Opening the Black Box: The Internal Labor Markets of Company X

MING-JEN LIN*

This paper sets out to analyze an internal data set on a Taiwanese auto dealer employing three distinct types of workers. The effects of jobs and levels are positive on both the salary and bonus equations, albeit smaller under a fixed effects than under OLS; however, when factoring in individual fixed effects, the reductions in the bonus equations are greater than those in the salary equations. With changing economic conditions, any consequent variations are greater in bonuses than in salaries, with the most extreme variations being felt by higher ranking employees than lower-level workers. Promotion premiums between levels are smaller than the average differences in pay, and although wage variations do exist within and between levels, the greater effect is on bonuses rather than salaries. The variations in both salaries and bonuses, defined by the coeffficient variations, are also greater in those years when demand is high, as opposed to years of low demand. Entry and exit behavior is observed at all levels, although it is more likely to occur among the lower levels of the hierarchy. Finally, we present strong evidence in support of the cohort effect. Overall, our findings confirm the prevalence of internal labor market (ILM) theories.

The best scenario imaginable is that I just sit here doing nothing, and enjoy the profits that my employees earn for me.

CEO of Company X
On the functions of the internal labor market

In neoclassical economics, wages are determined by their marginal value; however, it is difficult to believe that wages are solely determined by spot markets, since individuals actually spend most of their

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lives in firms, or internal labor markets. In their seminal work, Doeringer and Piore (1971) set out to fill the gap that existed at that time by raising the concept of "internal labor markets" (ILMs):

> An ILM is an administrative unit within which the pricing and allocation of labor is governed by a set of administrative rules and procedures. ILMs interact with external labor markets (ELMs) through certain ports of entry or exit, with the remaining jobs within the ILMs being filled by promotions or transfers. In consequence, these jobs are shielded from any direct influence of the ELMs.

Nevertheless, it is clearly the case that promotions, hierarchies, rules, hidden information, and even organizational culture, all have some part to play in ILMs. Although their claims cannot be viewed as theories, Doeringer and Piore's observations did inspire a wide range of economic theories that attempted to explain what happens inside the firm. The list includes specific human capital (Becker 1993), authority and control (Rosen 1982), principal-agent theory (Holmstrom 1979), learning and matching (Jovanovic 1979a,b), tournament (Lazear and Rosen 1981), and institutional design (Lazear 1979, 1986).[1] Gibbons and Waldman (1999b) went on to provide a comprehensive survey of these models, whilst Lazear (1999) even defined research along such lines as "personnel economics," suggesting that "personnel economics, defined as the application of labor economics to business issues, has become a major part of economics."

This area of research does, however, suffer from a scarcity of empirical works, which is why Baker and Holmstrom (1995) claimed that the subject of ILMs had "too many theories, and too few facts." Furthermore, most of the empirical studies tend to be based upon Western companies and white-collar workers; however, as Gibbons (1997) put it, "all four systems (salaried, industrial, craft, and secondary), as systems in other countries, deserve more attention." Therefore, using data on blue- and white-collar workers within a Taiwanese firm, this paper sets out to contribute to the knowledge that has thus far escaped the attention of many researchers in this field.

Although the spirit of this study is very much in line with Baker, Gibbs, and Holmstrom (1994a,b), because of the uniqueness of the data adopted, this paper contains a lot of new findings. One of the most interesting observations is that, although this is a Taiwanese company heavily influenced by Japanese culture, most of the findings corroborate those contained in the existing literature on the broad patterns generally found in U.S. and

[1] Models mixing at least two of the above elements are Murphy (1986), Prendergast (1993), and Gibbons and Waldman (1999a).

European firms. Furthermore, since we have three types of workers and detailed data on salaries and bonuses, we can simultaneously compare six different responses for each question asked. As compared to many of the earlier studies, which have invariably used only managers as observation points, this study also sheds light on the ways in which the differences in work characteristics affect the results.

The remainder of this paper is organized as follows. The next section provides a review of the literature, followed, in Section 3, by a description of the data set, new methods of identifying the hierarchical structure, and details of transition within the company. Section 4 provides a description of the effects that jobs and levels have upon salaries and bonuses, as well as variations within and between the different levels of the sub-ILMs and the model specifications. We also compare the coefficient reductions of wage regressions, for both salaries and bonuses, between OLS estimations and a fixed effects model, as well as wage variations between salaries and bonuses for years of both high and low market demand. Section 5 discusses the existence of ports of entry and exit, followed by an examination of the cohort effect in Section 6. The conclusions drawn from this study are presented in Section 7.

Literature Review

A summary of our review of the literature, including the type of firms being studied, the countries involved, the periods covered, the sample workers, the compensation variables used, and the main conclusions, is provided in Table 1. Our review focuses primarily on those studies that have used personnel data to investigate the ways in which workers are allocated and priced, the ways in which the rewards system (or the human resource management system) affects the behavior of workers,[2] and the ways that ELMs interact with ILMs. As the table shows, 19 of the 28 studies surveyed were undertaken after 1999, which indicates that this is still a relatively young field.

Furthermore, with the exception of one Japanese firm, all of the samples in the prior studies are taken from Western countries (half of them being in the United States), demonstrating a distinct lack of studies for comparison in the East. Moreover, only seven of these studies were able to obtain data on the entire workforce, which precludes any overall comparison of the sub-ILMs across firms. Most of the samples were either white, male managers,

[2] Such as piece rates versus hourly wages, promotion versus demotion, and tournament.

TABLE 1

LITERATURE SURVEY OF EMPIRICAL STUDIES ON INTERNAL LABOR MARKETS

	Study	Company	Period covered	Sample workers	Earnings variable	Main conclusions
1	Medoff and Abraham (1980)	Manufacturing (U.S.)	Company A: 1977 Company B: 1976	White male managers and professionals	Wage	a. At identical levels, senior workers received higher salaries but were no more productive than junior employees.
2	Medoff and Abraham (1981)	Manufacturing (U.S.)	1973–1977	Managers and professionals	Wage	a. As in Medoff and Abraham (1980), there was no correlation between performance and seniority.
3	Lazear (1992)	Corporation (U.S.)	1970s–1980s (13 years)	All employees (with the exception of high-level managers)	Wage	a. Changing jobs was the key to increasing wages. b. Within jobs, heterogeneity was important. c. Weak ports of entry and exit.
4	Craig and Pencavel (1992)	Plywood firms in Washington State, U.S.	1968–1986	Firms as observation points	Firm-average wage	a. Cooperatives are more inclined to adjust pay than employment. b. Membership of the cooperatives has been extremely profitable.
5	Lambert, Larcker and Weigelt (1993)	303 large publicly-traded U.S. firms	1982–1984	Four levels of officerss (from plant managers to CEO)	Wage, bonus stock options	a. Organizational incentives are better characterized by a combination of the three models: tournament, managerial power and incentive theories, rather then being completely described by a single theoretical description.
6	Baker, Gibbs and Holmstrom (1994a,b)	Services (U.S.)	1969–1988	Managers and employees	Wage	a. Clear and simple hierarchy. b. No ports of entry or exit. c. Strong correlation between job levels and wages. d. Promotion important to wage growth.
7	Gibbs (1995)	Services (U.S.)	1969–1988	Managers and employees	Wage and Bonus	a. Higher performance leading to substantial wage increases. b. Promotion was an important source of incentives, and dependent on performance. c. Possible substitution between promotion and short-term compensation.

8	McCue (1996)	PSID	1976–1988		Wage	a. Position change accounts for 15 percent of wage growth over the life cycle. b. Better paid workers are promoted more rapidly. c. Most moves are made early in the career.
9	Ichniowski, Shaw and Prennushi (1997)	36 steel production lines owned by 17 U.S. companies			Productivity (delays)	a. Lines using a set of innovative work practices, such as incentive pay, teams, flexible jobs, etc., achieve higherproductivity levels.
10	Lazear (1999)	Finance (U.S.)	1986–1994	All employees	Wage	a. Promotion important to wage growth. b. The existence of a "Star performer" track.
11	Ariga, Brunello, and Ohkusa (1999)	High-tech (Japan)	1971–1994	All employees ("stayers" only)	Wage	a. Multiple ports of entry and exit. b. Fast tracks exist but are not correlated with ability.
12	Chiappori, Salanie, and Valentin (1999)	State-owned (France)	1960–1982	Executives	Wage	a. When one controls for the wage at date t, the wage at date $t + 1$ should be negatively correlated with the wage at date $t - 1$.
13	Eriksson (1999)	220 Danish firms	1992–1995	2600 executives	Wage, bonus and pension	a. Evidences from the data support the prediction of tournament theory in general.
14	Paarsch and Shearer (1999)	British Columbia tree-planning firm	1994	155 planters	Hourly wage versus piece rate	a. Profit would increase by 17 percent if the firm were to implement optimal static contracts.
15	Lazear (2000)	Safelite Autoglass Ohio, U.S.	Jan 1994–Jul 1995	Auto glass installers	Hourly wage versus piece rate	a. Tenure has a greater effect on wages than output. b. Overall increase of 44 percent in productivity resulting from the switch from hourly wages to piece rates. c. Pay compensation relative to productivity.
16	Seltzer and Merrett (2000)	Banking (Australia)	1888–1900	Entry cohort	Wage	a. Limited ports of entry. b. Internal promotion preferred to external hiring. c. Pay largely determined by specific characteristics, particularly tenure. d. Deferred compensation used to screen employees.

TABLE 1 (cont.)

	Study	Company	Period covered	Sample workers	Earnings variable	Main conclusions
17	Treble et al. (2001)	Finance (UK)	1989–1997	Managers and clerical staff	Wage and Bonus	a. Unclear ports of entry. b. Changes in hierarchy structure more marked than in firms previously studied. c. Within levels, pay compression exists only for staff workers.
18	Flabbi and Ichino (2001)	Banking (Italy)	1974–1995	Male workers (nonmanagerial)	Wage	a. Only at the lowest levels of the firm's hierarchy does human capital theory contribute or explain the effect of seniority on wages. b. At least at other levels, the explanation of the observed upward sloping profile has to be based on theories in which wages are deferred for incentives or insurance reasons.
19	Gibbs (2001)	Department of Defense (U.S.)	1982–1996	Skilled civilians and engineers	Wage	a. Unlike the private sector, there was no increase in returns on skills in the government laboratory.
20	Howlett (2001)	Great Western Railway (UK)	1870–1913	Traffic staff	Wage	a. Ports of entry and exit exist. b. No fast track promotion path. c. Demotion remained a probability at all levels. d. Job level was important to wages.
21	Hamilton and MacKinnon (2001)	Canadian Pacific Railway (Canada)	1921–1944	Mechanical and operation workers	Wage	a. No fast tracking, but the internal labor market does protect workers from layoffs. b. Wages are directly linked to jobs. c. Demotion is widely used, even during expansion.
22	Lima and Pereira (2001)	74 large manufacturing firms in Portugal	1991–1995	All employees	Wage	a. Promoted workers receive a positive wage premium, vise versa for demoted workers. b. The wage-career dynamic generate a U shape to the wage premium for promotion over the hierarchical ladder.

23	Grund (2002)	Two plants—same owner (U.S. and Germany)	(U.S.) 1975–1995 (G) 1978–1998	(U.S.) All employees (G) Partial employees	Wage	a. Convex profiles in both plants. b. U.S. plant shows higher intensity of intra-firm competition in terms of higher intra-level inequality and promotion rates. c. Wages within the German firm are more distinctly linked to hierarchy levels.
24	Kwon (2002)	Insurance (U.S.)	1993–1995 (910 days)	Female, white collar, non-managerial, claims processors	Wage and Bonus	a. Average productivity increases with tenure. b. Wages correlated to job levels, but there are significant wage variations within, and wage overlaps between, job levels.
25	Eriksson and Werwatz (2003)	222 Danish private firms	1980–1995	All employees	Hourly Wage Rate	a. Turnover rate is high at all levels in firms. b. Promotions within the firm are not a prominent feature in firms. c. Wages are attached to job levels. d. Employees are not completely shielded from the external market conditions.
26	Lazear and Oyer (2003)	(Almost) All Swedish Private Sector Firms	1970–1990	White collar employees	Wage	a. Internal promotion is important. b. External market conditions affect both wage setting and hiring pattern.
27	Gibbs and Hendricks (2004)	Corporation (U.S.)	1989–1993	Domestic workers	Wage	a. Firm uses standard, highly centralized, compensation policies. b. Wages are implicitly linked to jobs. c. Salary system shields employees from external labor markets.
28	Dohmen, Kriechel, and Pfann (2004) Dohmen (2004)	Fokker Aircraft (now bankrupt)	1987–1996	All wmployees	Wage	a. Stable hierarchy. b. Ports of entry concentrated at the lower blue and white collar levels. c. Wages strongly linked to job levels. d. Horizontal job mobility important as it affects promotion prospects and wage growth.

SOURCE: Collated by the author.

or particular occupational groups, such as installers or claims processors. Finally, only five of the studies have any significant data on bonuses; however, since bonuses are extremely important to employees in company X, especially for salespeople and technicians, a separate exploration of the bonus system may raise some interesting issues.

