin Historical Society. Milwaukee Area Research Center. Golda Meir Library. University of Wisconsin – Milwaukee, 1847–1925.

Berger, Peter and Thomas Luckman, *The Social Construction of Reality, A Treatise in the Sociology of Knowledge*. New York: Anchor Books, 1966.

Bijker, Wiebe E., Thomas P. Hughes, and Trevor Pinch (editors)., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology.* Cambridge: the MIT Press, 1987.

Boltanski, Luc and Larent Thevenot, *De la justification: Les Economies de la Grandeur*. Paris: Gallimard, 1991.
Brown, Stephen and David Sibley, *The Theory of Public Utility Pricing.* Cambridge: Cambridge University Press, 1986.
Burke, Henry G., *The Public Service Commission of Maryland.* Baltimore: Johns Hopkins University Press, 1932.
Byatt, I.C.R., *The British Electrical Industry 1875-1914: The Economic Returns to a New Technology.* Oxford: Oxford University Press, 1979.
Callon, Michel and John Law, "On the Construction of Sociotechnical Networks: Content and Context Revisited," In L. Hargens, R.A. Jones, and A. Pickering (editors). *Knowledge and Society: Studies in the Sociology of Culture Past and Present: A Research Annual* 8(1989): 57–83. Greenwich, CT: JAI Press.
Camic, Charles, "The Making of a Method: A Historical Reinterpretation of the Early Parsons," *American Sociological Review* 52/4(1987): 431–439.
Carruthers, Bruce, *City of Capital*. Princeton: Princeton University Press, 1996.
Carruthers, Bruce and W. Espeland, "Accounting for Rationality: Double-Entry Bookkeeping and the Rhetoric of Economic Rationality," *American Journal of Sociology* 97/1(1991): 31–69.
Chung, Chi-nien, "Networks and Governance in Trade Associations: AEIC and NELA in the Development of the American Electricity Industry: 1885–1910," *International Journal of Sociology and Social Policy* 17/7–8(1997): 57–110.
Clark, John Maurice, *Studies in the Economics of Overhead Costs*. Chicago: University of Chicago Press, 1923
Cronon, William, *Nature's Metropolis: Chicago and the Great West.* New York: W.W. Norton, 1991.
Cyert, Richard M. and James G. March, *A Behavioral Theory of the Firm*. Englewood Cliffs, N.J.: Prentice-Hall, 1963.
DiMaggio, Paul J., "Interest and Agency in Institutional Theory," In *Institutional Patterns and Organizations.* Cambridge, MA: Ballinger Publishing Company, 1988.
DiMaggio, Paul J. and Walter W. Powell, "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields," *American Sociological Review* 48(1983): 147–160.
Doherty, Henry L., "Equitable, Uniform and Competitive Rates," In *The Development of Scientific Rates for Electricity Supply.* Detroit, MI: The Edison Illuminating Company of Detroit, 1900/1915.
Eisenmenger, Hugo, *Central Station Rates in Theory and Practice.* Chicago: F.J. Drake and Company, 1921.
Espeland, Wendy, *The Struggle for Water: Politics, Rationality and Identity in the American Southwest*. Chicago: University of Chicago Press, 1998.
Fligstein, Neil, "Markets as Politics: A Political-Cultural Approach to Market Institutions," *American Sociological Review* 61(August)(1996): 656–673.
Granovetter, Mark, "Problems of Explanation in Economic Sociology," In *Networks and Organizations: Structure, Form, and Action.* Edited by N. Nohria and R.G. Eccles, 1992.
Granovetter, Mark, "Coase Revisited: Business Groups in the Modern Economy," *Industrial and Corporate Change* 4/1(1995): 93–130.
Granovetter, Mark and Patrick McGuire, "The Making of an Industry: Electricity in the United States," In Michel Callon, editor, *The Law of Markets*. London: Blackwell, 1998.
Gruchy, Allan, "Institutional Economics Prior to 1939," 19–80 in *Contemporary Economic Thought; The Contribution of Neo-Institutional Economics*. Clifton, N.J.; Augustus Kelly, 1972.
Hamilton, Walton, *Price and Price Policies.* New York: McGraw-Hill Book Company, 1938.
Harris, Abram L., "Types of Institutionalism," *Journal of Political Economy* 40/6(1932): 721–749.
Hausman, William J. and John L. Neufeld, "Time-of-Day Pricing in the U.S. Electric Power Industry at the Turn of the Century," *The Rand Journal of Economics* 15/1(1984): 116–126.

