Explaining Wage Inequality in Telecommunications Services: Customer Segmentation, Human Resource Practices, and Union Decline

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EXPLAINING WAGE INEQUALITY IN TELECOMMUNICATIONS SERVICES: CUSTOMER SEGMENTATION, HUMAN RESOURCE PRACTICES, AND UNION DECLINE

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This study examines factors related to within-occupation wage inequality among service and sales workers in the telecommunications industry. The author draws on a 1998 survey of a nationally representative sample of 354 service and sales centers in the industry to examine the importance of management practices and union institutions in shaping wage variation. The results strongly indicate that business strategies of customer segmentation and human resource practices explain variation in wages over and above that explained by the human capital of the work force. In addition, despite extensive deregulation and de-unionization of the industry, the union wage premium is 22%.

Most of the literature on wage inequality has come from economic analyses of aggregate-level wage data. Economists have found consistent evidence of growing within-group wage inequality, with groups primarily defined by demographic characteristics such as age, education, and gender (for example, Levy and Murname 1992; Freeman and Katz 1996). The empirical evidence supports both market and institutional explanations for this trend. Human capital and market explanations focus on differences in the relative supply of college-educated workers in the 1980s and the 1970s (Murphy and Welch 1989) and variation in the demand for skill. On the demand side, economists have found modest effects of trade on the displacement of low-skilled workers (Freeman 1996; Wood 1996); they have found stronger evidence that increased

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demand for skill, attributed to new skills required for new technologies (or "skill-biased technical change"), has driven up the wage at the high end (Bound and Johnson 1992; Johnson 1997; Topel 1997). Institutional explanations, including those emphasizing the role of unions and public policies such as the minimum wage, also have received strong support (Card and Freeman 1993; Freeman 1996; Blau and Kahn 1996; DiNardo, Fortin, and Lemieux 1996; Fortin and Lemieux 1997).

Direct evidence supporting the skill-biased technical change argument is slim, however, because most studies using aggregate-level data do not contain direct measures of the concept (Topel 1997:60). Organization-level studies and qualitative field research provide the kind of direct measures needed to examine mechanisms linking technology and wage variation.

This paper contributes to the literature on wage inequality in two ways. First, I use original establishment-level data to examine the concept of skill-biased technical change by measuring how business and human resource strategies influence the use of technology and human capital and, in turn, affect wages. Second, unlike most wage inequality research, which has focused on male earnings inequality or within-group variation based on demographic characteristics, this study analyzes wage variation in a female-dominated occupation (customer service and sales). I focus on one industry setting—call centers in telecommunications services—to improve measurement of technology and management practices.

The central argument of the paper is that skill-biased technical change consists of indirect and direct mechanisms (Levy and Murnane 1996), and these mechanisms are the result of business and human resource strategies. In service and sales operations, the context of this study, business strategies of market differentiation are accomplished through customer segmentation. Segmentation allows firms not only to target customer groups by their unique demand characteristics, but also, and more important, to create a more specialized division of labor in which each segment is matched to a distinct labor market group, sorted by skill level. The resulting labor market stratification increases variation in job structures and wages within occupational groups and within large primary sector firms. This segmentation fundamentally differs from prior labor market organizing principles based on firm size, primary-secondary firm location in production chains, or core-periphery models based on employment status (Doeringer and Piore 1971; Osterman 1988). This type of customer segmentation has diffused rapidly in the sales channels of both service and manufacturing industries due to advances in information technologies and process reengineering, and may be viewed as an indirect mechanism of skill-biased technical change.

In addition to business strategy, firms vary in their adoption of work organization and human resource practices, and these function as the direct mechanisms through which skill-biased technical change occurs. Consistent with previous research on high performance work systems (Becker and Gerhart 1996; Ichniowski et al. 1996; Appelbaum et al. 2000), I have examined how those management practices that lead to the more or less productive use of human capital explain the variation in wages among workers in otherwise similar establishments.

Growing Wage Inequality Among Service and Sales Workers

Service and sales workers in call centers are a useful group to examine because call centers have grown dramatically in many industries as a result of advances in information systems and process reengineering. They are typical of the kind of computer-mediated service work that is likely to dominate office work in the twenty-first century. The call center work force in telecommunications is particularly interesting because it constitutes one of the few female-dominated groups of service workers that is highly unionized and continues to enjoy middle-class wages. Historically, the median wages of female office workers in the telephone

industry were over twice those of their counterparts in comparable service occupations (Spalter-Roth and Hartmann 1995). Deregulation, de-unionization, and technology change, however, have brought about profound changes in the nature of work and structure of occupational wages.[1]

Findings from prior analyses of data from the Current Population Survey (CPS), which inform the current study, show dramatic increases in within-occupational wage inequality in the telecommunications industry.[2] With the break-up of the Bell system in 1984, wage inequality among telecommunications service and sales workers grew by over 30% between 1983 and 1998. As a result, the 90/10 ratio of median weekly wages for service and sales workers in telecommunications approached the average ratio for service and sales workers in all industries. At the same time, union density among these workers fell from 63% in 1983 to 32% in 1998, and the ratio of union to non-union median weekly wages grew from .95 to 1.20. The median weekly wage for a full-time service and sales union worker (one working over 35 hours per week) was $600 in 1998, compared to $500 for non-union workers. The union/non-union wage gap grew almost entirely because of falling real wages in the non-union segment; union-negotiated wage increases from 1983 to 1998, by contrast, largely tracked the Consumer Price Index (CPI).

Inequality also rose after divestiture within each of the union and non-union segments. Among unionized service and sales workers, the 90/10-wage ratio increased by 21.6%—from 2.00 in 1983 to 2.47 in 1998. An analysis of union contracts shows that part of this rise in inequality is related to the growth of new job titles, both at the high end and at the low end. In AT&T contracts, for example, the number of wage grades for service and sales workers rose from 11 in 1984 to 26 in 1996. Most of the increase in wage dispersion was due to increases in sales titles at the upper end of the distribution. Overall, the ratio of pay in the top grade to that in the bottom grade in these contracts rose from 1.71 in 1984 to 2.58 in 1996. For non-union workers, by contrast, the 90/10 ratio was 3.30 in 1983 (or two-thirds higher than the comparable union ratio), and it grew by 25% to 4.12 over the period. Consequently, by 1998, the 90/10 ratio for non-union workers was 75% higher than for union workers.

With this background in industry-level trends, therefore, in the current study I seek to understand the establishment-level mechanisms that help explain variation in wages within the occupation. Given that no longitudinal data exist, I cannot examine the determinants of wage inequality over time. The historical record is clear, however, that many management practices—including customer segmentation, the use of new technologies for process reengineering and electronic monitoring, the

[1]Industry deregulation began in the 1960s, but the court-ordered breakup of AT&T in 1984 marks the date when deregulation and industry restructuring began to take hold. That order allowed AT&T to compete in long distance and equipment markets only, and it allowed the other 22 local Bell companies (reorganized into seven regional Bell operating companies, or RBOCs) to continue as monopoly providers of local service. State-by-state changes in rate regulation proceeded from then on; and the 1996 National Telecommunications Act mandated deregulation of local service as well. However, the RBOCs largely continued as monopoly providers of local service through the 1990s. For background on industry deregulation and restructuring, see Keefe and Boroff (1994), Keefe and Batt (1997), and Batt and Keefe (1999).

[2]These findings are based on Batt and Strausser's (1998) analysis of the CPS Merged Outgoing Rotation Group between 1983 and 1996. The analysis was updated to include 1998 for this paper. The analysis combines clerical and sales workers into one category for two reasons. First, there has been a blurring of boundaries between clerical (service) and sales workers in the industry; "order takers" are defined in the CPS as clerical workers, but with deregulation, workers who were "order takers" are now retail sales workers. Some companies refer to them as customer service representatives and some as sales representatives, even though the content of work is virtually identical. In addition, traditional sales workers increasingly do "service work" in the form of handling billing inquiries or repair requests. Second, in the CPS data, the industry-occupation-union/non-union cell for sales workers is too small to be reliable. The method used here follows Katz and Murphy (1992).

use of employee participation and teams, and the use of contingent pay and staffing—did not exist in any important way prior to deregulation of the industry in 1984 (Keefe and Batt 1997; Batt and Keefe 1999). Thus, current cross-sectional data provide the opportunity to examine whether the type of management practices introduced since deregulation help explain within-occupation wage variation.