A point worth mentioning is the nature of the data. Most ILM studies tend to adopt what is essentially a "case study" method, using data on individual firms; one reason for this is the scarcity of national employer–employee matching data. Eriksson (1999), Lima and Pereira (2001), Eriksson and Werwatz (2003), and Lazear and Oyer (2003) are exceptions to this rule, since each of these studies used data on European countries in their entirety. However, while data on all of the firms within a single country may be useful in determining the general features of ILMs, data on a single firm still have their own advantages in terms of defining jobs and levels; hence, promotion and demotion, for example, can be more precisely defined. Furthermore, workers in the same firm are also faced with the same personnel policies that critically affect their behavior; in contrast, the use of large-scale data makes it extremely difficult to control for the effects of changes in internal policies even through a fixed effects model. Hence, these two types of data should be seen as complementary to the overall understanding of ILMs.

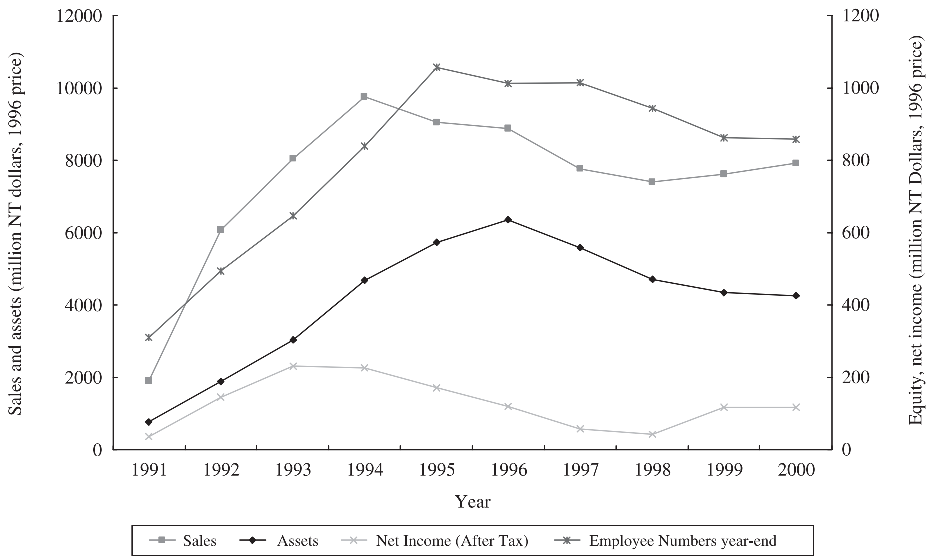
As to the purposes of the prior studies in this area, some set out to establish the stylized facts of ILMs (Lazear 1992; Baker et al. 1994a,b; Seltzer and Merret 2000; Treble et al. 2001; Eriksson and Werwatz 2003; Lazear and Oyer 2003; Gibbs and Hendricks 2004), while others focused on more specific issues, such as the relationship between tenure and productivity (Medoff 1980, 1981; Lazear 2000; Flabbi and Ichino 2001; Kwon 2002), or the effects of changes in compensation methods (Ichniowski et al. 1997; Paarsch and Shearer 1999; Lazear 2000). This paper follows similar lines to the Baker, Gibbs, and Holmstrom (1994a) and Lazear (1992) studies; consequently, the results derived from this data may be viewed as either confirming or contesting the literature, at least from the perspective of other firms and/or cultures.

Data, Hierarchy, and Transition

Overview of the Firm. The sample for this study is an auto dealer engaging in the sale and maintenance of automobiles; it has more than ten years history in Taiwan and has a share of the Taiwanese vehicle market in excess of 5 percent. The period covered by the data is from 1991 to 2000, a period during which there were, on average, around 600 to 800 people working in the

FIGURE 1

SALES, ASSETS, NET INCOME AFTER TAX (IN 1996 NT$ MILLIONS), AND EMPLOYEE NUMBERS



company at any given time, comprising of both white- and blue-collar workers. The data include the personal characteristics of each worker, such as age, gender, the number of years and type of education, tenure within the firm, salary and bonuses (both performance-related and profit-share based), as well as details on job codes, levels, performance rating for staff workers, and so on.

Between 1991 and 1996, the company achieved rapid growth in virtually every area; however, after 1996, as a result of the rapidly increasing market competition and the general slowdown in the Taiwanese economy, the company found itself facing a slight decline in overall performance. Figure 1 shows the basic financial conditions of company X, demonstrating around fivefold growth in sales from NT$2 billion in 1991 to NT$9 billion in 1994, and thereafter, a slight decrease from NT$10 billion in 1995 to NT$8 billion in 2000.[3] A similar pattern is discernible in employee numbers, up from 300 in 1992 to 1000 in 1995, then stabilizing at around 850 at 1999. Assets also reached their peak in 1996, while net income reached its highest level, of NT$230 million, in 1993, followed by a general decline; there was, however, an apparent recovery in this area from 1999 onward. An examination of the

[3] We report only rough numbers here to prevent the identity of the firm being revealed.

general features of this growth–decline pattern will be undertaken later in the discussion of the interaction between ELMs and ILMs.

Identifying the Hierarchy. Jobs are used to "define" employees, as well as their levels of responsibility and authority within a firm. A hierarchy, according to Baker, Gibbs, and Holmstrom (1994a), is usually said to "consist of job titles aggregated into levels related to the job's authority and placed in the path of decision-making." Hence the term "levels" can be viewed as the simple version of "jobs" to define a hierarchy, and transitions between levels can also help us to gain an understanding of the relationship existing between different units within the organization. Hence correctly defining jobs and levels is the cornerstone for any subsequent analysis.

In a prior work, Lazear (1992) used average pay to define levels; however, when undertaking an investigation of the relationship that exists between pay and levels, this is, essentially, an example of tautology. In contrast, Baker, Gibbs, and Holmstrom (1994a,b) used information on moves between job titles to define levels, selecting fourteen major titles from their data set (which represented 90 percent of the sample) and using the transition matrix of these titles to construct the hierarchy, as well as the levels within it. Nevertheless, the major disadvantage of both methods is that the observations on compensation, job titles, and transitions are used to infer the structure of the hierarchy, and are thus sensitive both to the errors that can occur during the sampling process and to the process itself. Baker, Gibbs, and Holmstrom (1994a) admitted that although they had 4000 cost center codes, they could not use these as a means of describing the hierarchy because of the unavailability of data on the reporting relationships.

The first contribution of this paper is its use of job titles, levels of authority, and the hierarchical structure chart (provided by the company's HR department) to directly identify job levels.[4] This is the first paper to specifically use an organizational chart to identify the hierarchy and, as we will see in the following section, the results confirm, quite strongly, that the Baker, Gibbs, and Holmstrom method was very effective, despite the fact that they did not have an organizational chart at their disposal. Since there are around thirty job titles in total, we begin by defining the CEO as the highest level, and then trace each level of direct authority down to the lowest levels. For example, if documents initiated and reviewed by the Deputy Chief Manager have to pass through the hands of the General Chief Manager before being seen

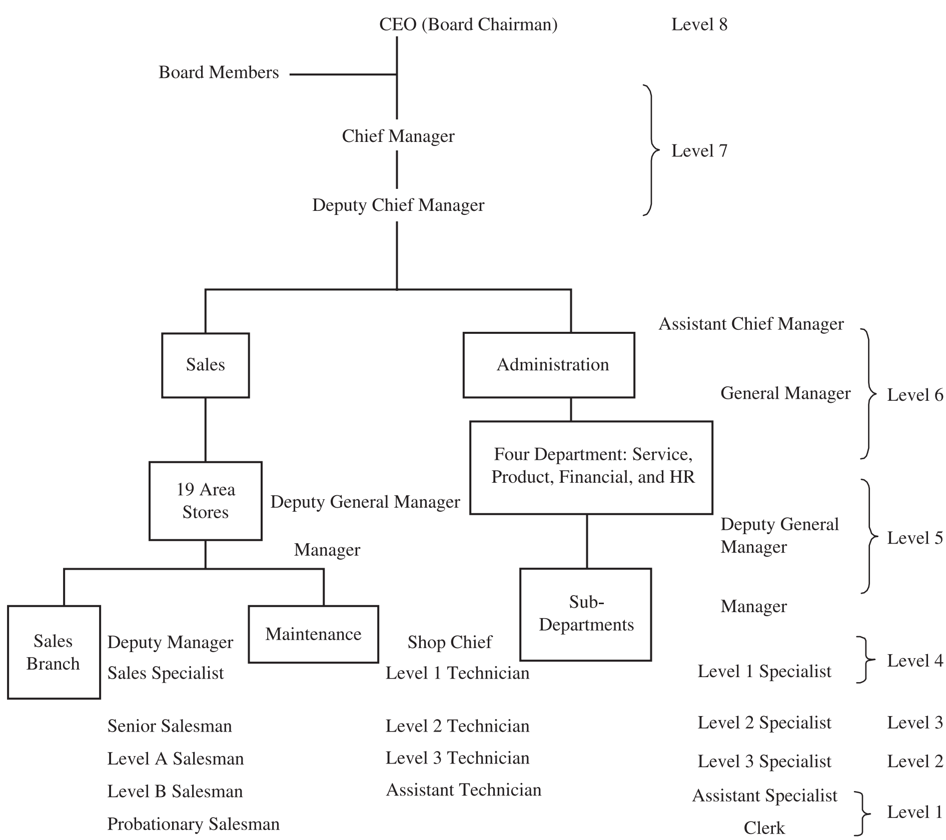
[4] The way in which this company allocates employees' seats is also a method of identifying levels, with the results being similar.

by the CEO, then the hierarchy, and the levels defined by authority, would follow the order of CEO, General Chief Manager, and then Deputy Chief Manager.

The company's HR department also has its own hierarchical chart which provides a representation, in very graphic detail, of the way that the company sees its own organizational structure. Sometimes a job title itself will describe the relationship. By using such readily available information, we are able to quickly construct the hierarchy of the firm, and its levels, as shown in Figure 2. As can be seen from the figure, the CEO and his officers

FIGURE 2

Organizational Structure, Job Titles, and Hierarchical Levels



Notes: All sales and maintenance workers are part of the Sales section, whereas all staff workers are part of the Administration section. Higher values on the right edge of the figure correspond to higher levels; thus, level 1 is the lowest. However, among technicians and specialists, level 1 is the highest level, and level 3 the lowest. We leave the definitions this way since these are the titles used within the company.

control the company through two sections, Sales and Administration, which are headed by two Assistant Chief Managers.

The administration section has overall responsibility for finances and human resource management, while the most important job for the sales section is to direct product sales by the head of the product department (General Manager) and the area store chiefs (who may have the title of Deputy General Manager or Manager). Below the area stores are the sales branches, whose job is to promote and sell the products, and the maintenance branches, which are responsible for repairing or maintaining the products sold by them.

There are also three sub-hierarchies within these branches. Bonuses for salespeople are calculated by the number of cars sold, with approximately 80 percent of a salesperson's annual compensation being derived from this source. In contrast, only 20 percent of a staff worker's annual compensation is derived from bonuses, which are related to the worker's performance rating. Team and individual incentives are used for technicians, and as a result, about 50 percent of a technican's income is derived from group or individual bonuses.

It should be noted, however, that our field survey shows that whilst the reporting rules for staff workers and technicians are rigid and unambiguous, levels of authority among salespeople are more informal,[5] particularly between levels 1 and 2; and indeed, two different ranks are sometimes categorized at exactly the same level, simply because their numbers are so small. For example, there was only one level 1 specialist in any given year of the entire 10-year data period. This categorization should not, however, affect our results.

Different Transition Paths for Different Workers. Investigating the movement of employees within the ILM is another way of gaining an understanding of the hierarchy from a dynamic perspective. Although, in their sample of managers, Baker, Gibbs, and Holmstrom (1994a) found that demotion rates were rare (less than 0.3 percent), it is, nevertheless, intuitive to think that different types of workers may have different transition paths due to factors such as the time taken to build up firm-specific human capital, or the preciseness of output measurement. Furthermore, demotions may also be used, in effect, to provide incentives. We go on here to use the data set to explore this particular issue.

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[5] That is, the sanctions for not obeying a higher-level salesperson comprise of a mix of peer pressure and institutional punishment.

TABLE 2

A

Transition Matrix between Levels, Salespeople, 1991–2000

		Level in subsequent year						
Old level	Exit	Level 1	Level 2	Level 3	Level 4	Level 5	Total (%)	Sample size
Level 1	32	58	5	3	2	—	100	2163
Level 2	7	18	52	12	11	—	100	243
Level 3	12	11	10	47	19	1	100	224
Level 4	5	—	—	4	85	6	100	444
Level 5	2	—	—	—	2	96	100	186
Total (%)	24	40	8	7	15	6	100	3260

B

Transition Matrix between Levels, Technicians, 1991–2000

		Level in subsequent year					
Old level	Exit	Level 1	Level 2	Level 3	Level 4	Total (%)	Sample size
Level 1	22	75	3	—	—	100	870
Level 2	10	0.5	87	2	0.5	100	874
Level 3	3	—	1	89	7	100	264
Level 4	3	—	—	1	96	100	218
Total (%)	12	18	55	8	7	100	3661

C

Transition Matrix between Levels, Staff Workers, 1991–2000

		Level in subsequent year						
Old level	Exit	Level 1	Level 2	Level 3	Level 4	Level 5	Total (%)	Sample size
Level 1	17	79	3	1	—	—	100	558
Level 2	13	—	78	7	2	—	100	172
Level 3	1	—	—	88	10	1	100	100
Level 4	4	2	—	—	76	17	100	54
Level 5	—	—	—	—	—	100	100	79
Total (%)	12	46	16	11	6	9	100	963

Table 2A–C show the respective transition matrices for the company's three different types of workers between 1991 and 2000. We find that the exit rates for level 1 technicians and staff workers were about 20 percent, while around 75 to 89 percent of these workers remained at the same level in the subsequent year. Promotion rates for these groups were around 3 to 7 percent, while demotion rates were between 0.5 and 2 percent. In line with the Baker, Gibbs, and Holmstrom (1994a) findings, the number of demotions amongst these two types of workers was not large.