Hirsh, Richard, *Technology and Transformation in the American Electric Power Industry*. Cambridge: Cambridge University Press, 1989.

Hodgson, Geoffrey M., "The Approach of Institutional Economics," *Journal of Economic Literature* 36/1(1998): 166–192.

Hopkinson, John, "On the Cost of Electric Supply. Presidential Address to the Junior Engineering Society," In *The Development of Scientific Rates for Electricity Supply.* Detroit, MI: The Edison Illuminating Company of Detroit, 1892/1915.

Houthakker, Henrik S., "Electricity Tariffs in Theory and Practice," *Economic Journal* 61/241(1951): 1–25.

Hughes, Thomas P., *Networks of Power. Electrification in Western Society, 1880–1930.* Baltimore: The Johns Hopkins University Press, 1983.

Insull, Samuel, "Some Advantages of Monopoly," In *Proceedings of the Engineers' Club of Dayton.* Ohio: The Club at Dayton, 1914.

Joskow, Paul L. and Richard Schmalensee, *Markets for Power. An Analysis of Electric Utility Deregulation.* Cambridge, MA: The MIT Press, 1983.

Kahneman, D., J. Knetsch, and R. Thaler, "Fairness as a Constraint on Profit Seeking: Entitlements in the Market," *American Economic Review* 76/4(1986): 728–741.

Kaplan, A.D.H., Joel B. Dirlam, and Robert F. Lanzillotti, *Pricing in Big Business. A case approach.* Washington, D.C.: The Brookings Institution.

Koch, James V., *Industrial Organization and Prices.* Englewood Cliffs, NJ: Prentice-Hall, 1974.

Latour, Bruno, *Science in Action.* Cambridge: Harvard University Press, 1987.

Lewis, W. Arthur, *Overhead Costs: Some Essays in Economic Analysis.* New York: Rinehart, 1949.

Little, I.M.D., *The Price of Fuel*. Oxford: Oxford University Press, 1953.

McDonald, Forrest, *Insull*. Chicago, IL: The University of Chicago Press, 1962.

McGuire, Patrick, Mark Granovetter, and Michael Schwartz, "Thomas Edison and the Social Construction of the Early Electricity Industry in America," In Richard Swedberg, editor, *Explorations in Economic Sociology.* New York: Russell Sage Foundation, 1993.

McGuire, Patrick and Mark Granovetter, Business and Bias in Public Policy Formation: The National Civic Federation and Social Construction of Electric Utility Regulation, 1905–1907," unpublished paper, presented at the annual meeting of the American Sociological Association, San Francisco, California, 1998.

McGuire, Patrick and Mark Granovetter, "Shifting Boundaries and Social Construction in the Early Electricity Industry, 1878–1915," In Marc Ventresca and Joseph Porac, editors. *Constructing Industries and Markets,* New York: Elsevier-Pergamon Press, 2005.

Melbin, Murray, *Night as Frontier*. New York: The Free Press, 1987.

Meyer, John W. and Brian Rowan, "Institutionalized Organizations: Formal Structure as Myth and Ceremony," *American Journal of Sociology* 83(1977): 340–363.

Milgrom, Paul and John Roberts, *Economics, Organization, and Management.* Englewood Cliffs, NJ: Prentice-Hall, 1992.

Nash, L.R., *The Economics of Public Utilities.* New York: McGraw-Hill Book Company, 1925.

National Electric Light Association (NELA), *The Minutes of the Conventions.* New York: The James Kempster Printing Company, 1890–1910.

Neufeld, John L., "Price Discrimination and the Adoption of the Electricity Demand Charge," *The Journal of Economic History* 47/3(1987): 693–709.

Nicholson, Walter, *Microeconomic Theory: Basic Principles and Extensions.* 6th edition. Orlando, FL: The Dryden Press, 1995.

Northwestern Electrical Association, *Fourth Semi-Annual Convention*. WI: Marinette, 1896.

Okun, Arthur, *Prices and Quantities*. Washington, D.C.: Brookings Institution, 1981.