My hypothesis is that deregulation freed up companies to experiment with market-driven customer segmentation and HR practices in both the union and non-union segments, and these practices created more differentiated job structures and wage outcomes than had existed historically. The data analyzed in this paper come from a unique 1998 nationally representative survey of 354 call centers in the industry. Cross-sectional regression analysis is used to examine the relative importance of unions, customer segmentation, human capital, and human resource practices in explaining wage variation. I also use extensive field research and archival data from union contracts to help interpret the quantitative findings.

Indirect Mechanisms of Skill-Biased Technical Change: Business Strategy

Business strategy involves a series of decisions regarding the industry and customer segments to be targeted, the type of product offerings, and the basis on which to compete (for example, quality, service, innovation, cost), among other things (Porter 1985:231ff.). In this paper, I focus on one dimension of strategy, customer segmentation, because it allows companies to pursue differentiated market strategies by segment and because it has become a central organizing principle for service and sales delivery channels. In the past, service markets in many industries were local or regional in scope, and employees typically provided "universal service" to all customers in a given geographic area (Lovelock 1990). Markets in which this occurred include local banks, utilities, telephone companies, and insurance companies. However, advances in marketing research showed that it is more efficient and effective to organize service delivery by homogeneous groups of customers, according to their demand characteristics or potential value-added (Ames and Hlavacek 1989; Day 1990; Kotler 1994; Pine 1993). This "strategic segmentation" (Keltner et al. 1999) allows firms to create unique marketing campaigns and to tailor product and service offerings to each group according to their preferences or willingness to pay for quality and customization. Moreover, with the proliferation of product and service offerings made possible through new technologies, segmentation strategies have become more useful as a technique for matching customer demand to product offerings. In telecommunications, for example, the shift from mechanical to digital systems has led to the proliferation of voice, video, data, and internet services, but consumer groups vary substantially in their demand for these products.

The advantages and scale economies associated with customer segmentation are realized as the scope of the market increases—for example, from a local to a regional or national level. Customer segmentation strategies became more profitable in the 1990s because firms were able to increase market scope by using previously unavailable information technologies and call distribution systems. These new technologies allowed firms to reengineer and consolidate offices into "remote centers" covering a larger customer base and accessed by 1–800 numbers. AT&T and GTE, for example, each closed hundreds of local service bureaus and replaced them with about 50 large call centers, each serving a distinct customer base on a regional or national basis.

To implement customer segmentation, companies typically create separate business units led by a Vice President responsible for strategy and operations in the unit or "distribution channel." A common approach is to separate out and automate service activities that add cost but have little or no revenue-generating potential. Examples include ATM machines in retail

banking and operator services in telecommunications. Then, firms distinguish several tiers of residential and business consumers, with the past value of the account serving to forecast future revenue. One company in this study, for example, separates residential and business customers, and then defines four tiers of business segments: accounts up to $500 per month; those between $500 and $3,000; those between $3,000 and $5,000; and those larger than $5,000.

These changes in how firms approach their customer markets have allowed them to reorganize their labor markets as well, matching customer demand characteristics to the human capital characteristics of the work force (Batt and Keefe 1999). As each customer segment is more or less homogeneous, companies can identify different levels of skills sufficient to meet the different levels of product complexity and customization for each consumer group. For example, in the telecommunications industry, residential consumers demand standardized services with some potential for value-added services such as voice messaging, call waiting, additional lines, or Internet services. Compared to the past, new technologies have dramatically increased the number of different types of products, but each product has quite standard features. Workers serving residential customers typically need a high school education plus firm-specific skills to process a high volume of transactions by simultaneously inputting data into the computer and completing calls while the customer is on line.

Compared to residential customers, small businesses tend to demand more varied products, including data transfer, internal call transfer, and Intranet capabilities, and representatives assigned to this market segment have more opportunity to sell to and interact with the customers. Account agents for larger business customers require knowledge of still more varied and complex products, with greater potential for customization. Large business representatives sell complex internal communications for companies, including private branch exchange systems and local area networks for voice, data, and video transactions. These representatives need less ability to rapidly manipulate information databases, but greater skills in social interaction and negotiation to customize offerings. This type of segmentation in telecommunications resembles that found by Keltner and Jenson (1998) in commercial banking and insurance.

In sum, customer segmentation provides a mechanism for product differentiation for distinct customer segments, and, in turn, a sorting mechanism for the demand for skill. With different telecommunications call centers dedicated to particular segments, it is easier for the firm to create distinct criteria for selection and hiring based on the skill level required to meet the level of complexity and customization for each customer segment. Compared to the past, when local service representatives handled a wide variety of customers, customer segmentation has led to the existence of more homogeneous skill groups within each market segment, and more variation across market segments.

It is important to note in passing that labor market stratification based on customer segments differs fundamentally from other forms of labor market stratification discussed in the literature. This stratification is not based on differences between primary and secondary firms, as in the internal labor market or dual and segmented labor market literatures (Doeringer and Piore 1972; Berger and Piore 1980). Nor is it a product of contrasting core/periphery uses of full-time versus contingent or part-time employees (Osterman 1988). Rather, differentiation in this process of labor market stratification occurs within firms and within occupations based on distinct customer strata.

Firms are likely to pursue this segmentation strategy because there are good reasons to expect it to lead to better economic performance. From an economic perspective, segmentation should lead to greater labor productivity and efficiency by creating a more specialized division of labor. Also, from the perspective of strategic hu-

man resource management, segmentation allows firms to "fit" or match their business strategy to their human resource strategy, and where "fit" exists, firms are likely to have better organizational performance (Dyer 1985; Arthur 1992; Wright and McMahan 1992).

Where companies implement this type of segmentation strategy, human capital theory would suggest a direct relationship between the value of the customer segment served and the wage levels of the work force. The resulting labor force segmentation may thereby serve as a mechanism for sorting human capital. If so, then in multivariate analyses, any relationship between the customer segment and employee wage levels should disappear once human capital characteristics are taken into account. If not, this would suggest that a price premium exists for working in a particular segment, over and above the value added by human capital. This might be true, for example, if higher value-added customers are more profitable (pay a price premium for better service) and workers share in that premium through contingent pay practices. These issues are considered in the analysis below.

Direct Mechanisms of Skill-Biased Technical Change: Human Resource Strategies

The ability to match customer characteristics to labor market strata is one type of advantage that firms derive from customer segmentation. A second advantage, however, is the ability to create a coherent human resource system to manage the customer-provider interface. Once centers are dedicated to a homogeneous group of customers, firms have the opportunity to create a coherent "systems architecture" (Becker and Gerhart 1996)—from process design and information technology to human resource practices—to compete in that market segment. This might be viewed as the functional equivalent of creating a manufacturing plant dedicated to building a particular product line, as in General Motor's Saturn plant.

In call centers, a coherent systems architecture entails the design of information technology and process flows, work tasks, and incentives so that employees can implement the firm's customer strategy. Firms have a range of options, depending on the extent to which their customer strategy emphasizes cost versus quality, service, or innovation. Management theorists (Schelesinger and Heskett 1991) have identified two ideal typical models of service production that are the functional equivalents of mass production and high-involvement (or high-performance) work systems found in the industrial relations literature (Appelbaum and Batt 1994). These distinct systems vary along three dimensions: the relative skills of the work force, the design of work and technology, and the use of HR incentives that induce commitment and effort (Appelbaum et al. 2000).

Call centers competing primarily on cost are likely to create work systems that maximize call volume and minimize costs. In this work system, firms design information systems with standardized menus of options that limit customers' discretion so as to minimize variability or uncertainty in the production system (Bowen 1986; Mills and Morris 1986). With standardization built into software systems, jobs require low relative skills and discretion, and firms are likely to rely heavily on electronic monitoring to ensure minimum levels of customer service. Referred to as the engineering or "production line" approach to services (Levitt 1972), this type of HR strategy has grown since the 1960s as a means of improving low productivity growth in the service sector (Lovelock 1990). Individuals working in this system have high efficiency as they repetitively perform simple tasks. Labor costs are low because there are few costs associated with selection, training, participation, or compensation. However, service quality in this system is likely to suffer because automation both limits product and service options and shifts labor costs to customers through self-service menus. Also, employees have limited discretion to meet customer needs and the division of labor leads to multiple hand-offs

(Schlesinger and Heskett 1991).