The most active and significantly different transition path within the company, in terms of both promotion/demotion rates and exit rates, was found amongst salespeople. The probability of a salesperson at level 1 leaving the company in the subsequent year was 32 percent, as compared to 22 percent for technicians and 17 percent for staff workers. Only 50 percent of salespeople at levels 2 and 3 would remain at the same level in the subsequent year; however, whilst 20 percent would receive promotions, a similar proportion would be demoted, and 10 percent would be likely to leave the company; thus, demotions are clearly not so rare among salespeople. It should also be noted that we calculated the transition rates for those remaining with the firm between the good (1991–1995) and bad (1996–2000) years, and found no differences, which indicates that the firm uses relative, rather than absolute, performance standards to evaluate its employees.[6]

Why do these transition paths differ so much? The simple answer is that the promotion rules are written into the company's personnel books; each salesperson undergoes a review every three months, and his or her level is determined, routinely, on the basis of performance (i.e., the number of cars sold). Thus, if they continually fail to perform well, senior salespeople can quite easily be demoted to level A within six months. The rapid transition rates also indicate that the reporting relationships between salespeople from levels 1 to 3 are more informal than those for other types of workers.

Such personnel policies result in the emergence of an extremely wide-ranging transition path between different types of workers, which gives rise to a very interesting question; i.e., what is the economic intuition behind these rules? In general, promotion serves more than one purpose, since it includes the provision of additional incentives, it sends out signals to third parties, and brings with it on-the-job training, placement, and screening (Waldman 1984); hence the rate of promotion may also be related to these factors. On the provision of incentives, Lazear (1986) highlighted the conditions whereby a firm should use higher power incentive schemes (such as piece rates, as opposed to fixed salaries). The work of a salesperson seems to fall into line with every aspect of this theory; it is easy to measure the salesperson's output; errors in output measurement are extremely low, monitoring costs are high (a deputy manager cannot follow a salesperson every working day); and workers are less homogeneous (selling products to people requires charm, which is sometimes regarded as a talent that cannot be taught). Since higher compensation, including internal and external status,

[6] Since the transition rates did not differ, we do not report them in this study.

usually comes with promotion, a rapid promotion system would provide stronger incentives because the immediate value of the expected return for each car sold would be that much higher. Staff workers, on the other hand, are at the opposite end of the scale; it is extremely difficult to measure their output, both in qualitative and quantitative terms; hence, errors in output measurement will be high. It will therefore take longer to judge such workers' abilities, which inevitably results in a slower promotion/demotion incentive scheme.

To summarize this section, we have aimed to provide an overall definition of jobs and the hierarchy of the company. As the transition matrix shows, most people will stay at the same level in the subsequent year and there are some promotions and demotions, although, with the exception of salespeople, occurrences of the latter are rare. It is, however, clear that transition paths are quite different across different types of workers. Whilst 20 percent of salespeople will experience promotion in the subsequent year, a similar proportion will also experience demotion; this is a direct result of the personnel policies of the company and the special characteristics of the work of its salespeople. Some economic intuition is provided in order to explain this phenomenon, but it may well be that, in the future, a formal model will be required.

Jobs, Levels, and Pay

One of the important features of the Doeringer and Piore (1971) study was that wages in ILMs were determined by an administrative process rather than by the spot market, and hence were attached to jobs or levels. In fact, a number of empirical studies (including Baker, Gibbs, and Holmstrom 1994a,b; Treble et al. 2001; Grund 2002; and Kwon 2002) have found that levels and jobs are strongly correlated to wages. Tournament theory (Lazear and Rosen 1981), scale of operation effects (Rosen 1982), levels as a proxy to sort ability (Gibbs 1995), or inducing human capital (Prendergast 1993) are theories that are often used to explain this phenomenon. Although this evidence seems to support Doeringer and Piore's argument, at the same time, almost every study on ILMs finds that there are substantial pay variations, both within and between levels (Baker, Gibbs, and Holmstrom 1994a; Treble et al. 2001; Grund 2002; Kwon 2002; and Gibbs and Hendrick 2004). If wages are only decided by levels or jobs, then we have clear evidence on ILMs since they are not affected by the conditions of ELMs. Furthermore, if there are variations within and between levels, and these variations vary across different years, then the effects of the spot markets may also be coming into play. However, Gibbs and Hendricks (2004) found that, whilst wage variations existed between levels, the wages of those who were not promoted were, in the long run, attached to their jobs. The following discussion aims to probe these phenomena.

Salaries, Bonuses, and Jobs. Most of the prior studies have used levels to estimate the relationship between hierarchy and compensation; one exception was Seltzer and Merrett (2000), which, using job codes as the unit of analysis, demonstrated that job dummies had an effect on wages. Since we have clear job codes, we can also undertake a direct comparison of the coefficients of job dummies in order to determine whether wages are attached to jobs; the first task here, however, is to adequately define compensation.

The compensation of employees within firms in Taiwan generally comprises of four parts: (1) salaries, which are the basis of all compensation and which are dependent on both the job itself and tenure; (2) performance bonuses, which are dependent on worker performance, based, for example, on the number of items a salesperson can sell; (3) year-end bonuses, which represent the traditional form of bonus schemes in Taiwan, and are paid on December 16 of the lunar calendar—these usually comprise of around one-and-a-half to three months' salary and are adjusted both by tenure and an individual's performance measure for that year; and (4) profit sharing, where 1 or 2 percent of a company's post-tax profits may be distributed to its employees, according to their job levels and seniority; however, this does not usually take place each year.

Although Lazear (1992) and Baker, Gibbs, and Holmstrom (1994a) used only salaries (the fixed element of earnings) as their object for analysis, bonuses are, nevertheless, becoming increasingly important. For example, in the company under examination in this study, 80 percent of the total compensation for a typical salesperson, and 40 to 50 percent of the total compensation for a technician was derived from performance bonuses. This paper therefore uses salaries and bonuses [bonus = (2) + (3) + (4)] as the basic units of analysis for compensation, under the following model specifications:

$$\begin{aligned}\ln(\text{Earnings}_{ijt}) = {} & \beta_0 + \beta_{1j}{*}\text{Job}_{it} + \beta_2{*}\text{Education Dummies}_{ijt} \\ & + \beta_3{*}\text{Male} + \beta_4{*}\text{Tenure} + \beta_5{*}\text{Tenure}^2 + \beta_6{*}\text{Year Dummies} \\ & + \beta_7{*}\text{Performance Dummies (staff workers only)} + E_{ijt} \qquad (1)\end{aligned}$$

where i is the individual; j is the job code dummy; Tenure and its square indicate years worked with the firm; and year dummies are used to exclude the economy-wide shock. This is the Mincer specification used in Baker, Gibbs, and Holmstrom (1994a), Card (1999), Gibbs and Hendricks (2004), and many other papers within the literature. The dependent variables used in this study are compensation, salaries, and bonuses. In order to correct the unobserved time invariant variable bias and serial correlation, we adopt the following employee fixed effects AR(1) model:

$$\ln(\text{Earnings}_{ijt}) = \beta_0 + \beta_{1j}{}^*\text{Job}_{it} + \beta_2{}^*\text{Education Dummies}_{ijt} + \beta_3{}^*\mu_i + \beta_4{}^*\text{Tenure} + \beta_5{}^*\text{Tenure}^2 + \beta_6{}^*\text{Year Dummies} + \beta_7{}^*\text{Performance Dummies (staff workers only)} + E_{ijt} \quad (2)$$

where $E_{ijt} = U_{ijt} + P_i{}^*U_{ij(t-1)}$. Model specification (2) indicates that, in addition to the employee fixed effects μ_i, the error terms of the last period also affect the dependent variable, with the effect of P_i being different for different individuals. The main point of interest here, of course, is to see whether all, β_{1j} should be included in the model (the F value of the exclusion test), and whether, β_{1j} is different across different jobs. The results are shown in Table 3A. Note that the total number of job titles used in the regression is 17, as opposed to the 30 mentioned earlier; this comes as a result of the combination of some of the job titles with very few observations.

The first thing we can see is that the F value of the exclusion test is very large, indicating that job dummies are a valid set of independent variables. Furthermore, almost every coefficient is significant. In the OLS model, for example, based on a comparison with an assistant specialist, the annual total compensation for a level 2 specialist is 29 percent higher, while the total compensation for a level 2 technician is 42 percent higher, and that of a level A salesperson is 62 percent higher. We can also see that the coefficients increase with rank within different types of worker groups. Some of the coefficients in the bonus and salary regressions for the salespeople group are negative, because, in absolute terms, salespeople typically receive very low salaries; by far, the greatest proportion of their compensation (80 percent) is derived from bonuses. Hence, it is possible that in absolute terms, the salary of a level A salesperson could be smaller than that of a staff worker (the comparison group in Table 3A); indeed, the larger number of coefficients in the bonus columns for the sales group confirms this point. To some extent, this corresponds with the point made by Lazear (1998) that the firm "sells the jobs" to its salespeople. We also find that the employee fixed effects AR (1) model produces similar to the OLS estimations, albeit with generally slightly smaller coefficients.

Another interesting approach would be to see whether changes in the overall economic conditions would bring about greater variations in earnings for some jobs than for others. In good years versus bad years, for example, the CEO's bonus may vary significantly more than the bonuses received by other employees. Hence, we run the OLS regressions for 1994 (the highest

TABLE 3A

EFFECTS OF DIFFERENT JOBS ON COMPENSATION, SALARY, AND BONUSES: OLS AND EMPLOYEE FIXED EFFECT WITH AR (1) CORRECTION MODELS

	ln compensation		ln salary		ln bonus	
	OLS	Employee fixed effect + AR (1)	OLS	Employee fixed effect + AR (1)	OLS	Employee fixed effect + AR (1)
Staff workers						
Level 3 specialist	0.18***	0.11***	0.20***	0.18***	0.14***	0.06
	(0.03)	(0.03)	(0.02)	(0.03)	(0.05)	(0.06)
Level 2 specialist	0.35***	0.22***	0.33***	0.29***	0.43***	0.16**
	(0.03)	(0.04)	(0.02)	(0.03)	(0.06)	(0.08)
Deputy Manager (Admin)	0.47***	0.39***	0.49***	0.47***	0.54***	0.38***
	(0.04)	(0.05)	(0.03)	(0.04)	(0.08)	(0.09)
Deputy General Manager (Admin)	0.70***	0.57***	0.69***	0.64***	0.87***	0.67***
	(0.04)	(0.05)	(0.03)	(0.04)	(0.07)	(0.09)
Technicians						
Assistant technician	0.09***	0.07***	–0.06***	–0.04**	0.53***	0.44***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.03)	(0.04)
Level 3 technician	0.29***	0.20***	0.21***	0.18***	0.67***	0.51***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.03)	(0.04)
Level 2 technician	0.48***	0.35***	0.41***	0.35***	0.86***	0.68***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.04)	(0.06)
Shop Chief (Maintenance)	0.62***	0.48***	0.50***	0.45***	1.05***	0.82***
	(0.03)	(0.04)	(0.02)	(0.03)	(0.05)	(0.07)
Salespeople						
Level B salesperson	0.45***	0.44***	–0.20***	–0.20***	1.25***	1.20***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.03)	(0.04)
Level A salesperson	0.69***	0.60***	–0.06***	–0.09***	1.58***	1.40***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.04)	(0.05)
Senior salesperson	0.74***	0.56***	–0.08***	–0.08***	1.72***	1.36***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.05)	(0.05)
Deputy Manager (Sales)	0.93***	0.73***	0.21***	0.15***	1.84***	1.52***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.04)	(0.05)
Deputy General Manager (Area store)	1.01***	0.84***	0.56***	0.47***	1.77***	1.53***
	(0.03)	(0.04)	(0.02)	(0.03)	(0.05)	(0.07)
Executive Level						
Assistant Chief Manager (Sales)	1.15***	0.97***	0.91***	0.77***	1.63***	1.50***
	(0.07)	(0.10)	(0.05)	(0.07)	(0.13)	(0.18)
Assistant Chief Manager (Admin)	1.01***	0.86***	1.03***	0.99***	1.07***	0.83***
	(0.05)	(0.08)	(0.04)	(0.06)	(0.10)	(0.15)
Deputy (Chief) Manager	1.37***	1.25***	1.48***	1.43***	1.40***	1.22***
	(0.06)	(0.09)	(0.05)	(0.06)	(0.11)	(0.17)
CEO	1.76***	1.65***	1.77***	1.72***	1.89***	1.77***
	(0.09)	(0.15)	(0.07)	(0.10)	(0.17)	(0.27)
Male	0.29***	—	0.06***	—	0.53***	—
	(0.01)		(0.01)		(0.02)	
High school	–0.10***	–0.09*	–0.17***	–0.16***	0.01	0.02
	(0.03)	(0.05)	(0.02)	(0.03)	(0.06)	(0.09)

TABLE 3A (cont.)