Phlips, Louis, *The Economics of Price Discrimination*. Cambridge: Cambridge University Press, 1983.

Polanyi, Karl, *The Livelihood of Man*. New York: Academic Press, 1977.

Powell, Walter W. and Paul J. DiMaggio, *The New Institutionalism in Organizational Analysis.* Chicago: The University of Chicago Press, 1991.

Platt, Harold H., *The Electric City. Energy and the Growth of the Chicago Area, 1880–1930.* Chicago, IL: The University of Chicago Press, 1991.
Ripley, Charles M., "Manufacturers' Interest in Isolated Plants," *The Iron Age* 83 (January 7, 1909): 26–28.
Roy, William G., *Socializing Capital: the Rise of Large Industrial Corporation in America.* Princeton, NJ: Princeton University Press, 1997.
Scott, Richard, *Institutions and Organizations. Thousand Oaks, CA: Sage Publications.* 1995.
Selznick, Philip, *Law, Society, and Industrial Justice.* New York: Russell Sage Foundation, 1969.
Selznick, Philip, "Institutionalism 'Old' and 'New," *Administrative Science Quarterly* 41(1996): 270–277.
Sicilia, David B., *Selling Power: Marketing and Monopoly at Boston Edison, 1886–1929.* Ph.D. Dissertation, Brandeis University, 1991.
Smith, Charles W., *Auctions: The Social Construction of Value.* New York, NY: Free Press, 1989.
Stanfield, J.R., "Institutions and the Significance of Relative Prices," *Journal of Economic Issues* 29/2(1995): 459–465.
Stinchcombe, Arthur L., "On the Virtues of the Old Institutionalism," *Annual Review of Sociology* 23: 1–18.
Tirole, Jean, *The Theory of Industrial Organization.* Cambridge, MA: The MIT Press, 1988.
Tool, Marc R., "Contributions to an Institutional Theory of Price Determination," In *Rethinking Economics: Markets, Technology and Economic Evolution.* Edited by G.M. Hodgson and E. Screpanti. Aldershot: Edward Elgar, (1991) 19–39.
Tool, Marc, *Pricing, Valuation, and Systems; Essays in Neoinstitutional Economics*, Brookfield, Vt.: Edward Elgar Publishing, 1995.
Tucker, D.G., *Gisbert Kapp.* Birmingham, England: University of Birmingham, 1973.
Uzzi, Brian and Ryon Lancaster, "Embeddedness and Price Formation in the Corporate Law Market," *American Sociological Review* 69/3(2004): 319–344.
Velthuis, Olav, "Symbolic Value of Prices: Constructing the Value of Contemporary Art in Amsterdam and New York Galleries," *Theory and Society*, 32/2(2003): 181–215.
Wald, Matthew L., "Utilities Trying New Approaches to Pricing Energy," *The New York Times*, July 17, 2000.
Walker, S.F., "Public Service Rate Regulation," In *Central Station Rates in Theory and Practice.* Chicago: Frederick J. Drake & Co., 1921.
Weber, Max, *Economy and Society.* Totowa, NJ: Bedminster Press, 1921/1968.
Williamson, Oliver E., *Markets and Hierarchies.* New York: Free Press, 1975.
Williamson, Oliver E., *The Economic Institutions of Capitalism*, New York: The Free Press, 1985.
Wilson, Robert, *Nonlinear Pricing.* New York: Oxford University Press, 1993.
Yonay, Yuval, *The Struggle over the Soul of Economics: Institutional and Neoclassical Economists in America Between the Wars.* Princeton: Princeton University Press, 1998.
Young, Peyton, *Equity: In Theory and Practice.* Princeton: Princeton University Press, 1994.
Zajac, E.E., *Fairness or Efficiency: An Introduction to Public Utility Pricing*. Cambridge, MA: Ballinger, 1978.
Zajac, E.E., *Political Economy of Fairness*. Cambridge, MA: MIT Press, 1995.
Zbaracki, Mark J., "Pricing Structure and Structuring Price," Working paper, 2003.
Zelizer, Viviana A., *Pricing the Priceless Child: The Changing Social Value of Children.* New York, NY: Basic Books, Inc., 1985.
Zuckerman, Ezra W., "The Categorical Imperative: Security Analysts and the Illegitimacy Discount," *American Journal of Sociology* 104/5(1999): 1398–1498.