Those call centers competing on quality and customization, by contrast, are likely to use human resource practices similar to those defined as high-involvement systems (Appelbaum and Batt 1994). In this work system, firms design information systems to provide a rich data base of information on customers; and they design jobs to enhance employees' discretion to customize services using data in the information systems and their own knowledge of products, clients' needs, and system capabilities. Firms pursuing this approach are likely to retain higher-skilled employees, design jobs giving employees greater discretion, and provide commitment-enhancing incentives such as investment in training and employee development, performance-based pay, and employment security (Schlesinger and Heskett 1991). This "service profit chain" (Heskett et al. 1997) or "relationship management" strategy (Gutek 1995; Keltner 1995; Keltner et al. 1999) views good service as a "bridge to sales." Some research shows that loyal customers buy more and have more inelastic demand curves, so that profitability per customer is multiplicative (Reichheld 1996).

Empirical studies carried out primarily in manufacturing have found fairly consistent evidence that high-involvement practices are associated with better organizational performance in a number of industries (Black and Lynch 1998), including apparel, medical electronics, and steel rolling mills (Appelbaum et al. 2000); auto assembly (MacDuffie 1995); semi-conductors (Bailey 1998); steel mini-mills (Arthur 1992); steel finishing lines (Ichniowski 1997); and general manufacturing (Snell and Dean 1992; Youndt et al. 1996). The most commonly cited explanation for this positive relationship is that changes in global markets and technology have reduced the advantages of mass production systems that focus on cost alone. High-involvement practices provide employees with the skills, opportunities, and incentives to use new technology more effectively, leading to higher organizational performance. Recent research has begun to show that such high-involvement practices also lead to better organizational performance in service activities (Batt 1999, 2000; Delery and Doty 1996; Preuss 1997).

Previous research, however, has not fully examined whether workers who use high-involvement work practices receive higher wages, and if so, why. A small number of recent studies show mixed results. In a longitudinal study using a nationally representative sample of establishments, Osterman (2000) found no evidence that establishments with high-involvement practices paid higher wages to workers than did other firms. By contrast, Appelbaum, Bailey, Berg, and Kalleberg (2000) found that the use of high-involvement systems was associated with higher wages in a qualitative and quantitative study of the steel, apparel, and medical instruments industries. Similarly, Hunter and Lafkas (1998) found that the interactive effect of more autonomous work organization and new technology produced higher wages for retail bank workers. Two other studies of workers in self-managed teams, often a key component of high-involvement systems, found that they received higher wages because they worked more overtime to absorb supervisory tasks (Weisman et al. 1993; Batt 2001).

If high-involvement systems are associated with better performance, then it is reasonable to ask whether these outcomes translate into higher wages for workers. The emphasis on skills in the high-involvement literature is consistent with the human capital argument that higher-skilled workers are more productive and hence receive higher wages. The issue examined in this paper is whether the design of work, technology, and incentives explains variation in wages over and above that explained by the skills of the work force. There is reason to believe that variation in these dimensions of work systems should contribute to explaining wage variation because they influence the extent to which employees are able to use their skills productively. As indicated above, work designed to enhance individual discretion allows employees to respond immediately to customer demands and to identify sales opportuni-

ties when interacting with the customer. Collaboration in teams is likely to pay off because workers have more opportunities for learning. Batt (1999), for example, found that service representatives in self-directed teams had the same job duties as those in traditionally supervised groups, but had statistically significantly higher sales because of better learning and problem-solving relating to customers and the use of new technology. Similarly, technology designed to provide a rich database of customer information is likely to enhance employees' ability to provide good service (enhancing customer loyalty) and generate new sales.

Because telecommunications firms are likely to place more emphasis on cost in price-conscious mass (or residential) markets, it is likely that the production line approach is more common in call centers serving mass markets and the high-involvement approach is more common in call centers serving higher-value customers. For example, a transparent indicator of the emphasis on high-volume, low-cost transactions is the number of calls handled per employee per day (or job cycle time). The survey data for this study show that the typical operator handles 900 calls per day; the typical residential representative, 100; the typical small business representative, 64; and the typical large business representative, 32. However, even among establishments serving the same customer segment, it is likely that firms will vary in their relative emphasis on cost versus quality or service. Thus, variation in human resource systems should explain variation in wages over and above that explained by customer segment and human capital.

In sum, the model of wage determination used in this paper views wages as a function of business strategies of customer segmentation and the choice of HR system along with other causal factors. In the analyses below, I first consider whether customer segmentation is simply a sorting mechanism for the demand for skill. If so, then any independent relationship between customer segment and wage level should disappear when human capital variables are added to the wage equation. The second question is whether the choice of work and HR practices exerts an influence on wage levels over and above that predicted by customer segment and human capital. To the extent that high-involvement practices allow human capital to be used more productively, a wage premium should be associated with the use of these practices.

Finally, other conditions are likely to influence wage levels directly, or indirectly by influencing the firm's ability to pursue its preferred business strategy and HR practices. Unions influence wage levels directly by negotiating wages in collectively bargained contracts. Recent estimates of the union wage premium across all industries are in the range of 15–18% (Lemieux 1993; Card 1998). The union wage premium for telecommunications service and sales workers was 20% in 1998, according to my analysis of the 1998 CPS data. Similarly, local labor market conditions, such as the level of unemployment and the local cost of living, are likely to directly affect firms' wage-setting policies. Other factors that are likely to indirectly influence wage levels include the competitiveness of product markets, organizational size, and whether establishments are part of larger organizations (Osterman 1994). Thus, my model of wage determination controls for relevant product market, labor market, and organizational factors likely to influence business strategy, HR practices, and wage levels. In sum, the following wage determination model is estimated in the statistical analysis that follows:

Wages = f(labor markets, product markets, organizational characteristics, union presence, customer segment targeted, human capital, HR practices)

Methods

I used several techniques to reduce measurement problems often found in workplace studies. First, because human resource practices vary considerably by organizational unit and occupational subgroup (Osterman 1987; Jackson et al. 1989), survey questions asked managers about their

"core" non-management group of service and sales workers. This strategy follows Osterman (1994, 2000), among others. To reduce problems of reliability, I used only general managers as respondents, since some research shows that they are less likely than HR managers to be excessively optimistic in their assessments of HR practices (Wright et al. 1999).

Another way to improve reliability is to base survey questions on field research and to frame questions in language that is industry- and occupation-specific. I conducted site visits to 15 telecommunications call centers in a range of markets (local, long distance, cellular, cable) and customer segments (residential, small business, large business) in 6 companies in 5 geographic regions. Interviews covered the general manager, middle managers in operations and information systems, first-line supervisors, and service agents. I also observed workers' interactions with customers, their use of information systems, and discretion at work.

Based on this information, in the survey I operationalized concepts in terms that were industry- and occupation-specific, resulting in questions that a general manager could readily answer about such things as call handling time, scripts, and the use of electronic monitoring. This approach helps reduce measurement error by focusing on relatively objective information in the language that the call center manager uses. The trade-off resulting from this focus on a specific occupation is lower generalizability. I chose to privilege contextual validity because it is more likely to yield accurate results, especially given this study's reliance on one respondent. However, I also included in the analysis standardized scales drawn from the human resources/industrial relations literature.

I also used outside information as a random check to verify survey responses. First, I compared survey items (date establishment founded, primary market, and size) to data contained in the Dun and Bradstreet listing. The means for each variable in the two data sets are not statistically significantly different. The mean date of founding in each data set, for example, is 1986 ($r = .75$). The primary industry segment is a categorical variable (wireline, wireless, cable, internet), and is correlated at $r = .78$. The mean establishment size in the Dun and Bradstreet listing is 108 (s.d. 144), and in the survey data it is 119 (s.d. 174) ($r. = .55$). Establishment size estimates are likely to be larger in the survey data because the industry is rapidly expanding and consolidating, and the Dun and Bradstreet data were collected almost one year prior to the survey data. Second, I examined union contracts and found that the wage rates and job titles reported by managers at specific Bell companies were comparable to those in the corresponding union contracts. Third, I compared my survey data to the 1998 CPS data for the telecommunications industry (CPS 1998). The most comparable group in the CPS is clerical and sales workers. The 1998 median annual pay in the CPS is $31,200 for union clerical and sales workers and $26,000 for non-union workers, compared to $33,000 for union workers and $28,000 for non-union workers in my sample. Given the fact that I oversampled large establishments that tend to pay higher wages and to be more heavily unionized, these comparisons are reasonably consistent.