	In compensation		In salary		In bonus	
	OLS	Employee fixed effect + AR (1)	OLS	Employee fixed effect + AR (1)	OLS	Employee fixed effect + AR (1)
2 years college	–0.14***	–0.12**	–0.20***	–0.19***	–0.03	–0.01
	(0.03)	(0.05)	(0.02)	(0.03)	(0.05)	(0.09)
4 years college	–0.14***	–0.12***	–0.18***	–0.17***	–0.07	–0.05
	(0.03)	(0.05)	(0.02)	(0.03)	(0.05)	(0.09)
Graduate school	–0.13***	–0.09	–0.13***	–0.10***	–0.07	–0.04
	(0.04)	(0.06)	(0.03)	(0.04)	(0.07)	(0.11)
Tenure	0.06***	0.08***	0.08***	0.08***	0.05***	0.06***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.004)	(0.01)
$Tenure^2$	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
Constants	12.55***	12.53***	12.21***	12.17***	11.11***	11.14***
	(0.04)	(0.05)	(0.03)	(0.04)	(0.07)	(0.10)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Obs (Employee-year)	5796	5368	5798	5378	5795	5367
No. of employees		1083		1083		1083
Adjusted R^2	0.6951	—	0.7788	—	0.6290	—
F (Wald) statistics	401.31	6640.36	619.49	11,451.20	298.72	4756.57
(Prob > $F(\times2)$)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Exclusion test for job code dummies: F(OLS) and Wald (AR1) value (Prob > $F(\times2)$)	266.81 (0.0000)	1653.81 (0.0000)	349.06 (0.0000)	2904.56 (0.0000)	305.65 (0.0000)	2033.98 (0.0000)

NOTES: *** indicates significance at the 99% level; ** indicates significance at the 95% level; and * indicates significance at the 90% level. Comparison group includes clerks and specialist assistants of staff workers. The difference in observations between OLS and AR (1) correction is due to the fact that there are people who only stay in the company for 1 year. The AR (1) correction is employee specific, that is, each employee has a different serial correlation structure. An exclusion test is calculated to test whether or not we should include all job dummies into our regression.

sales value, which represents a good year) and 1998 (the lowest sales value, which represents a bad year); the results are presented in Table 3B.

We find that the variations in salary across different jobs, represented by the differences in job-code coefficients between good and bad years, were quite limited. For example, the CEO's coefficients in the salary equations for 1994 and 1998 were 1.86 and 1.64, respectively, indicating a 20 percent decrease. For level 2 technicians, the corresponding numbers were 0.47 and 0.39, indicating a 15 percent drop. There were, however, substantial differences between the good- and bad-year coefficients within the bonus equations. For example, the CEO's coefficients in the 1994 and 1998 bonus equations were 1.33 and 2.84, respectively, indicating a 110 percent increase. For level 2

TABLE 3B

Effects of Different Jobs on Compensation, Salary and Bonuses: OLS Results for "Good Year" (1994) and "Bad Year" (1998)

	ln compensation		ln salary		ln bonus	
	1994	1998	1994	1998	1994	1998
Staff workers						
Level 3 specialist	0.25**	0.17***	0.27***	0.19***	0.25	0.04
	(0.11)	(0.06)	(0.08)	(0.04)	(0.18)	(0.13)
Level 2 specialist	0.46***	0.39***	0.39***	0.34***	0.60***	0.43***
	(0.10)	(0.08)	(0.07)	(0.04)	(0.16)	(0.16)
Deputy Manager (Admin)	0.44	0.49***	0.42***	0.50***	0.54*	0.46**
	(0.17)	(0.06)	(0.12)	(0.06)	(0.28)	(0.23)
Deputy General Manager (Admin)	0.73***	0.78***	0.76***	0.61***	0.70***	1.09***
	(0.29)	(0.11)	(0.07)	(0.06)	(0.17)	(0.21)
Technicians						
Assistant technician	0.03	0.17***	–0.04	–0.02	0.14	0.74***
	(0.06)	(0.05)	(0.04)	(0.03)	(0.09)	(0.10)
Level 3 technician	0.26***	0.27***	0.33***	0.20***	0.30***	0.69***
	(0.06)	(0.04)	(0.04)	(0.02)	(0.09)	(0.09)
Level 2 technician	0.44***	0.49***	0.47***	0.39***	0.51***	0.93***
	(0.08)	(0.06)	(0.06)	(0.03)	(0.13)	(0.12)
Shop Chief (Maintenance)	0.59***	0.65***	0.64***	0.45***	0.65***	1.23***
	(0.10)	(0.07)	(0.07)	(0.04)	(0.15)	(0.13)
Salespeople						
Level B salesperson	0.68***	0.48***	–0.18***	–0.21***	1.24***	1.43***
	(0.05)	(0.04)	(0.04)	(0.02)	(0.09)	(0.09)
Level A salesperson	1.00***	0.63***	–0.06	–0.09***	1.65***	1.58***
	(0.08)	(0.06)	(0.06)	(0.03)	(0.13)	(0.11)
Senior salesperson	1.05***	0.90***	–0.05	–0.11***	1.72***	2.11***
	(0.13)	(0.06)	(0.09)	(0.03)	(0.21)	(0.12)
Deputy Manager (Sales)	0.99***	1.02***	0.28***	0.23***	1.53***	2.11***
	(0.07)	(0.05)	(0.05)	(0.03)	(0.11)	(0.11)
Deputy General Manager (Area store)	1.04***	1.13***	0.72***	0.49***	1.38***	2.19***
	(0.11)	(0.08)	(0.07)	(0.04)	(0.17)	(0.15)
Executive level						
Assistant Chief Manager (Sales)	1.13***	1.13***	1.28***	0.94***	0.95**	1.44***
	(0.29)	(0.19)	(0.20)	(0.10)	(0.46)	(0.37)
Assistant Chief Manager (Admin)	0.82***	1.01***	1.23***	1.04***	1.27***	0.96***
	(0.20)	(0.13)	(0.14)	(0.07)	(0.33)	(0.27)
Deputy (Chief) Manager	1.33***	1.48***	1.55***	1.26***	1.06***	2.10***
	(0.18)	(0.18)	(0.12)	(0.10)	(0.28)	(0.36)
CEO	1.63***	2.03***	1.86***	1.64***	1.33***	2.84***
	(0.29)	(0.26)	(0.20)	(0.14)	(0.46)	(0.51)
Obs (Employee-year)	523	788	523	789	523	788
Adjusted R^2	0.7011	0.7127	0.8046	0.8793	0.6796	0.6716
F statistics (Prob > F)	52.02	82.36	90.56	240.28	47.13	68.06
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Exclusion test for job code dummies: F value (Prob > F)	37.32	50.69	51.14	87.08	43.82	62.92
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Notes: *** indicates significance at the 99% level; ** indicates significance at the 95% level; and * indicates significance at the 90% level. Comparison group includes clerks and specialist assistants of staff workers. All other independent variables are included. An exclusion test is calculated to test whether or not we should include all job dummies into our regression.

technicians, the corresponding numbers were 0.51 and 0.93, indicating a 90 percent increase.

We also found that the variations in the bonus equations were greater for executive-level employees than for lower-level staff workers and salespeople. For example, the 1994 and 1998 Deputy Chief Manager's coefficients for 1994 and 1998 were 1.06 and 2.10, respectively, indicating a 100 percent increase, while the corresponding numbers for senior salespeople were 1.72 and 2.11, indicating a 17 percent increase. To summarize, when economic conditions change, workers experience greater variations in bonuses than salaries, with the greater variations being felt among higher-ranking employees than lower-level staff workers and salespeople. Overall, the evidence points to differences in remuneration for different jobs, irrespective of whether this is measured in terms of total compensation, fixed salaries, or bonuses.

Finally, we also ran a fixed effects AR(1) regression to dispose of the unobserved time invariant variables and to correct any serial correlation errors. The results show that while the coefficients of job titles are still significant, they are significantly weakened. With a change in economic conditions, the greatest variations are felt in terms of bonuses rather than salaries, with higher-ranking employees experiencing greater variations than lower-level staff workers and salespeople. The variation is also greater in the bonus equations than in the salary equations; we shall explore this issue later, together with the equation results for different worker levels.

Correlation between Salaries, Bonus, and Levels. In order to further investigate the relationship between pay and hierarchy, we categorize job codes into level variables and run:

$$\begin{aligned}\ln(\text{Salary}(\text{Bonus})_{ijt}) = {} & \beta_0 + \beta_{1j}{*}\text{Level}_{it} + \beta_2{*}\text{Education Dummies}_{ijt} \\ & + \beta_3{*}\text{Male} + \beta_4{*}\text{Tenure} + \beta_5{*}\text{Tenure}^2 + \beta_6{*}\text{Year Dummies} \\ & + \beta_7{*}\text{Type Dummies} + \beta_8{*}\text{Performance Dummies} \\ & (\text{staff workers only}) + E_{ijt} \qquad (3)\end{aligned}$$

The compensation regression results for the different specifications are presented in Table 4. The procedure and the results here are basically the same as those presented in Table 3A and in equations (1) and (2), with the exception that the job dummies are now replaced by level dummies. The employee fixed effects AR (1) model results (with employee-specific error term structure) are also reported, with the findings indicating that levels are positively correlated to compensation across different specifications, and that the coefficient of the employee fixed effects AR (1) model is again, positive, albeit smaller. The results and conclusions drawn are thus similar

TABLE 4

Effects of Human Capital and Hierarchical Levels on Compensation, 1991–2000

	Human capital (1)	Level effects (2)	Combined effects (3)	Employee fixed effect with AR (1) correction (4)
Level 2	—	0.24***	0.19***	0.12***
		(0.01)	(0.01)	(0.01)
Level 3	—	0.48***	0.34***	0.17***
		(0.01)	(0.01)	(0.02)
Level 4	—	0.67***	0.49***	0.32***
		(0.01)	(0.01)	(0.02)
Level 5	—	0.86***	0.60***	0.44***
		(0.02)	(0.02)	(0.03)
Level 6	—	1.14***	0.89***	0.70***
		(0.04)	(0.04)	(0.06)
Level 7	—	1.54***	1.35***	1.20***
		(0.06)	(0.06)	(0.09)
Level 8	—	1.90***	1.73***	1.60***
		(0.09)	(0.09)	(0.15)
Male	0.48***	0.24***	0.30***	—
	(0.01)	(0.01)	(0.01)	
High school	–0.03	—	–0.10***	–0.09*
	(0.04)		(0.03)	(0.05)
2 Years college	–0.10***	—	–0.13***	–0.11**
	(0.03)		(0.03)	(0.05)
4 Years college	–0.08**	—	–0.14***	–0.11**
	(0.03)		(0.03)	(0.05)
Graduate school	0.22***	—	–0.11***	–0.06
	(0.04)		(0.04)	(0.06)
Tenure	0.12***	—	0.06***	0.08***
	(0.002)		(0.002)	(0.003)
Tenure^2	–0.002***	—	–0.001***	–0.001***
	(0.0000)		(0.0000)	(0.0001)
Type I	0.40***	0.42***	0.43***	0.41***
	(0.01)	(0.01)	(0.01)	(0.02)
Type II	0.05***	0.10***	0.09***	0.07***
	(0.01)	(0.01)	(0.01)	(0.02)
Constant	12.46***	12.57***	12.56***	12.52***
	(0.04)	(0.02)	(0.04)	(0.05)
Obs	5798	5802	5794	5366
Adjusted R^2	0.5823	0.6534	0.6928	
Year dummy	Yes	Yes	Yes	Yes
F (Wald) statistics	449.94	576.57	523.68	6486.64
(Prob > $F(\times 2)$)	(0.00)	(0.00)	(0.00)	(0.00)

Notes: Type I: Sales, output-based incentive group; Type II: shop technicians, medium incentive group; Type III: staff workers, input-based incentive group. "Type" coefficients are estimated in Table 4, as opposed to being precise measures, which means that workers will routinely change from one type to another. *** indicates significance at the 99% level; ** indicates significance at the 95% level, * indicates significance at the 90% level.

to those in Table 3A. One phenomenon, which also occurs in Table 3A, is the small, but negative, effect of education. This non-intuitive result may be due to some of the education coefficients being obtained after controlling for levels. If education is positively related to levels (that is, education affects wages mainly through levels), we may detect an insignificant, or even negative, effect of education on earnings.

Running all workers and pay within one regression has its advantages, since all workers come under one general personnel rule; however, since this company has three types of workers, one might argue that there are actually three sub-ILMs within our data set. It may also be useful to check whether different levels have different effects on salaries and bonuses. Here we use "log bonus" and "log salary" as the dependent variables, and separate the samples by the different types of workers. The specifications include OLS estimations and the employee fixed effects model with AR(1) corrections, in similar vein to equation (3). The results are presented in Table 5.

For the purpose of brevity, we report only the coefficients of levels, although all the other independent variables are included. We find that when using the employee fixed effects model with AR(1) corrections, both the salary and bonus equations for salespeople and technician levels have a positive but smaller effect than the OLS model. The results for staff workers are also similar; however, the positive relationship between levels and bonuses is weakened. These results are basically consistent with the Eriksson (1999) and Seltzer and Merrett (2000) findings, and can be interpreted from the perspective of individual heterogeneity; higher-level employees were paid more due to both their higher abilities and the policy of attaching higher wages to higher levels.

We also arrive at the same conclusion with the employee fixed effects AR(1) model with job codes as the independent variables (Table 3A), and total compensation as the dependent variables (Table 4). The reduced effect brought about by adding in the individual fixed effects is, however, greater in the bonus equations than in the salary equations. The salary of a level 3 technician, for example, is 47 percent higher than a level 1 worker in the OLS (combined) model, but only 11 percent higher in the fixed effects model; however, in the bonus equation, the same employee earns 47 percent more in the OLS model, but only 6 percent more (which is, in fact, insignificant) in the fixed effects model.

For staff workers, however, after controlling for human capital variables or after using the fixed effects AR(1) models, explanatory power seems strong only at the higher levels. Overall, this suggests that cross-sectional variations between salaries for different levels cannot be explained by the predetermined differences between them, at least for staff workers, which

TABLE 5

EFFECTS OF HIERARCHICAL LEVELS ON SALARY AND BONUS, BY WORKER TYPE

	OLS combined	Employee fixed effect	Employee fixed effect +AR (1)	OLS combined	Employee fixed effect	Employee fixed effect +AR (1)
Salespeople						
Level 2	0.12***	0.08***	0.08***	0.31***	0.11***	0.12***
	(0.02)	(0.01)	(0.01)	(0.04)	(0.04)	(0.03)
Level 3	0.08***	0.10***	0.10***	0.49***	0.07*	0.05
	(0.02)	(0.01)	(0.01)	(0.05)	(0.04)	(0.03)
Level 4	0.36***	0.31***	0.30***	0.60***	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.04)	(0.01)	(0.04)
Level 5	0.69***	0.39***	0.38***	0.55***	0.03	0.02
	(0.02)	(0.02)	(0.02)	(0.06)	(0.07)	(0.06)
Obs (Employee-year)	2167	2167	1942	2167	2167	1942
No. of employees	—	447	439	—	447	439
Adjusted R^2	0.7778	0.7514		0.5066	0.2746	
F (Wald) statistics	399.94	323.12	21193	118.03	332	11,266
(Prob > $F(\times 2)$)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Technicians						
Level 2	0.29***	0.05*	0.04*	0.26***	0.03	0.03
	(0.01)	(0.03)	(0.02)	(0.02)	(0.05)	(0.04)
Level 3	0.47***	0.13***	0.11***	0.47***	0.05	0.06
	(0.02)	(0.03)	(0.03)	(0.04)	(0.06)	(0.05)
Level 4	0.55***	0.19***	0.19***	0.63***	0.17***	0.17***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.07)	(0.06)
Obs (Employee-year)	2828	2828	2694	2826	2826	2694
No. of employees	—	538	535	—	538	535
Adjusted R^2	0.6393	0.5777		0.4023	0.3530	
F (Wald) statistics	261.95	209.66	20,525	101.09	83.54	10,401
(Prob > $F(\times 2)$)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Staff workers						
Level 2	0.06**	0.05	0.01	–0.03	0.01	–0.09
	(0.02)	(0.03)	(0.03)	(0.05)	(0.07)	(0.06)
Level 3	0.09***	0.07*	0.05	0.14**	–0.08*	–0.13*
	(0.03)	(0.04)	(0.04)	(0.07)	(0.07)	(0.08)
Level 4	0.14***	0.15***	0.15***	0.15*	–0.10	–0.11
	(0.04)	(0.04)	(0.04)	(0.09)	(0.07)	(0.09)
Level 5	0.30***	0.15***	0.20***	0.27***	0.20**	0.18**
	(0.04)	(0.05)	(0.05)	(0.09)	(0.11)	(0.08)
Obs (Employee-year)	693	693	643	693	693	643
No. of employees	—	145	146	—	145	146
Adjusted R^2	0.7319	0.5422		0.6406	0.5173	
F (Wald) statistics	83.14	34.21	13,696	54.55	31.21	6674.02
(Prob > $F(\times 2)$)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

NOTES: *** indicates significance at the 99% level; ** indicates significance at the 95% level, and * indicates significance at the 90% level. The comparison group is level. All the regressions include human capital variables and year dummies. Performance ratings are included in the staff workers' regression; however, the results with and without performance rates as independent variables are similar.

TABLE 6

COMPARISON BETWEEN PROMOTION PREMIUM AND DIFFERENCE IN MEAN WAGES BETWEEN ADJACENT LEVELS 1 TO 4

	Salespeople		Technicians		Staff workers	
	Salary	Bonus	Salary	Bonus	Salary	Bonus
Level 1 Average	166	380	199	133	214	81
Average of last year as Level 1	166	510	213	139	226	97
Average of first year as Level 2	192	604	232	153	241	100
Level 2 Average	204	508	282	200	284	104
Average of last year as Level 2	192	652	319	224	299	185
Average of first year as Level 3	204	567	334	263	329	218
Level difference>	38 > 26	128 > 94	83 > 19	67 > 14	70 > 15	23 > 3
Promotion premium?	Yes	Yes	Yes	Yes	Yes	Yes
Level 3 Average	210	523	376	257	351	179
Average of last year as Level 3	215	617	379	293	331	143
Average of first year as Level 4	288	667	413	288	412	198
Level difference>	6 < 12	15 > –85	83 > 19	57 > 39	67 > 30	75 > 33
Promotion premium?	No	Yes	Yes	Yes	Yes	Yes
Level 4 Average	314	668	448	324	404	188
Level difference>	104 > 73	145 > 50	72 > 34	67 > –5	55 > –6	9 < 55
Promotion premium?	Yes	Yes	Yes	Yes	Yes	No

NOTE: *The unit is NT$1000.

contradicts the argument of Dorengier and Piore (1971) that "wages are attached to jobs or levels." It is also clear that human capital theory has its own role to play in the wage regressions.

When the fixed effects model is used, the effects of levels can only be identified by those moving up or down within the hierarchy; the reduction of the effects of levels from the OLS model to the fixed effects model (presented in Tables 3A, 4, and 5) is also consistent with the finding that pay increases based on promotion are smaller than the average differences in pay between levels, one of the ten core questions on ILMs for which, according to Gibbons (1997), empirical researchers should provide evidence. In order to investigate this argument more directly, we can simply compare the average growth in wages, based on promotion, to the differences in mean wages for adjacent levels.

Table 6 presents the promotion premium and the mean wage difference between levels across the different types of workers. We can see, for example, that the average level 1 salesperson earns a salary of NT$166,000, which is the same as the previous year's salary for a level 1 salesperson; however, in his first year as a level 2 salesperson, his salary would raise to NT$192,000, despite the average salary for a level 2 salesperson being NT$204,000. We can see, therefore, that the promotion premium (26) within a salesperson's salary, is less than the average difference between adjacent levels (38); indeed, of the 18 comparisons calculated, 16 support this claim.

Our data support the argument that pay increases based on promotion are smaller than the average difference in pay between levels. This result is as predicted by the Gibbons and Waldman (1999a) study, which developed a model to integrate job assignments, human capital acquisition, and learning. Promotion, in their model, came from the accumulation of effective ability. In the case of full information or symmetric learning, the average higher-level workers, who were much older, had accumulated much more human capital than lower-level workers. Their model also implied that unobserved talent was positively correlated with job levels, with the more talented workers invariably ending up in the higher job levels. Nevertheless, promotion could only capture "one year of the wage difference"; hence the difference in average wages between two adjacent levels was greater than the average wage increase based on promotion.

The evidence presented here, which distinguishes between salaries and bonuses, sheds new light on these issues; indeed, the evidence presented on the differences between salaries and bonuses essentially suggests that, largely as a result of administrative rules, salaries are more rigid than bonuses. Presumably, bonuses are more likely to reflect short-term incentives or product market considerations, whereas salaries are more likely to reflect long-term considerations, such as a worker's accumulated effective ability.

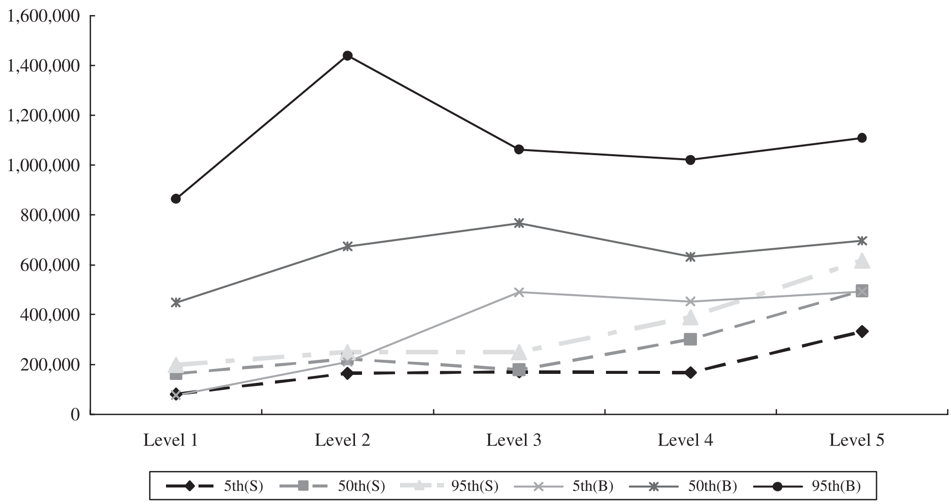
As mentioned earlier, variations within and between levels are also important in testing the hypothesis that "wages are attached to jobs." In order to determine whether there are actually wage variations within and between levels, and whether these variations are different across different types and years, we plot the 5th, 50th, and 95th percentile salaries and bonuses of salespeople, technicians, and staff workers, by levels, for the years 1995 and 2000. Figure 3A–F illustrate these results. The immediate impression gained is of a positive correlation between salaries (the dotted lines) and levels, with the one exception of the medium salary figure for level 2 to level 3 salespeople in 1995. As to bonuses, the relationship is generally positive, with the occasional odd deviation (for example, the drop in bonuses between levels 3 and 4, but only for the 95th percentile of staff worker in 2000). These features, shown by the raw data, are consistent with the regression results.

Variations Within and Between Levels. As to the variation within and between levels, we can see that salaries and bonuses both have some degree of variation

FIGURE 3

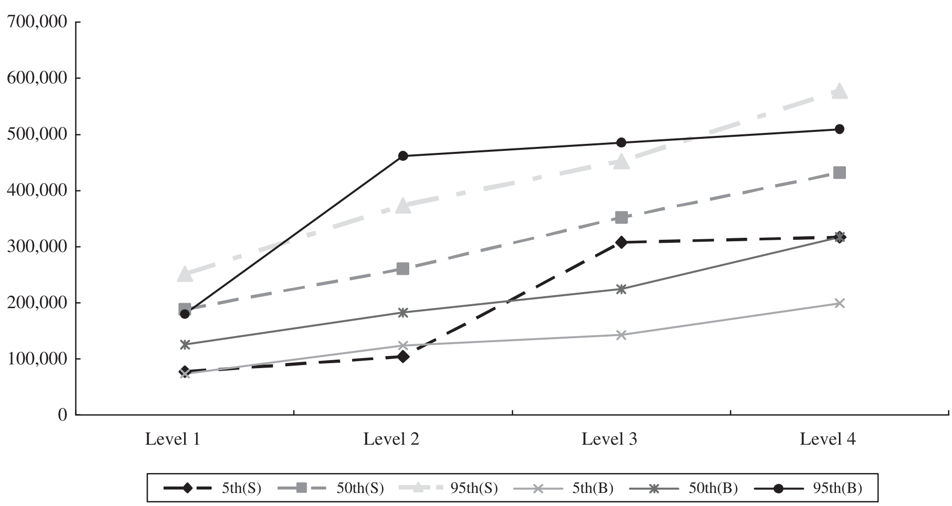
A

Fifth, Fiftieth, and Ninety-fifth Salaries and Bonuses for Salespeople, 1995



B

Fifth, Fiftieth, and Ninety-fifth Salaries and Bonuses for Technicians, 1995

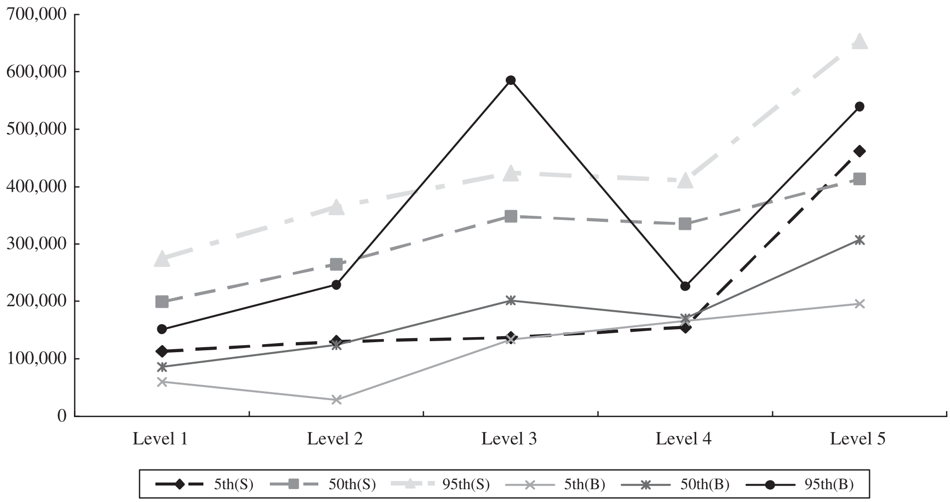


across both years and types of workers. For example, in 2000, the salary range between the 5th percentile and the 95th percentile for salespeople at levels 2 and 3 were almost identical. The salary level at the 95th percentile for a level 2 salesperson is about 50 percent higher than his 5th percentile

FIGURE 3 (cont.)