Sample

The sample is a stratified random sample drawn from the Dun and Bradstreet listing of establishments. Establishments were stratified by size (10–99 employees, 100-plus employees) and by SIC code (4812, cellular; 4813, wireline; 4841, cable), with establishments with over 100 employees over-sampled so that the results would represent a larger percentage of the industry's work force. The sample also was stratified by state location, and all states are represented. Because Internet service providers (ISPs) are an important new part of the industry, but not systematically captured by SIC code, additional ISPs were identified through the Directory of National Dial-up Providers and Area Codes of Operation.

A university-based survey team adminis-

Table 1. Sample Distribution by Industry Segment, Customer Segment, and Unionization.

Segment	*No. Establishments*	*No. Workers*	*% Establishments*	*% Workers*	*% Union Establishments*	*% Union Workers*
Industry Segment						
Wireline	187	26,349	52.8	69.5	26.7	54.9
Wireless	85	5,514	24.0	14.6	1.2	2.8
Cable TV	57	4,197	16.1	11.1	5.3	1.8
Internet SP	25	1,834	7.1	4.8	0.0	0.0
Total	354	37,894	100.0	100.0	15.3	38.9
Customer Segment						
Large Business	68	4,312	19.2	11.4	4.4	8.1
Small Business	86	6,362	24.3	16.8	12.8	42.2
Residential	106	20,024	29.9	52.8	21.9	39.0
No Targeted Segment	77	5,445	21.8	14.4	14.3	56.6
Operator Services	17	1,751	4.8	4.6	35.3	46.2
Total	354	37,894	100.0	100.0	15.3	38.9

Source: 1998 Survey of Telecommunications Services Establishments.

tered the telephone survey in the fall of 1998. The telephone interview averaged 52 minutes, and yielded a 54% response rate. To check for response bias, I estimated a logit model with the dependent variable equal to 1 if the establishment participated in the survey. There were no statistically significant effects for whether the establishment was a branch or a single location, whether it was publicly or privately held, or whether a Bell company owned it. Internet service providers were somewhat less likely to respond, perhaps because they are less likely than other segments to self-identify with the telecommunications industry (compared to, for example, software and information services). Smaller establishments were somewhat more likely to respond.

To identify customer segmentation, I divided establishments into five groups: operator services, residential target, small business target, large business target, and universal centers. Operator services is included because it represents the lowest-valued service channel: while it is historically a cost center, deregulation has turned it into a fee-generating business because directory assistance is no longer free. What I refer to as large business primarily includes regional businesses, because national and global accounts are typically handled through small offices inside larger office complexes that were not accessible through the Dun and Bradstreet listing. Thus, this study does not capture the high value added customers, nor the high end of the labor market. It represents a more conservative estimate of wage inequality in service and sales operations.

Table 1 shows the final distribution of the sample, both by the number of establishments, and weighted by the number of "core" employees in each establishment, defined as the largest group of non-managerial employees who perform the core production work of the establishment. The weighting is important because there is great size variation among the establishments, reflecting the co-existence of the traditionally dominant players from the Bell system and new entrants. The sample breakdown by establishment is 53% in wireline, 24% in wireless, 16% in cable TV, and 7% in Internet services. This distribution closely resembles the original distribution in the Dun and Bradstreet listing. The wireline segment, however, covers 70% of the work force, showing the continued dominance of this segment in the industry.

With respect to customer segments, the largest group of establishments (30%) and the largest group of workers (53%) serve the residential or mass market. Another 24% of establishments (17% of workers)

serve small business; and 19% of establishments (11% of workers) serve large business. Over three-quarters of offices in the sample were pursuing a targeted customer strategy, while 22% had no such strategy. The share of all telecommunications workers employed by operator services, which stood at 60% in the 1920s and 45% in the 1950s, is now less than 5% as a result of automation and self-service dialing (Kohl 1993).

Reflecting the fact that unionized establishments tend to be relatively large, a total of 15% of all establishments in the sample are unionized, but 39% of the sample work force is unionized. This is somewhat higher than the 32% rate of union density for this occupational group in the CPS data, and the difference again reflects my strategy of over-sampling larger establishments. Union membership continues to be concentrated in the wireline industry, in which 55% of the core work force is unionized. By contrast, less than 3% are unionized in the newer industry segments. Also, unionization is concentrated in the lower value-added customer segments. While less than 10% of workers serving large business are unionized, 39% or more are union members in the lower-valued customer segments and operator services. All unionized workers are represented by the Communications Workers of America (CWA).

Measures

Complete definitions of all variables are provided in the appendix. There are three dependent variables in this study, all measured at the establishment level: natural log of median annual pay, natural log of median total annual pay (wages + overtime), and natural log of median total compensation (median annual pay + the costs of benefits, but excluding overtime). Comparing wages with and without overtime is important because almost 30% of the work force in this sample are exempt from wage and hour laws and ineligible for overtime. Because the outcomes are very similar for the three dependent variables, I present the analyses for median annual pay and then describe the results for the other dependent variables. The independent variables fall into four categories: market, organizational characteristics, and union presence; business strategy; human capital; and work organization and HR practices (including the design of work, use of information technology, and HR incentives).

For product market characteristics, I included the primary industry segment served, defined by SIC code: wireless, cable TV, Internet service providers, or the traditional wireline segment (the omitted category). I included the 1998 local unemployment rate in the county or city where the establishment is located, based on the Local Area Unemployment Statistics of the Bureau of Labor Statistics. The 1998 local cost of living is drawn from the Economic Research Institute's *Geographic Reference Report* (see the appendix for a fuller description of these data). Organizational characteristics include size and whether the establishment is part of a larger organization. Union presence is captured by a dummy variable (where 1 = union, 0 = no union). The core work force is defined narrowly enough to fall completely within one bargaining unit, and therefore either is entirely represented by a union or is non-union.

Business strategy, as indicated above, is measured by a series of dummy variables for each of the five segments; the universal center is the omitted category.

Human capital characteristics are captured by four categories: formal education, exempt employment status, company tenure, and gender. Formal education is the average years of education of the typical core worker in the establishment. Exempt status is a dummy variable, with 1 indicating establishments that classify their core work force as exempt from wage and hour laws. Tenure is captured by two measures: the proportion of the work force that has less than one year of company tenure, and the proportion that has more than ten years of tenure. Gender of the work force is the percentage of the establishment's core work force that is female. As this study is limited to non-managerial employees, exempt status is likely to

Table 2. Means, Standard Deviations, and Correlations among Variables.