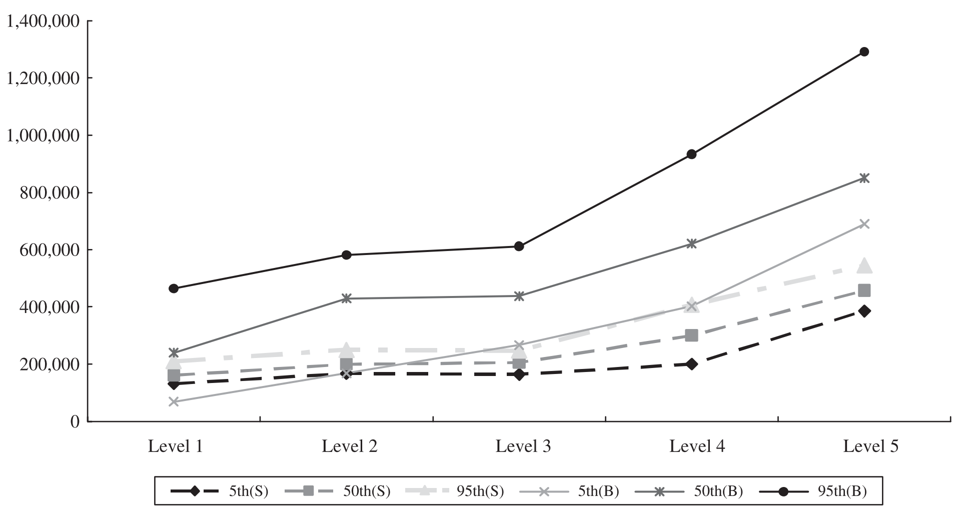
C

FIFTH, FIFTIETH, AND NINETY-FIFTH SALARIES AND BONUSES FOR STAFF WORKERS, 1995



D

FIFTH, FIFTIETH, AND NINETY-FIFTH SALARIES AND BONUSES FOR SALESPEOPLE, 2000

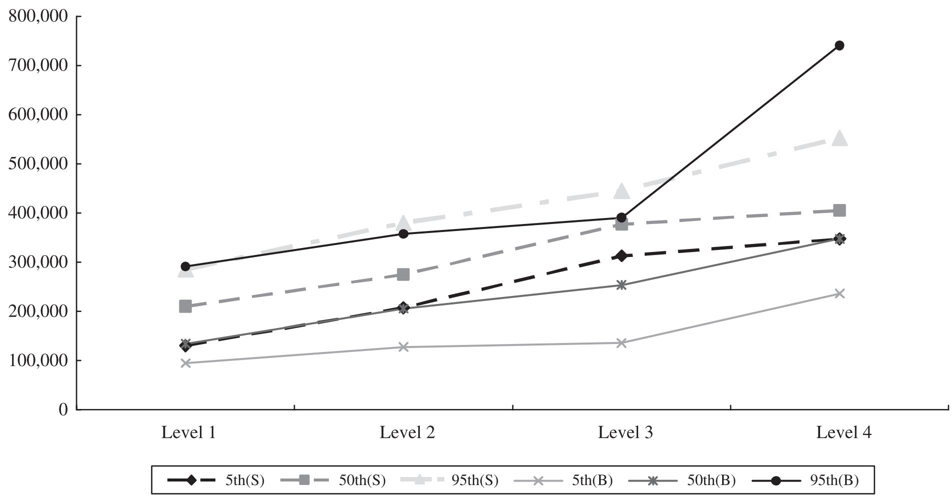


colleague. In 1995, the salary and bonuses for a 50th percentile level 3 staff worker were even greater than those of a corresponding counterpart at level 4.

For most cases, however, a 95th percentile lower-level worker earns more than an upper-level 50th percentile worker, while the salary and bonuses of

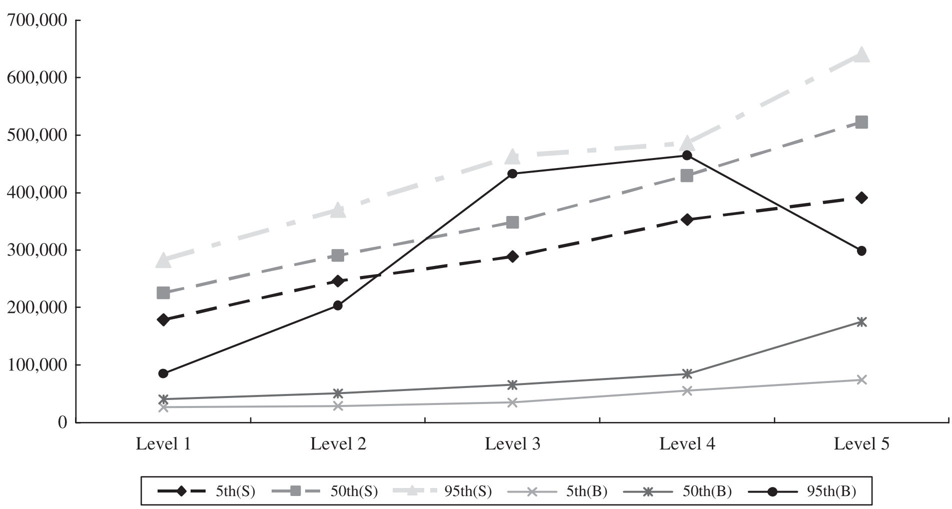
E

FIFTH, FIFTIETH, AND NINETY-FIFTH SALARIES AND BONUSES FOR TECHNICIANS, 2000



F

FIFTH, FIFTIETH, AND NINETY-FIFTH SALARIES AND BONUSES FOR STAFF WORKERS, 2000



95th percentile workers are also around 50 percent to 200 percent greater than their 5th percentile colleagues at the same level. We can also find that the variations in bonuses, both within and between levels, are significantly greater than those of salaries across different years, different type of workers,

TABLE 7

COEFFICIENT OF VARIATION*IN SALARIES AND BONUSES BY LEVEL AND TYPE OF WORKERS, 1995 AND 2000

		Salespeople		Technicians		Staff workers	
		Salary	Bonus	Salary	Bonus	Salary	Bonus
1995	Level 1	0.04	0.28	0.09	0.08	0.06	0.27
2000	Level 1	0.02	0.25	0.04	0.16	0.03	0.35
1995	Level 2	0.02	0.21	0.11	0.28	0.07	0.17
2000	Level 2	0.01	0.10	0.04	0.13	0.02	0.54
1995	Level 3	0.04	0.07	0.03	0.16	0.07	0.28
2000	Level 3	0.01	0.05	0.01	0.06	0.03	1.21
1995	Level 4	0.09	0.07	0.04	0.14	0.12	0.02
2000	Level 4	0.05	0.07	0.02	0.15	0.02	0.82

NOTE: *Coefficient of variation = standard/mean.

or different levels. We can therefore argue that variations within and between levels do exist, and that these are greater for bonuses than for salaries.

A further interesting method of approach, with regard to verifying the existence of ILMs, would be to compare the scale of the variations between years of positive growth and years of decline; this is undertaken by investigating the ways in which external economic conditions have an effect upon wage policies within the firm. We use here, as a normalized standard, the coefficient of variance (CV), which is equal to standard divided by mean, in order to compare the amount of variation across levels, pay variables and different types of workers. Table 7 tabulates the results. Across the same types of workers, levels and pay variables, we find a persistent pattern of CVs in 2000 (a year of decline) being smaller than in 1995 (a growth year). For example, the CV for bonuses for a level 2 salesperson in 1995 is 0.21, but in 2000, the number falls to 0.10. We also see that the CV for salaries for a level 2 staff worker in 1995 was 0.07, but in 2000, the number falls to 0.02, representing a 70 percent drop.

The only exception is the comparison of bonuses for staff workers. Hence, the firm does undertake adjustments to its salary and bonus structures, for any given levels and types of workers, in response to changes in external conditions. This corresponds with the results of the “implicit contract story” in Beaudry and DiNardo (1991). Furthermore, the size of the CV for bonuses is greater than that for salaries across different levels and types of workers, similar to the findings of Gibbs and Hendricks (2004), and consistent with our findings presented in Figure 3A–F. It seems, therefore, that market demand, and hence external market conditions, do impact upon the ILM through both salaries and bonuses, and that bonuses are more sensitive in their response than salaries. The whole picture suggests that, at least in this firm, workers are not completely shielded by the ILMs, and that the level of such shielding is different across different market conditions and pay variables.

We find that the overall effects on the salary and bonus equations, for both jobs and levels, are positive and smaller under a fixed effects model than under an OLS (combined) model; however, when adding in the individual fixed effects, the reductions are greater in the bonus equations than in the salary equations. The latter result, together with a direct calculation of the promotion premium and the mean wage difference in adjacent levels, provides support for one of the "ten core questions" posed by Gibbons (1997) that pay increases based on promotion are smaller than the average differences in pay between different levels. Wage variations do exist, both within and between levels, and they are larger for bonuses than for salaries. Furthermore, the variations in both salaries and bonuses, defined by the coeffficient variations, are greater in those years when demand is high than in those years when demand is low. The last of these findings is new to the literature and may require further theoretical investigation in the future.

Ports of Entry and Exit

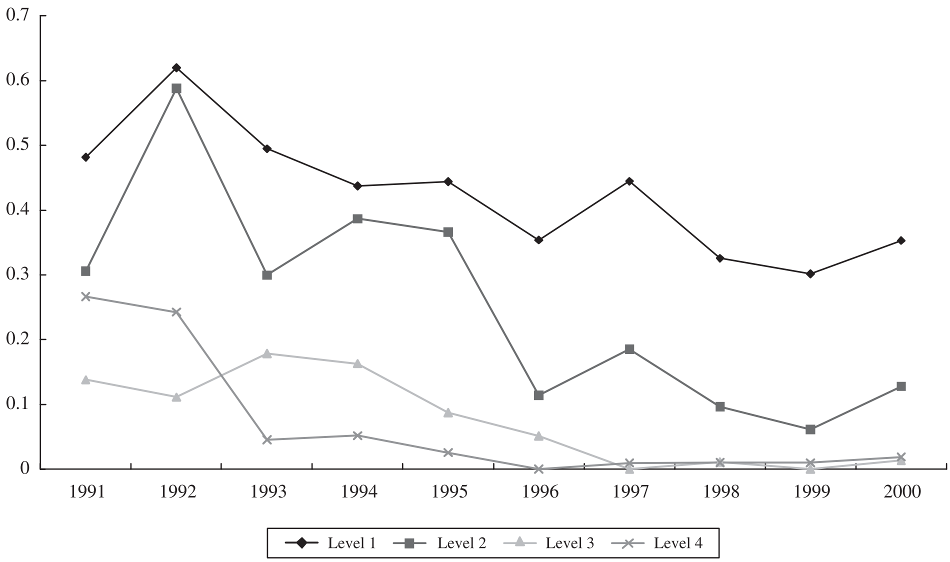
According to Doeringer and Piore (1971), workers enter or leave a firm through ports of entry and exit, with incumbents having priority with regard to internal promotion,[7] and indeed, this is an important element with regard to providing support for the existence of ILMs. It may be that job matching and learning theories can also provide support for this statement. Jovanovic (1979a) found that a worker's inherent abilities are revealed in gradual steps, over time; hence a "stayer" realizes that there is no need to quit and to have to start looking once again for another match. Jovanovic (1979b) found that if the information revealed about a worker was sufficiently positive, the worker would invest a greater amount of firm-specific human capital into the company, and thus, would succeed in gaining promotion; if the reverse was true, the worker would leave. Both models imply that high frequency matching (entry and exit) should occur in the lower levels of the firm since opportunities for leaving at a higher level are

[7] An extreme example would be the Army.

FIGURE 4

A

RATES FOR NEWLY HIRED EMPLOYEES, LEVELS 1–4, 1991–2000



smaller. Becker's specific human capital theory can also be used here. If the human capital possessed by workers is rather general in nature, then the cost of leaving will be small, even though they may be in the higher levels of the company. Hence ports of entry should exist when human capital is more firm specific. Baker et al. (1994a) and Hamilton and MacKinnon (2001) each interpreted their finding on the basis of this argument.

We therefore examine, in this section, whether these issues are apparent within our data set, with Figure 4A–B providing details of the firm's new hiring rates and the exit rates for all employees, by levels and years. Two properties are immediately clear. First, there are occurrences of entry and exit in all four levels investigated. Second, levels are, in general, negatively associated with entry and exit rates. Overall, from 1993 to 2000, the new hiring rates went from 50 percent to 30 percent for level 1, from 40 percent to 12 percent for level 2, from 20 percent to 2 percent for level 3, and from 5 percent to 2 percent for level 4. The same pattern is also discernible in the figures for exit rates. Between 1994 and 2000, the exit rate was around 30 percent to 40 percent for level 1, and around 20 to 25 percent lower than the new hiring rate for level 2, at around 10 to 15 percent. The exit rate was around 5 percent to 10 percent for levels 3 and 4, quite a bit higher than the new hiring rate.