Variable	*Mean*	*s.d.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1 Median Annual Pay	10.356	0.509	1.000										
2 Wireless Market	0.237	0.426	–0.075	1.000									
3 Cable TV Market	0.158	0.365	–0.288	–0.242	1.000								
4 Internet Market	0.071	0.257	0.076	–0.154	–0.120	1.000							
5 Avg. 1998 Loc. Unempl.	4.417	2.400	–0.129	0.038	–0.011	–0.093	1.000						
6 Avg. 1998 COLA	1.069	0.158	0.189	–0.053	–0.009	–0.022	0.135	1.000					
7 Avg. Wkly. Work Hrs.	43.298	8.598	0.395	–0.030	–0.092	0.168	–0.044	0.052	1.000				
8 Total Employees (Ln)	4.149	1.576	0.047	–0.124	0.174	–0.037	–0.127	–0.066	–0.017	1.000			
9 Part of Bell Company	0.246	0.431	0.104	0.098	–0.248	–0.132	0.079	0.017	–0.044	0.144	1.000		
10 Union Presence	0.153	0.360	–0.003	–0.217	–0.120	–0.117	0.061	0.018	–0.094	0.274	0.414	1.000	
11 Large Business Target	0.192	0.395	0.531	–0.103	–0.172	0.034	–0.043	0.142	0.191	–0.067	–0.012	–0.148	1.000
12 Small Business Target	0.243	0.429	–0.019	–0.037	–0.047	0.075	0.006	0.064	–0.027	–0.122	–0.033	–0.040	–0.276
13 Residential Target	0.299	0.459	–0.270	0.012	0.274	–0.036	0.003	–0.051	–0.088	0.281	0.014	0.119	–0.319
14 Operator Services	0.048	0.214	–0.239	0.092	–0.061	–0.062	0.087	–0.101	–0.100	–0.003	–0.006	0.125	–0.110
15 Education (Yrs.)	13.717	1.696	0.645	0.018	–0.297	0.231	–0.110	0.156	0.337	–0.096	0.032	–0.243	0.424
16 % of Work Force Exempt	0.298	0.458	0.556	–0.071	–0.233	0.146	–0.069	0.137	0.190	–0.091	–0.041	–0.162	0.491
17 Tenure < 1 Year (%)	4.883	19.286	–0.024	–0.061	–0.054	0.168	–0.007	0.085	0.054	–0.080	–0.036	–0.089	0.001
18 Tenure > 10 Year (%)	8.068	24.698	0.028	0.073	–0.059	0.105	–0.007	–0.021	0.090	–0.024	0.053	–0.055	–0.015
19 Female (Percent)	0.630	0.299	–0.470	–0.056	0.251	–0.299	0.096	–0.112	–0.223	0.207	0.089	0.207	–0.278
20 No. Emails/Day	10.898	13.624	0.391	–0.056	–0.120	0.299	–0.079	0.039	0.244	0.044	0.036	–0.086	0.317
21 % Electronically Monitored	0.362	0.405	–0.368	–0.043	0.228	–0.134	0.048	–0.080	–0.143	0.340	0.066	0.177	–0.186
22 Technology Mediation Scale	0.671	0.255	–0.480	–0.062	0.212	–0.056	–0.034	–0.071	–0.200	0.255	–0.019	0.147	–0.349
23 Discretion Scale	2.928	0.697	0.426	–0.001	–0.189	0.190	–0.041	0.048	0.233	–0.276	–0.124	–0.298	0.321
24 Offline Probl.-Solv. Teams	0.510	0.376	0.109	–0.002	–0.059	0.102	0.043	0.016	0.081	–0.148	–0.097	–0.149	0.089
25 Online Self-Directed Teams	0.170	0.330	0.148	–0.068	–0.059	0.161	–0.007	0.028	0.164	–0.051	–0.090	–0.130	0.141
26 Ongoing Training	2.008	1.702	0.079	–0.012	0.068	0.070	0.078	–0.012	0.090	0.043	0.021	0.024	0.096
27 % Variable Pay	0.226	0.273	0.402	0.176	–0.179	0.096	–0.084	–0.050	0.179	–0.190	–0.054	–0.205	0.219
28 % Full-Time & Permanent	0.894	0.195	0.287	–0.076	–0.018	–0.054	0.030	–0.014	0.128	0.105	0.031	0.083	0.157

indicate professional status, or having a four-year college degree (it correlated with education level at .54). However, over 15% of establishments in the lower-skilled mass market defined the core as "exempt," suggesting efforts to either "quasi-professionalize" the work force or deter unionization.

For work and human resource practices, I developed three types of measures: the use of technology, the design of work, and HR incentives. As noted earlier, the literature on high-involvement work systems usually includes skill level as one of the dimensions of HR practices, because practices such as selection, recruitment, and training influence the stock of human capital in the establishment. In this case, I examined skill level separately (as one measure of human capital), which creates a more conservative estimate of the influence of HR practices.

Three items capture how technology is used—one captures its use as an information resource; one measures automation (technology-mediated customer interaction); and one measures electronic monitoring. Technology as a resource is measured by the number of emails sent by

	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12	1.000															
13	−0.370	1.000														
14	−0.127	−0.147	1.000													
15	0.016	−0.255	−0.166	1.000												
16	−0.031	−0.240	−0.149	0.536	1.000											
17	0.030	−0.007	−0.040	0.172	0.036	1.000										
18	−0.057	0.013	0.107	−0.002	0.005	0.266	1.000									
19	−0.061	0.200	0.138	−0.441	−0.328	−0.049	0.027	1.000								
20	−0.154	−0.036	−0.136	0.363	0.324	0.068	−0.041	−0.194	1.000							
21	−0.027	0.203	0.168	−0.327	−0.326	−0.051	−0.119	0.247	−0.169	1.000						
22	−0.050	0.250	0.203	−0.428	−0.349	0.013	−0.026	0.466	−0.150	0.435	1.000					
23	−0.014	−0.249	−0.195	0.449	0.397	0.068	0.104	−0.296	0.291	−0.443	−0.338	1.000				
24	−0.045	−0.096	−0.039	0.150	0.189	0.004	−0.020	−0.068	0.081	−0.045	−0.069	0.286	1.000			
25	−0.086	−0.027	−0.061	0.150	0.188	0.127	−0.045	−0.113	0.171	−0.052	−0.040	0.260	0.225	1.000		
26	−0.041	0.016	−0.125	0.069	0.092	−0.095	−0.043	0.016	0.164	−0.014	−0.048	0.115	0.065	0.039	1.000	
27	0.100	−0.215	−0.102	0.410	0.249	−0.005	−0.007	−0.295	0.139	−0.228	−0.360	0.370	0.092	0.171	0.163	1.000
28	−0.034	−0.113	−0.085	0.222	0.172	−0.024	−0.025	−0.037	0.149	−0.060	−0.101	0.165	0.134	−0.033	0.109	0.089

Note: Values greater than |0.11| are significant at $p < .05$.

management each day to update employees about product information or company procedures. Technology as a monitoring device is measured by the percentage of employees' performance that is electronically monitored each day. Technology-mediated service is captured by a three-item scale: the percentage of work time core employees spend providing telephone-mediated (as opposed to face-to-face) service (0–100%); the percentage of transactions they complete while the customer is on the telephone; and the percentage of work time core employees spend simultaneously on-line at a computer and answering the telephone. Items in the scale were standardized, and a mean score was computed (Cronbach's alpha = .67).

Work design, or the opportunity to use one's skills, is measured by three variables: discretion; use of offline problem-solving groups; and use of self-directed teams. Discretion is defined by ten items with 1–5 Likert scales adapted from MacDuffie (1995) and Hunter and Lafkas (1998). The scale includes employee influence over tasks; tools; work methods; pace of work; work schedules; use of computers; and methods for handling customer interactions, complaints, and non-routine requests. The variables measuring discretion were rescaled to mean 0 and a standard deviation of one, and the mean score was computed (Cronbach's alpha = .79). Use of teams is measured by the percentage of the core work force that participates in the two types of teams. Off-line problem-solving teams refer to groups of employees, usually in conjunction with supervisors, who meet periodically off the job to solve work-related issues. On-line self-directed teams are groups (rather than individuals) who form the basic unit of production and are responsible for many operational decisions without consulting management. Three measures of HR incentives are used: days of on-going training each year; the percentage of pay that is variable; and employment security (percent of work force that is full-time and permanent rather than part-time or temporary). I also control for average weekly work hours.

Table 3. Means of Human Capital, HR Practices, and Wages by Targeted Customer.

Variable	*Large Business*	*Small Business*	*Residential Customer*	*Operator Services*	*Signif.: p. < .05*
Human Capital					
a) Education Level of Core (Yrs.)	15.197	13.765	13.049	12.438	a,b,c,d
b) Use of Exempt Staffing	75.758	26.190	12.871	0.000	a,c,d
c) % Female Work Force	45.769	59.500	72.225	81.625	a,b,c,d
d) % with < 1 Year Tenure	26.925	31.372	31.154	35.176	
e) % with > 10 Years Tenure	29.773	22.940	32.606	66.000	a,b,c
Human Resource Practices					
Technology Use					
a) Emails to Employees/Day	19.810	7.232	10.144	2.941	a,b,c,d
b) % Time Electronically Monitored	20.652	34.217	48.731	66.176	a,b,c,d
c) Technology Mediated Service	0.487	0.648	0.768	0.917	a,b,c,d
Work Design					
a) Discretion (1–5 Scale)	3.385	2.910	2.661	2.324	a,b,c,d
b) % in Problem Solving Teams	0.578	0.480	0.454	0.445	b
c) % in Self-Directed Teams	0.265	0.120	0.157	0.082	a,c
HR Incentives					
a) On-Going Training (Wks./Yr.)	2.342	1.885	2.049	1.063	a
a) % Pay That Is Variable	34.758	27.506	13.693	10.588	a,b,c,d
b) % Permanent & Full-Time	95.360	87.759	86.089	82.054	a,c,d
HIWS Index (Std)	0.391	–0.039	–0.181	–0.496	a,b,c,d
Union Presence					
% of Establishments Unionized	4.412	12.791	21.905	35.294	a,d
Compensation					
Median Annual Base Pay	$61,603	$34,786	$27,271	$19,382	a,b,c,d
Median Annual Overtime Pay	$339	$1,674	$1,764	$1,346	c
Benefits Costs as % of Base Pay	17.167	24.534	25.973	26.667	
Total Compensation	$78,390	$45,504	$35,708	$24,061	a,b,c,d

a = residential and large businesses are significantly different at $p < .05$; b = residential and small business are significantly different at $p < .05$; c = small business and large business are significantly different at $p < .05$; d = operators are significantly different from residential, small business, and large business at $p < .05$.

Findings

Table 2 provides the means, standard deviations, and correlation matrix for all variables. To provide a transparent view of the data, Table 3 provides the means and analysis of variance of the dependent and independent variables by customer segment served. As expected, it shows a consistent pattern of variation in skills, HR practices, and wage levels across the four identified segments, and the differences are statistically significant for most variables.

For example, the mean education level is 12.4 years in operator services, 13 years in residential centers, 13.7 in small business, and 15.2 in large business. Whereas women account for 46% of the work force in the large business segment, they comprise 82% of operator services workers. Similarly, the percentage of establishments that are unionized is 4% in the large business segment, but 35% in operator services. With respect to technology use, the percentage of daily work that is electronically monitored varies from 21% in centers serving large business to 34% in those serving small business, 49% in residential services, and 66% in operator services. Variable pay averages 35% for large business reps, 27.5% for small business reps, 14% for residential reps, and 11% for operators. The percentage of the work force that is permanent and full-time varies from 95% in the large busi-

ness segment to 82% in operator services. Median annual pay ranges from $61,603 for large business representatives to $19,382 for operators.

Only call centers targeting small businesses and residential consumers have some characteristics in common, which is probably due to the fact that many small businesses ("mom and pop shops") resemble high-end residential consumers (for example, with home offices), making it difficult to differentiate these customer segments. In sum, the data suggest there is systematic variation in human capital, HR practices, and wages across the targeted customer segments. In addition, separate analyses confined to the subsample of companies with multiple establishments yielded very similar patterns, indicating that the variation by customer segment occurs across establishments in the same company, rather than only across establishments in different companies. Also, in regression analyses not shown, the customer segment consistently is a statistically significant predictor of human capital and HR variables.

To examine multivariate relationships, I used ordinary least squares (OLS) regressions. However, because the data pertain to multiple establishments for some companies, the OLS assumption that observations are independently distributed is violated. I therefore used a Huber correction technique (Huber 1967) to correct for the company cluster effect and to create more robust standard errors. The results reported here use a Huber correction.[3] For each dependent variable, I estimated separate equations for each group of independent variables (Table 4). I then estimated a set of four hierarchical equations (Table 5). Equation (1) (Table 5) provides the base case, including product and labor market characteristics, organization characteristics, and union presence; the second equation adds the business strategy of customer segmentation; the third adds human capital variables; and the fourth adds measures of human resource practices. Each table reports coefficients and standardized betas.

In Table 4, each set of factors explains a statistically significant portion of the variance ($p < .001$). Product market, labor market, and organization characteristics, together with union presence, explain 31% of the variance; customer segments explain 34%; human capital variables explain 53%; and HR practices explain 49.5%. In these equations, most of the independent variables are statistically significant ($p < .05$) in the expected direction.

In the first equation in Table 4, wages are statistically significantly lower in call centers serving the wireless ($p < .05$) and cable TV ($p < .001$) product markets, even with the addition of controls for the higher unionization rates in wireline establishments. As expected, a higher local unemployment rate is associated with statistically significantly lower wage levels ($p < .001$), while a higher cost of living is associated with statistically significantly higher wage levels ($p < 01$). Unions are associated with lower wage levels when customer segments are not controlled for, a reflection of the fact that (as shown in Table 3) they are found in the lower-skilled tiers of the occupation. It is noteworthy that when wage levels are regressed on the union variable only, the union explains virtually none of the variance. In equation (2), relative to establishments taking a universal approach to service (the omitted category), those call centers targeting large business pay wages that are statistically significantly higher ($p < .001$); those centers in residential or operator services pay wages that are statistically significantly lower ($p < .01$; $p. < .001$);

[3] I also estimated the models using weighted least squares (WLS), weighted by the size of the core work force in each establishment. The logic for using WLS is that the wage data are collected at the establishment level, but the size of each establishment varies substantially, with larger establishments more likely to be unionized. Outcomes using both methods produced very similar results, with the exception that the WLS regressions provided a better fit and explained an additional 10% of the variance in the final model, due primarily to the added significance of the union coefficient. Because I do not have individual-level data, and in order to provide a more conservative estimate, I report the results using OLS regressions.

Table 4. Predictors of Ln Median Annual Pay of Service and Sales Workers.

	Coeff.	*Std. beta*	*Coeff.*	*Std. beta*	*Coeff.*	*Std. beta*	*Coeff.*	*Std. beta*
Markets, Organization, Union								
Wireless Market	−0.167	−0.147*						
Cable TV Market	−0.446	−0.337***						
Internet Market	−0.089	−0.042						
Avg. 1998 Local Unemploym.	−0.026	−0.131***						
Avg. 1998 COLA	0.571	0.170**						
Avg. Wkly Work Hours	0.022	0.356***						
Total Employees (Ln)	0.020	0.057						
Part of Bell Company	0.113	0.093*						
Union Presence	−0.137	−0.089*						
Business Strategy								
Large Business Target			0.618	0.470***				
Small Business Target			0.049	0.042				
Residential Target			−0.167	−0.151**				
Operator Services			−0.467	−0.206***				
Human Capital								
Education (Yrs.)					0.135	0.446***		
% of Work Force Exempt					0.287	0.255***		
Tenure < 1 Year (%)					−0.003	−0.127*		
Tenure > 10 Year (%)					0.002	0.093+		
Female (Percent)					−0.328	−0.197***		
Human Resource Practices								
No. Emails/Day							0.009	0.238***
% Electronically Monitored							−0.137	−0.108*
Technology Mediated Service							−0.596	−0.301***
Discretion Scale							0.105	0.141*
Offline Probl.-Solv. Teams							0.036	0.027
Online Self-Directed Teams							0.047	0.028
Ongoing Training							−0.011	−0.038
% Variable Pay							0.309	0.166**
% Full-Time & Permanent							0.586	0.202***
Constant	8.927***		10.274***		8.602***		9.767***	
F Ratio	17.480***		26.940***		61.660***		36.060***	
R-Squared	0.310		0.340		0.532		0.495	
N = 269.								

+Statistically significant at the .10 level; *at the .05 level; **at the .01 level; ***at the .001 level.

and the small business segment represents an intermediate case. Among human capital variables in equation (3), years of education has the largest statistically significant size effect ($p < .001$), followed by percentage of the work force that is exempt ($p < .001$). Establishments with a higher proportion of employees with low tenure pay wages that are statistically significantly lower ($p < .05$), as do those with a higher proportion of female workers ($p < .001$). With respect to the HR practice variables, all but teams and training are statistically significant (at least at $p < .05$). The analyses for each set of factors behave very similarly for the other two dependent variables, total pay and total compensation (analyses not shown).

The results in Table 4 are explored more fully in the hierarchical equations in Table 5. Over the base case (market, organizational, and union factors), which explains an initial 31% of the variance in wages, customer segmentation explains an additional 18% of variance, and the change in R^2 is statistically significant ($p < .001$).

Table 5. Predictors of Ln Median Annual Pay of Service and Sales Workers (Full Model).