B

Exit Rates, Levels 1–4, 1991–2000

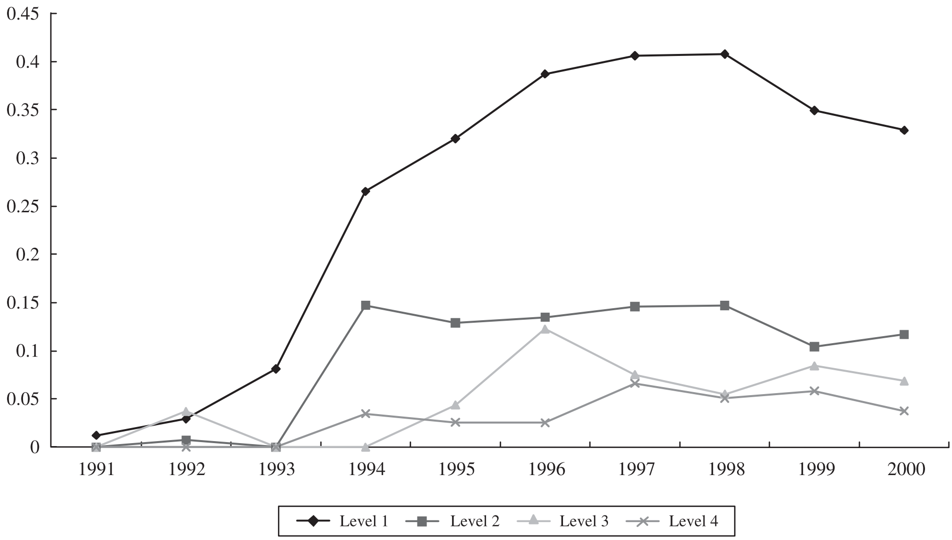


TABLE 8

Average Entry and Exit Rates, by Level and Type of Workers, 1991–2000

		Entry rate			Exit rate		
Type of worker	Level	1991–1995 (growth)	1996–2000 (decline)	10-year average	1991–1995	1996–2000	10-year average
Salespeople	1	0.54	0.40	0.47	0.15	0.44	0.30
	2	0.05	0.09	0.07	0.12	0.14	0.08
	3	0.20	0.03	0.12	0.05	0.14	0.09
Technicians	1	0.45	0.10	0.27	0.14	0.24	0.19
	2	0.42	0.12	0.26	0.06	0.13	0.09
	3	0.08	—	0.04	0.01	0.04	0.03
Staff workers	1	0.41	0.15	0.28	0.10	0.20	0.15
	2	0.38	0.14	0.26	0.07	0.17	0.12
	3	0.11	—	0.06	—	0.02	0.01

The existence of entry and exit ports can be further investigated across the three subsamples. Table 8 provides the entry and exit rates, recorded by years and types of workers, for the two periods, 1991–1995 (growth) and 1996–2000 (decline). The first impression is that entry and exit occurs in levels 1 to 3 across different types of workers; however, for technicians and staff workers, entry and exit rates decrease with levels. For example, the respective entry rates for technicians at levels 1, 2, and 3 were 0.27, 0.26, and 0.04, while their exit rates were 0.19, 0.09, and 0.03. The respective entry rates for staff workers at levels 1, 2, and 3 were 0.28, 0.26, and 0.06, while their exit rates were 0.15, 0.12, and 0.01. This can be explained by both learning and matching theory and human capital theory; higher-level workers are either better matched to the firm, or, as time goes by, they simply gain more firm-specific human capital. We also find higher entry and exit rates for salespeople at level 1; however, the entry and exit rates for these workers are greater at level 3 than at level 2.

To summarize, in this section we have argued that although entry and exit is observed at all levels, it is more likely to occur in the lower levels of the hierarchy for all three types of workers. This suggests that with an increase in levels, workers represent a good match with the firm, and possess more firm-specific human capital.

The Existence of the Cohort Effect

As pointed out in Mason and Fienberg (1985), cohorts are categorized by their idiosyncratic life experiences, in terms of, say, labor market or educational experiences. The use of cohorts refers to "groups defined by a point of entry into the social system." Those belonging to a large cohort or those entering university after the 1968 student movement, for example, are expected to be different from other cohorts. The cohort effect also plays an important role in the context of the ILM, and is again categorized as one of the "ten core questions" by Gibbons (1997).

According to Gibbs and Hendricks (2004), one of the most fundamental debates in the literature on ILMs is whether personnel policies have any real effect or whether they are just a "veil" through which the pressures of the external labor market act relatively unimpeded. In order to distinguish this issue, one needs to investigate the ways in which the ILM conditions, or the spot labor market conditions, affect workers' wages. Such an analysis should involve individual-level data, rather than aggregate-level data, in order to avoid any potential bias resulting from changes in the composition of the workforce.

The economic intuition justifying the existence of the cohort effect in ILMs is evident in two studies. First, Beaudry and DiNardo (1991) argued that, starting from the time of a worker's entry and under the assumption of simple implicit contracts, the history of the market conditions (whether these be market wages or unemployment rates) would maintain its effect, because that was the point when the employees and the employer signed their contract. There would, therefore, be a cohort effect in existence. If it was the spot market condition that dictated the employee's wages through the veil of the ILMs, then the cohort effect would not exist. Second, an alternative theoretical justification for the existence of the cohort effect can be seen in Gibbons and Waldman (2003) where they extended their earlier model (Gibbons and Waldman 1999a) by the addition of two further assumptions: first, that the economy can be good or bad, and second, that human capital is task specific, rather than firm specific, with some element of a worker's acquired human capital going underutilized at the time of their promotion.[8] They argued that "a cohort hired in a bad state has low average wages years later . . . [this] is because the proportions of workers who start at low level jobs will affect the numbers, and productivity, of workers in high level jobs, years later." What is even more interesting is that the model does not need to assume friction, as in the Beaudry and DiNardo (1991) study, since it works even under a spot market setup.

The prior empirical literature also provides support for the existence of the cohort effect. Using unemployment rates as the key factor in the cohort effect, Beaudry and DiNardo (1991) found that prior market conditions, together with current market conditions, also affected current wages, and thereby the implicit contract theory; hence, providing support for the cohort effect. Baker et al. (1994b) used cohort effect dummies to determine all of the relevant variables that would affect wages through the unique cohort experience and found that the cohort effect was highly nonlinear "as it should be, if it reflects external labor conditions." More recent studies (including Kwon 2002; and Gibbs and Hendricks 2004) have also investigated the cohort effect, and indeed, our aim in this paper is to reveal a much clearer picture of the existence of the cohort effect since our data set contains two pay variables for three different types of workers. Note that we focus on identifying the importance of the entire cohort dummies as a set of wage determinants, rather than the significance of any single coefficient, for reasons that we will explain later.

In order to investigate the existence of the cohort effect, we begin by modifying equation (3), simply by the addition of cohort dummies, and by replacing tenure within the firm, and its square, by tenure dummies:[9]

[8] Task-specific human capital is, as suggested, specific to the task being performed. This is also closely related to Adam Smith's idea that "learning by doing" at the level of the task is an important source of increased productivity.

[9] Our emphasis in this section is purely on the existence of the cohort effect, *per se*; we do not try to distinguish which model fits the data better.

$$\ln(\text{Salary(Bonus)}_{ijt}) = \beta_0 + \beta_{1j}\text{*Level}_{it} + \beta_2\text{*Education Dummies}_{ijt} + \beta_3\text{*Male} + \beta_4\text{*Tenure dummies} + \beta_5\text{*Cohort Dummies} + \beta_6\text{*Year Dummies} + \beta_7\text{*Type Dummies} + E_{ijt} \quad (4)$$

Theoretically, β_4, β_5, and β_6, respectively, represent the effects of human capital, particular cohort experience, and economic shock. Our interest would presumably rely upon the interpretation of β_5; however, as pointed out by Mason and Frienberg (1985), Heckman and Robb (1985), and Baker et al. (1994b), this specification is actually the famous Cohort-Tenure-Year (CTY) problem. While the use of tenure, cohort, and year can exist independently, since tenure (3 years in the firm) = year (2000) – cohort (entering in 1997), it therefore produces an exact linear relationship between the three. In consequence, no unique solution can exist for the OLS estimations; that is, there are many sets of, β_4, β_5, and β_6 that solve the equations, therefore, any individual interpretation of any β_5 would be meaningless. Without further restrictions, it is impossible to separate the effects of cohort, tenure, and year; we therefore refrain from identifying the individual coefficients here.

Fortunately, however, the CTY problem can be mitigated, if not solved, by various strategies. In this section, we will apply several of the techniques presented in the earlier literature to tackle the CTY problem. Note that six different matches of worker types and pay will be regressed for each of these methods.

The first solution involves verification only of the existence of the individual coefficient, rather than attempting to assess its economic significance. Indeed, it has been argued that, even without determining the ultimate solution, important conclusions can still be drawn, since "the question is whether or not we can reject the null hypothesis that all cohort effects are zero" (Baker et al. 1994b, p. 935). Using this strategy, and after controlling for tenure and year effects stemming from the high F statistics of the exclusion test, both Baker et al. (1994b) and Gibbs and Hendrick (2004) found that the addition of a cohort dummy into the regression significantly affected salaries over time. Thus, both studies verified the importance of the cohort effect. However, a limit to this approach is that the cohort coefficient patterns may be of some interest, since they may be related to business cycle variables.

The second strategy for a solution to the CTY problem was suggested by Mason and Fienberg (1985), and involved limiting any one of the three parameters to zero. A significant number of the earlier studies have assumed that only two of the three variables will affect the outcome (e.g., Glenn and Davis 1988; Glenn 1994). Kennedy (2003) also suggested that one way of solving the problem of multicollinearity was to drop one set of variables since, by so doing, we can obtain meaningful economic cohort coefficients. However, this process should be based on theoretical reasoning, not data. Since human capital theory predicts that working experience leads to increases in both productivity and wages (factors that have been widely verified empirically), and since the cohort effect coefficients are the estimates on which we are concentrating here, dropping the year dummies is our only choice; that is, our test will compare whether, after controlling for all observables, workers with the same numbers of years tenure, but entering the firm at different times, earn different wages.

The third strategy involves breaking down linear independence simply by assuming a nonlinear functional form of tenure. In order to check for sensitivity, we use the square, cubic, and quartic of tenure within the regressions. As Baker et al. (1994b) demonstrated, we can also compare those regressions that use different functional forms of tenure against those regressions that use tenure dummies, to determine whether or not tenure has a linear or quartic effect on wages.

The 30 regressions presented in Table 9A–C provide the results of the three strategies outlined earlier. We now use the salary regressions on salespeople as an example to illustrate our test procedure, first, running equation (4) with and without cohort dummies (specifications a and b), and then using the exclusion test to see whether the cohort effect should be included within the regressions. The F statistic obtained by testing specification (b) against specification (a) is 24.34, indicating that the cohort dummies as a whole represent significant determinants of the salary of a salesperson. This is the procedure for the first of the three strategies mentioned above.

For the second strategy, specification (c) is the same as (a), except that the tenure dummies are now replaced by a linear tenure variable. The F statistic of specification (c) tested against (a) is 2.38, which suggest that the tenure effect is not linear.[10]

For the third strategy, we again use equation (4), this time replacing the tenure dummies with tenure square, cubic, and quartic, so as to avoid the identification problem in specification (d). We find that four out of the eleven cohort coefficients are significant.[11] However, one might argue that the significance of the cohort dummies comes merely from the arbitrary selection of the comparison group; therefore, we also report the cohort dummy exclusion F test value (= 24.51), which again supports the existence

[10] A test to determine whether or not the tenure effect was linear was also reported in Baker et al. (1994b); 3rd last line of p. 935.

[11] These coefficients are also highly nonlinear, just as Baker et al. (1994b) argued.