	Coeff.	*Std. beta*	*Coeff.*	*Std. beta*	*Coeff.*	*Std. beta*	*Coeff.*	*Std. beta*
Markets, Organization, Union								
Wireless Market	−0.167	−0.147*	−0.022	−0.020	−0.026	−0.022	−0.058	−0.051
Cable TV Market	−0.446	−0.337***	−0.293	−0.221***	−0.124	−0.093+	−0.112	−0.084+
Internet Market	−0.089	−0.042	−0.002	−0.001	−0.239	−0.113*	−0.236	−0.111*
Avg. 1998 Local Unemploym.	−0.026	−0.131***	−0.020	−0.101**	−0.008	−0.042	−0.009	−0.043
Avg. 1998 COLA	0.571	0.170**	0.350	0.104*	0.250	0.074+	0.323	0.096*
Avg. Wkly. Work Hours	0.022	0.356***	0.017	0.281***	0.012	0.189***	0.010	0.161***
Total Employees (Ln)	0.020	0.057	0.029	0.083+	0.040	0.115***	0.065	0.187***
Part of Bell Company	0.113	0.093*	0.042	0.035	0.006	0.005	0.020	0.016
Union Presence	−0.137	−0.089*	0.052	0.034	0.188	0.123**	0.202	0.132***
Business Strategy								
Large Business Target			0.518	0.394***	0.200	0.153*	0.175	0.134*
Small Business Target			0.045	0.039	−0.013	−0.011	0.034	0.030
Residential Target			−0.108	−0.098*	−0.067	−0.060	−0.003	−0.002
Operator Services			−0.391	−0.173***	−0.292	−0.129***	−0.123	−0.055
Human Capital								
Education (Yrs.)					0.099	0.327***	0.061	0.200***
% of Work Force Exempt					0.222	0.197***	0.150	0.133*
Tenure < 1 Year (%)					−0.003	−0.096	−0.002	−0.088+
Tenure > 10 Yr. (%)					0.001	0.068+	0.001	0.055
Female (Percent)					−0.356	−0.214***	−0.253	−0.152***
Human Resource Practices								
No. Emails/Day							0.004	0.104*
% Electronically Monitored							−0.119	−0.094*
Technology Mediated Service							−0.219	−0.111*
Discretion Scale							0.101	0.136**
Offline Probl.-Solv. Teams							0.059	0.044
Online Self-Directed Teams							0.016	0.010
Ongoing Training							−0.012	−0.039
% Variable Pay							0.233	0.126**
% Full-Time & Permanent							0.150	0.052+
Constant	8.927***		9.169***		8.264***		8.262***	
F Ratio	17.480***		18.930***		28.470***		40.260***	
R-Squared	0.310		0.492		0.669		0.742	
Chg. R-Squared			0.181		0.177		0.073	
F for Chg. R-Squared			22.714***		26.740***		7.518***	
N = 269.								

+Statistically significant at the .10 level; *at the .05 level; **at the .01 level; ***at the .001 level.

Human capital variables explain another 17.7% of variance (p for change in R^2 < .001). Finally, HR practices add another 7.3% in explanatory power to the equations (p < .001). The full model explains 74.2% of the variance in median annual wages.

Several findings are noteworthy. In the second equation in Table 5, once other factors are controlled for, targeting particular customer segments has the predicted relationship to wages. Employees in large business centers receive a 67.9%[4] wage premium over those who work in centers providing universal service (the omitted category). Residential service centers pay

[4]For logged dependent variables, the formula for converting coefficients to percent change associated with the coefficient is $W = 100*(eB - 1)$, where e is the base for natural log (= 2.71....) and B is the value of the coefficient. All findings reported below are based on this formula.

10.2% less, and operator centers pay 32.4% less than those centers providing universal service. Also, with the addition of the customer segment variables, the statistically significant negative relationship between the union and wage levels becomes positive, indicating that the negative association found in Table 4 likely was due to union concentration in lower wage tiers of the occupation.

In equation (3) (Table 5), with the addition of the human capital variables, the size and statistical significance of the customer segment variables are reduced, but are not eliminated. This result suggests that, as expected, the segments are a sorting mechanism for skill. The magnitude of the coefficients is lower by over half for the large business segment and by about one-third for residential and operator services. However, human capital variables only partially mediate the relationship between customer segment and wage levels, as both the positive coefficient for large business segments and the negative coefficient for residential and operator services continue to be statistically significant. Turning to the individual human capital variables, years of education has the largest size effect, followed by the percentage of the work force that is female, and the percentage of the work force that is exempt.

In the full model (Table 5), six of the nine human resource variables are statistically significant (at least $p < .10$) and have the predicted relationship to wages. Also, the size and statistical significance of the customer segment and human capital variables are lower, but not eliminated in the presence of the HR variables. That is, consistent with Table 3 above, HR practices co-vary with the customer segment served and the level of human capital, with high-involvement HR practices more likely to be adopted for high-end customers and employees with higher skills serving those customers. However, HR practices also help explain wage variation over and above that explained by customer segment and human capital. There is a statistically significant relationship between wage levels and use of technology ($p < .05$), the level of discretion employees have ($p < .01$), use of variable pay ($p < .01$), and staffing policies that emphasize a full-time, permanent work force ($p < .10$). Teams and on-going training do not have a statistically significant association. Among the HR practices, the technology use variables as a group contribute the most to explaining variation in pay levels.

In the full model (Table 5), the union wage premium is 22.4%. When controls for human capital and HR practices, including variable pay, are included, the estimates indicate that those employed in large business call centers enjoy a 19.2% wage premium. There is likely to be a price premium for serving large business customers, and my findings suggest that employees share in the benefits of that premium. With respect to human capital variables, every year of education is associated with a 6.2% wage premium. Exempt status is associated with a 16.2% wage premium. A 10-percentage-point increase in the work force that is female is associated with a 2.24% lower wage. Relative to workers in centers serving the wireline portion of the industry, employees in the cable TV market and in Internet services receive 10.6% and 21% lower wages, respectively. Workers in counties that have a higher cost of living receive substantially higher wages than do those in lower-cost areas; and those who work in larger organizations receive more pay than their counterparts in smaller organizations.

With respect to the specific HR practices, greater email use is associated with higher wages, while electronic monitoring and technology-mediated service are associated with lower wages. A ten-percent increase in the time that employees are electronically monitored is associated with 1.1% lower wages. A one-standard deviation increase in the use of technology mediation is associated with 10.5% lower wages. A one-standard deviation increase in the discretion scale is associated with 14.6% higher wages. A ten-percent increase in the use of variable pay is associated with 2.6% higher wages. A ten-percent increase in the share of the work force that is full-time and

permanent is associated with 1.6% higher wages.

When standardized betas are examined in the full model (Table 5), the magnitude of coefficients is largest for years of education, establishment size, percentage of the work force that is female, discretion, serving large business customers, union presence, exempt status, and variable pay, in descending order. In a separate analysis using the full model (not shown), I substituted a high-involvement work index for the nine HR variables. The index was created by taking the mean of all nine variables, transformed into standardized z scores, with electronic monitoring and technology mediation reverse-coded. The results showed that a one-standard deviation increase in the combined index is associated with a 36% increase in wages.

I estimated the same set of equations with total pay (median wages plus overtime pay) and total compensation (median wages plus costs of benefits) as the dependent variables (equations not shown). The full model accounted for 74.2% of the variance in total pay and 70.1% of the variance in total compensation. The size and statistical significance of the variables are very similar to those reported above, with the exception of exempt status. When overtime pay is taken into account, the wage premium for exempt status disappears, suggesting that non-exempt workers close the earnings gap (between exempt and non-exempt) by working overtime hours. Also, exempt status is not statistically significant (even at the $p < .10$ level) in the total compensation equation, perhaps because workers in this highly unionized industry enjoy large benefit packages.

Discussion and Conclusions

I have focused on wage inequality among service and sales workers in the telecommunications industry. The cross-sectional analysis of establishment data examines whether management practices initiated since divestiture in 1984 help explain the current intra-occupational wage variation in this group. Several findings are noteworthy.

The first relates to the large and statistically significant relationship between business strategy and wage variation. Higher value-added customer segments are associated with substantially higher wage levels, and these relationships are statistically significant. However, these relationships are reduced in size and statistical significance with the addition of direct measures of human capital. This finding suggests that customer segmentation partially serves as a sorting mechanism for the demand for skill. Direct measures of HR practices further reduce the strength of the relationship between customer segment and wage levels. However, even in analyses that control for variation in skill and human resource practices, there continues to be a wage premium of about 19% for employees serving the large business segment.

Second, measures of human capital account for an additional 18% of the variation in wage levels. Among human capital variables, years of education has the largest size effect, followed by the percentage of the work force that is female, and the exempt status of the work force.

Third, variation in the use of technology and human resource practices explains an additional 7.3% of median pay. This estimate represents a conservative estimate of the importance of human resource practices because they are evaluated only after controlling for all other factors and because practices such as selection that influence the stock of human capital are not taken into account. Technology used as an information resource (email use) has a statistically significant positive relationship with pay, while technology used for electronic monitoring and automation has a statistically significant negative relationship. Establishments that provide employees with higher discretion, have higher variable pay, and offer more full-time permanent employment also have higher wage levels.

Fourth, the estimates for the union wage premium are quite consistent with those based on the CPS data. While field research for this study suggests that de-unionization and deregulation have weakened

the role of the union in constraining managerial prerogatives (Batt and Keefe 1999), the union wage premium remains high. The finding of a 22% union wage premium, in estimations that control for organization-level practices, is very close to the 20% union wage premium for this occupation calculated on the basis of the CPS 1998 data. Somewhat lower premiums were reported by Lemieux (1993), who estimated the union wage gap at 18% for U.S. men and 15.6% for U.S. women, and by Card (1998), who found that the union wage gap in 1993 was 16.8% for all men and 16.6% for all women.

There are important limitations to this study. Because the data were collected at the establishment unit of analysis, it was not possible to obtain the kind of individual-level data that capture variation in human capital characteristics within the establishment. Moreover, the cross-sectional nature of the data limits causal inferences. In this case, however, my statistical evidence is supplemented by a well-documented historical record of firm restructuring and reorganization into customer-driven business units; and union contracts provide a record of the proliferation of newly negotiated job titles and wage grades within the occupation (see, for example, Keefe and Batt 1997; Batt and Keefe 1999).

My interpretation is that segmentation has been used to create more differentiated labor market strata and to match these strata to customer demand characteristics. This business strategy is an indirect mechanism through which skill-biased technical change affects wage levels. The resulting labor market stratification, both within occupational groups and within large firms, dramatically differs from the outcomes of prior organizing principles based on firm size, primary-secondary firm location in production chains, or core-periphery distinctions based on the employment status of workers. Customer segmentation was made possible in the 1990s through advances in information technologies and process reengineering.

Over and above the issue of segmentation and labor market strata, this paper has examined how variation in human resource practices also functions as a direct mechanism through which skill-biased technical change affects wage outcomes. Arguably, the measures of human resource systems used in the study to some degree simply capture unobserved skills and abilities of the work force. A more precise assessment of causal channels would require a study that randomly assigns workers with the same level of skills and abilities to different work systems and then observes their productivity, or else a study that employs a pre-post test design. The opportunities to conduct this type of quasi-experiment in a field setting, however, are rare. A plausible interpretation of the findings in this study is that HR practices are the mechanisms through which firms make more productive use of human capital.

Given the case-based nature of this research, another question concerns the generalizability of these findings. Other recent studies suggest that market segmentation strategies are growing in other service industries, such as financial services and insurance (Keltner et al. 1999). Moreover, call centers have grown dramatically across all industries as a vehicle for interactions between customers and providers. Thus, one avenue for future research is to explore the role of customer segmentation strategies for customer-contact workers in other industries. Customer-driven business strategies have diffused widely across most industries, and supply chain management is the major focus of many manufacturing concerns. For example, many manufacturers have reorganized production lines according to the customers they serve, and give greater priority to serving higher value-added customers. To the extent that production-level workers have performance-based pay tied to serving a particular customer, we may begin to see the influence of customer-driven strategies on the pay of manufacturing workers as well.

In sum, the value of case-based research is to examine how general concepts, such as skill-biased technical change, in fact play out in distinct, context-specific ways. If "technical" changes are viewed as the means

through which human capital is used more or less efficiently and effectively, and thereby reflected in wages, then findings in this study suggest that skill-biased technical change is related to wage variation at various levels of analysis. Some influences of technical change occur indirectly at the corporate level, at lower organizational levels, or through fundamental labor market restructuring. Other effects of technical change are more direct, and influence wages through work and human resource practices that affect organizational performance and competitiveness. As researchers continue to identify the range of ways that new technologies interact with markets and management practices, a future challenge is to develop a conceptual framework that disaggregates the concept of skill-biased technical change into meaningful constructs that can be systematically examined.

Appendix
Variable Definitions

Dependent Variables

Natural log of median annual pay: The median annual before-tax earnings for full-time core employees, including variable pay but excluding deferred compensation such as stock options and employer contributions to benefits such as pensions and health care.

Natural log of median total pay: The sum of median and overtime pay of the median core worker.

Natural log of median total compensation: The total costs of median annual pay (see above) plus costs of benefits (such as employer contributions to health insurance and pensions, but excluding payroll taxes such as workers' compensation and social security).

Independent Variables

Product Markets, Labor Markets, Organizations, and Unions

Product market is a series of dummy variables:
Wireline: 1 = wireline, else 0 (omitted category).
Wireless: 1 = wireless, else 0.
Cable TV: 1 = cable TV, else 0.
Internet: 1 = Internet service provider, else 0.

1998 average local unemployment rate: 1998 average unemployment rate of the county or city in which the establishment is located, drawn from the Local Area Unemployment Statistics, Bureau of Labor Statistics (http://stats.bls.gov.laumthd.htm). Estimates are derived from unemployment insurance claims, ratios reflecting historical relationships between covered unemployment and covered employment, and between entrants into the labor force and the experienced unemployed and experienced labor force.

1998 cost of living adjustment: Ratio of local cost of living to the baseline of $48,000 for a middle-income family of three. The data are based on the *1999 Geographic Reference Report*, Economic Research Institute (ERI). The cost of living is defined as the "demand and supply for the goods and services which are purchased by these employees." This includes "housing, transportation, utilities, and consumables." The Geographic Assessor is "zip code specific." It provides cost of living data for 3,568 North American cities using the "Urban Family of Four" model of analysis.

Weekly work hours: Variable based on the following question: On average, how many hours per week, including overtime, do core employees work?

Total employees: Natural log of total full-time plus 1/2 total part-time employees.

Part of Bell company: Dummy variable, where 1 = part of Bell company, else 0.

Union presence: Dummy variable based on the following question: Are core employees at your location covered by a union contract? 1 = yes, 0 = no.

Business Strategy

Customer segmentation is a series of dummy variables:
Large business segment: 1 = large business customers targeted, else 0.
Small business segment: 1 = small business customers targeted, else 0.
Residential segment: 1 = residential customers targeted, else 0.

Operator services: 1 = operator services, else 0.
Universal channel: 1 = all customers served, else 0 (the omitted variable).

Human Capital

Formal education: How much formal education does the typical core employee have?

1 High school (recoded to 12 years)
2 Some college but no degree (recoded to 13 years)
3 Technical school degree (recoded to 14 years)
4 2-year college degree (recoded to 14 years)
5 4-year college degree (recoded to 16 years)
6 Graduate school (recoded to 20 years)

Exempt: 1 = exempt, 0 = non-exempt, based on the following question: Are core employees classified as exempt or non-exempt from wage and hour laws?

Tenure < 1 year: The percentage of core workers with less than one year of service with the company divided by the percentage of core workers with more than one year of service.

Tenure > 10 years: The percentage of core workers with more than ten years of service with the company divided by the percentage of core workers with less than ten years of service.

Female: The percentage of the establishment's core work force that is female.

Human Resource Practices

TECHNOLOGY USE

Email use: Number of email notices sent by management to core workers regarding work-related information updates (such as information relating to products, services, regulations, or procedures).

Electronic monitoring: The percentage of core employees' work performance that is electronically monitored continuously as they work each day.

Technology-mediated service: A scale of 3 variables (Cronbach's alpha = .74) for the following:

a. Phone service: The percentage of customer interactions that are handled by telephone (as opposed to face-to-face) (1–100%).
b. Transactional calls: The percentage of customer requests that core employees complete while the customer is on the telephone line (1–100%).
c. Time-on-line: The percentage of daily work hours (excluding breaks and lunch) that core employees spend simultaneously handling customer calls and using the computer to handle those calls (1–100%).

WORK DESIGN

Substantive discretion: An index of how much formal authority or informal discretion core employees have over the following ten items, using a 1–5 scale where 1 equals no discretion and 5 equals complete discretion:

What daily tasks or work assignments they do
What tools or procedures they use
The pace or speed at which they work
Setting performance objectives
Setting their daily lunch and break schedule
Setting their vacation schedule
The design or use of new technology
The types of customers or customer segments they serve
Handling additional requests from customers that may arise unexpectedly when the employee is interacting with the customer
How many customers should be served per hour

Offline problem-solving groups: The percentage of the core work force that participates in offline problem-solving groups.

Online self-directed teams: The percentage of the core work force that is organized into self-directed teams.

HR INCENTIVES

Ongoing training: Days of ongoing training for the core work force in a typical year.
Variable pay: The percentage of annual pay that is variable or performance-based (including profit sharing, gainsharing, commission pay or other bonuses not built into the base wage).
Employment security: The percentage of the work force that is full-time and permanent.

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