TABLE 9

A

Cohort, Tenure, and Year Effects on Salaries and Bonuses for Salespeople (N = 2167)

	ln(Salary)					ln(Bonus)				
	(a)	(b)	(c)	(d)	(e)	(a)	(b)	(c)	(d)	(e)
Tenure			0.08***		0.10***			0.03***		−0.08***
			(0.002)		(0.01)			(0.01)		(0.02)
Tenure square				0.03***	0.003***				−0.01	0.005**
				(0.01)	(0.001)				(0.01)	(0.002)
Tenure cubic				−0.003**					−0.0004	
				(0.001)					(0.002)	
Tenure quartic				0.0001**					0.0001	
				(0.0000)					(0.0001)	
Tenure dummies	Yes	Yes	No	No	No	Yes	Yes	No	No	No
Cohort 1988		0.45***		0.42***	0.25***		0.07		0.26	0.01
		(0.10)		(0.09)	(0.03)		(0.27)		(0.26)	(0.07)
Cohort 1989		0.27***		0.24***	0.09***		−0.02		0.15	−0.07
		(0.08)		(0.08)	(0.03)		(0.23)		(0.22)	(0.08)
Cohort 1990		0.12*		0.10	−0.03		0.15		0.29*	0.07
		(0.06)		(0.06)	(0.02)		(0.17)		(0.16)	(0.06)
Cohort 1991		0.03		0.01	−0.01		0.10		0.20*	0.14**
		(0.04)		(0.04)	(0.02)		(0.12)		(0.12)	(0.06)

Cohort 1992		0.003		−0.01	−0.0004		−0.03		0.02	0.03
		(0.02)		(0.02)	(0.02)		(0.07)		(0.06)	(0.05)
Cohort 1994		−0.10***		−0.09***	−0.11***		0.01		−0.04	−0.09*
		(0.03)		(0.03)	(0.02)		(0.07)		(0.07)	(0.05)
Cohort 1995		−0.10**		−0.08**	−0.07***		−0.24**		−0.32***	−0.44***
		(0.04)		(0.04)	(0.02)		(0.12)		(0.11)	(0.05)
Cohort 1996		−0.09		−0.07	−0.06***		−0.32*		−0.45***	−0.44***
		(0.06)		(0.06)	(0.02)		(0.17)		(0.16)	(0.06)
Cohort 1997		−0.08		−0.05	−0.05***		−0.19		−0.32	−0.22***
		(0.08)		(0.08)	(0.02)		(0.22)		(0.21)	(0.05)
Cohort 1998		−0.05		−0.01	−0.03		−0.33		−0.50*	−0.38***
		(0.10)		(0.09)	(0.03)		(0.28)		(0.26)	(0.08)
Cohort 1999		−0.06		−0.02	−0.09***		−0.47		−0.78**	−0.65***
		(0.12)		(0.11)	(0.04)		(0.34)		(0.32)	(0.09)
Year dummy	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
R^2	0.7798	0.8034	0.7771	0.8036	0.7307	0.5228	0.5297	0.5058	0.5185	0.4328
F value	265.51	222.32	420.60	286.92	280.80	82.81	61.99	124.16	76.25	79.72
D.F	292,137	402,126	182,148	312,135	212,145	292,137	402,126	182,148	312,135	212,145
Model *F* test		Against (1)	Against (1)	Against (2)			Against (1)	Against (1)	Against (2)	
		24.34	2.38	0.24			3.87	6.92	5.64	
Cohort Excl. *F* test				24.51	15.2				4.75	20.47

TABLE 9 (cont.)

B

COHORT, TENURE, AND YEAR EFFECTS ON SALARIES AND BONUSES FOR TECHNICIANS ($N = 2862$)

	ln(Salary)					ln(Bonus)				
	(a)	(b)	(c)	(d)	(e)	(a)	(b)	(c)	(d)	(e)
Tenure			0.03***		0.07***			0.01***		0.03***
			(0.002)		(0.003)			(0.003)		(0.004)
Tenure square				0.01***	−0.001**				−0.005**	−0.00***
				(0.001)	(0.0000)				(0.002)	(0.00)
Tenure cubic				−0.0001**					0.0000	
				(0.0001)					(0.0000)	
Tenure quartic				0.00					0.0000	
				(0.00)					(0.0000)	
Tenure dummies	Yes	Yes	No	No	No	Yes	Yes	No	No	No
Cohort 1988		0.23***		0.68***	−0.08**		−0.21		0.27***	−0.19***
		(0.08)		(0.06)	(0.03)		(0.14)		(0.10)	(0.06)
Cohort 1989		0.26***		0.61***	0.02		−0.003		0.40***	0.05
		(0.06)		(0.05)	(0.03)		(0.12)		(0.08)	(0.05)
Cohort 1990		0.17***		0.45***	−0.04		−0.09		0.23***	−0.07*
		(0.05)		(0.04)	(0.02)		(0.09)		(0.06)	(0.04)
Cohort 1991		0.12***		0.30***	0.001		−0.03		0.17***	0.03
		(0.04)		(0.03)	(0.02)		(0.06)		(0.05)	(0.04)
Cohort 1992		0.07***		0.16***	0.04**		−0.10***		0.0003	−0.04
		(0.02)		(0.02)	(0.02)		(0.04)		(0.03)	(0.03)

Cohort 1994		−0.14***		−0.23***	−0.12***		−0.05		−0.15***	−0.13***
		(0.02)		(0.02)	(0.02)		(0.04)		(0.03)	(0.03)
Cohort 1995		−0.16***		−0.33***	−0.08***		−0.02		−0.21***	−0.16***
		(0.03)		(0.02)	(0.02)		(0.06)		(0.04)	(0.03)
Cohort 1996		−0.19***		−0.46***	−0.08***		0.01		−0.28***	−0.12**
		(0.05)		(0.04)	(0.03)		(0.09)		(0.07)	(0.05)
Cohort 1997		−0.18***		−0.52***	−0.04		−0.05		−0.42***	−0.21***
		(0.06)		(0.04)	(0.03)		(0.11)		(0.08)	(0.05)
Cohort 1998		−0.22***		−0.66***	−0.07**		0.01		−0.46***	−0.09
		(0.08)		(0.05)	(0.04)		(0.15)		(0.10)	(0.06)
Cohort 1999		−0.20*		−0.76***	−0.13*		−0.05		−0.67***	−0.17
		(0.11)		(0.08)	(0.07)		(0.20)		(0.14)	(0.12)
Year dummy	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
R^2	0.6503	0.6618	0.5563	0.6515	0.5545	0.4112	0.4144	0.3913	0.4076	0.2832
F value	182.18	139.20	197.95	171.45	168.55	68.98	50.95	101.89	63.69	54,015
D.F	292,796	402,785	182,809	312,796	212,806	292,794	402,783	182,807	312,794	212,804
Model *F* test		Against (1) 9.62	Against (1) 68.3	Against (2) 9.47			Against (1) 2.41	Against (1) 8.59	Against (2) 3.60	
Cohort Excl. *F* test				29.64	13.54				5.29	6.84

TABLE 9 (CONT.)

C

COHORT, TENURE, AND YEAR EFFECTS ON SALARIES AND BONUSES FOR STAFF WORKERS (N = 2862)

	ln(Salary)					ln(Bonus)				
	(a)	(b)	(c)	(d)	(e)	(a)	(b)	(c)	(d)	(e)
Tenure			0.12***		0.13***			0.15***		−0.003
			(0.005)		(0.02)			(0.10)		(0.03)
Tenure square				0.05***	−0.005***				0.05***	−0.01**
				(0.01)	(0.001)				(0.01)	(0.03)
Tenure cubic				−0.01***					−0.003*	
				(0.001)					(0.002)	
Tenure quartic				0.0002***					0.0001	
				(0.0000)					(0.0001)	
Tenure dummies	Yes	Yes	No	No	No	Yes	Yes	No	No	No
Cohort 1988		−0.32***		−0.27***	0.08		−0.40**		−0.33*	0.71***
		(0.10)		(0.10)	(0.05)		(0.19)		(0.18)	(0.10)
Cohort 1989		−0.22**		−0.17*	0.08		−0.53***		−0.46**	0.32**
		(0.10)		(0.10)	(0.07)		(0.18)		(0.18)	(0.14)
Cohort 1990		−0.07		−0.04	0.13***		−0.28**		−0.23*	0.30***
		(0.07)		(0.07)	(0.05)		(0.13)		(0.13)	(0.09)
Cohort 1991		0.27***		0.30***	0.44***		0.26**		0.29***	0.69***
		(0.05)		(0.05)	(0.04)		(0.10)		(0.10)	(0.08)

Cohort 1992		−0.001		0.01	0.11***		−0.09		−0.08	0.20***
		(0.04)		(0.04)	(0.04)		(0.08)		(0.08)	(0.07)
Cohort 1994		−0.01		−0.03	−0.13***		0.20**		0.19**	−0.15*
		(0.05)		(0.05)	(0.04)		(0.08)		(0.08)	(0.08)
Cohort 1995		0.05		0.03	−0.14***		0.17		0.16	−0.45***
		(0.06)		(0.06)	(0.04)		(0.10)		(0.10)	(0.08)
Cohort 1996		0.21**		0.17**	0.07		0.26*		0.24	−0.58***
		(0.08)		(0.08)	(0.06)		(0.15)		(0.15)	(0.12)
Cohort 1997		0.40***		0.36***	0.02		0.13		0.10	−1.12***
		(0.10)		(0.10)	(0.07)		(0.19)		(0.19)	(0.13)
Cohort 1998		0.55***		0.50***	0.06		−0.01		−0.05	−1.46***
		(0.11)		(0.11)	(0.06)		(0.21)		(0.21)	(0.12)
Cohort 1999		0.54**		0.42*	−0.16		−0.64		−0.75*	−2.26***
		(0.23)		(0.22)	0.20		(0.42)		(0.42)	(0.39)
Year dummy	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
R^2	0.6605	0.7371	0.6563	0.7366	0.7051	0.6189	0.6582	0.6161	0.6583	0.5822
F value	52.81	55.65	81.39	70.92	87.96	44.19	38.49	68.50	49.10	51.61
D.F	30,769	41,758	19,781	32,768	22,778	30,768	41,757	19,780	32,767	22,777
Model *F* test		Against (1)	Against (1)	Against (2)			Against (1)	Against (1)	Against (2)	
		21.38	0.86	0.16			9.04	0.51	0.03	
Cohort Excl. *F* test				21.49	28.36				8.95	54.43

of the cohort effect. We also test specification (d) against (b), which gives an F statistic of 0.24, indicating that the tenure quartic function is sufficiently representative of the tenure dummies. The tenure effect within this specification is concave and reaches its peak at around 12 years. Specification (e) estimates the cohort effect by simply dropping the year dummies, which corresponds to the second strategy, where we compared whether those workers with the same number of years tenure, but who had entered the firm at different times, earned different wages. Again the cohort dummies' exclusion F test value was 15.2, which also provides evidence to support the existence of the cohort effect.

Now we can apply the same interpretation above to investigate all of the six type-pay matches. First, we find that cohort dummies are significant determinants for all types of workers and pay variables. The respective F statistics for the six type-pay matches (b against a) are 24.35, 3.87, 9.62, 2.41, 21.38, and 9.04. All of these passed the critical F exclusion test value at the 1 percent level.[12] The large cohort dummy exclusion F test values for specification (d) and (e) also verify the existence, importance, and nonlinearity of the cohort effect. Baker et al. (1994b) were concerned that the cohort effect might simply be due to changes in the composition of entrants; thus they ran the regression on entry wages only with the human capital and year dummies. In their test for whether the year dummies represented a set of meaningful dependant variables, they concluded that this was not the case, since they found a 22.97 F statistic. We ran the same specification and found that the respective F statistics for the six type-pay matches were 17.83, 11.25, 12.21, 26.41, 4.90, and 14.61, which supports the Baker et al. (1994b) findings.

Another interesting issue is the determination of whether a limited number of tenure variables is sufficient to pick up all of the tenure dummy effects. We can see that for staff workers, linear tenure, or the functional form that contains its square, cubic, and quartic terms, provides a sufficient approximation of the tenure effect. The same conclusion can be drawn for the salaries of both technicians and salespeople, but not for their bonuses. This finding contradicts the observations of Baker et al. (1994b) that linear tenure is a good proxy for the tenure effect. Finally, by comparing the size and significance of the coefficients, we can see that there is a weaker cohort effect among salespeople that amongst other workers. This is consistent with the evidence provided earlier that salespeople have higher rates of demotion, and that most of their compensation comes from bonuses, which ties them more directly to their market value. Overall, we have confirmed

[12] The 1 percent critical value of $F(10, \infty) = 2.32$.

that there is strong evidence supporting the existence of the cohort effect, similar to many of the findings in the prior literature, and that this effect is not driven by the composition of the entrants.

Conclusions

This study has presented an analysis of the internal labor economics of a Taiwanese auto dealer, Company X, comprising of three different sub-ILMs, salespeople, technicians, and staff workers. We have offered evidence on ILMs from the perspective of another culture, and have therefore attempted to render these stylized facts more reliable and universal. Our empirical results are similar to those of Baker et al. (1994a,b), providing mixed evidence on Doeringer and Piore (1971).

Using job title, authority level, and the structural hierarchy of the company to identify the various levels, we find significant differences in the employment transition paths across the different types of workers. We argue that the effects of jobs and levels, on both the salary and the bonus equations, are positive and smaller under a fixed effects model than under an OLS (combined) model; however, when adding in individual fixed effects, the reduction is greater in the bonus equations than in the salary equations. With changes in economic conditions, greater variations occur in bonuses than in salaries, and higher-ranking employees feel the effects of these variations more than lower-level staff workers and salespeople. Wage variations do exist within and between levels, and they are greater for bonuses than for salaries. Furthermore, the variations for both salaries and bonuses, defined by the coeffficient variations, are greater in the years when demand is high than in years of low demand. Entry and exit is observed at all levels, but this is more likely to occur in the lower levels of the hierarchy. We have also verified the existence of the cohort effect and find that it is not driven by the composition of the entrants.

Our evidence shows that the external and internal markets are both working, and that ILMs can only partially shield workers. Furthermore, a very interesting finding is that although this is a Taiwanese company, heavily influenced by Japanese culture, most of the findings corroborate the earlier literature, in terms of the broad patterns found in U.S. and European firms, which suggests that ILMs work in a more general setting.

The data set has demonstrated a number of interesting comparisons with the stylized facts of ILMs. Through the concepts of the internal hierarchy, levels, ports of entry and exit, and the relationship between salaries, bonuses, jobs, and levels, we have verified the existence of sets of rules and procedures that effectively define the ILMs. It is hoped that the findings of this study will provide some contribution to the ongoing quest of many economists for the opening up of "the black box of the internal economics of the firm."

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