Incentives from Compensation and Career Movements on Work Performance: Evidence from a Reform of Personnel Policies

Job Market Paper

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September, 2016

Abstract

This paper empirically studies the effectiveness of compensation schemes and career movements on worker productivity in a Japanese auto sales firm that offers its employees both types of incentives. A salesperson's work performance influences not only his current commission, but also future career movements including promotion to the managerial level or transfer to other non-sales jobs. In response to the economic recession, the firm started a reform in personnel management that drastically revamped the compensation structure and how salespeople are promoted or transferred, providing us with rich data variation for estimating a dynamic model that captures salespeople's work effort decisions under different incentive systems. Our results show that, compared with the counterfactual scenario when there are only monetary compensations as the reward for performance, career movements increase the firm's gross profit by 85 percent. Furthermore, combining both incentives as a package in the contract offer achieves a profit higher than the sum of profits from offering the incentives separately, suggesting that the incentives are complements that enhance the worker productivity. We also find that about half of the profit increase from the reform comes from the change in the system of career movements, with the majority comes from young and middle-aged salespeople. Finally, we illustrate how the firm can further incentivize the work effort from young and middle-aged salespeople by implementing an alternative job evaluation that places more weight on performance and by increasing the current income spread between managers and salespeople.

1. Introduction

To motivate the work effort from employees, firms often explicitly or implicitly offer employees a contract package including a performance-related compensation scheme and potential career movements, including promotion and demotion, within the firm. Stimulated by a large stream of theoretical research on the power of incentives (Lazear 2000) in personnel economics, the past two decades witnessed a rapid growth of empirical research that identifies the relationship between worker compensation and productivity (for examples see Paarsch and Shearer 1999, 2000; Shearer 2004; Lazear 2000; Bandiera, Barankay, and Rasul 2007; Misra and Nair 2011; Chung, Steenburgh, and Sudhir 2014; Chan, Li and Pierce 2014). Promotions and demotions, on the other hand, provide a long-term incentive as the current performance of employees will influence future monetary and non-monetary payoffs. The tournament theory, starting from the seminal work of Lazear and Rosen (1981), has been used to explain why it is efficient for firms to use career advancements as an incentive.

In many cases, combining both incentives in contract offers can be mutually beneficial for firms and employees. The effectiveness of the two incentives can vary across employees. For young employees, career advancements may be the primary concern in their work decisions, but for employees who are near the age of retirement, such a long-term goal may no longer be relevant and the short-term incentive becomes more important (Gibbons and Murphy 1991). Knowing how each type of incentives works for different types of employees is essential for firms to understand how to improve the incentive system. Even for the same employee, combining both incentives can be more effective than offering either one. One the one hand, if an optimal compensation scheme which fully solves the moral hazard problem is difficult to implement, career movements can be a complement for the compensation to improve worker incentives. On the other hand, short-term compensations can motivate employees' performance in each month, which will help them step closer to long-term career advancements. The power of career incentives as a result will be strengthened.

The objective of this paper is to study the effectiveness of compensation schemes and career movements on the worker productivity. We study a personnel dataset on car salespeople provided by an auto sales firm in Japan, who offers employees both types of incentives. Previous research on the incentives of compensation schemes primarily uses a static modeling framework, as an employee's work performance is typically rewarded by the pay in the same period. To study career movements, however, a dynamic framework is required. This is because promotions and demotions typically rely on the evaluations of work performance over time, as such the incentive will primarily come from career concerns for the long future. To achieve our objective, we develop a structural dynamic model that allows both types of incentives to influence an employee's current and future work effort choices. The model also allows that, when facing a negative outcome in the career path, the employee may leave the firm to seek outside opportunities in the external labor market. Furthermore, we let promotions and demotions involve changes in jobs that differ in not only the monetary payment but also other non-monetary payoffs, such as the difficulty of job tasks, work environment, prestige, as well as the value of future options. Although the focus of the study is one particular empirical setting, this model can be applied to various compensation and promotion and demotion systems.

We choose the personnel data on salespeople as our empirical application for several reasons. First, salesforce is an important component of the economy. The Bureau of Labor Statistics reports that about 14 million people in the United States were employed in sales-related occupations in 2012, more than 10% of the workforce. The amount that firms spend on their salesforce is three times as high as spending on advertising (Zoltners et al. 2008). Understanding how the incentives work for salespeople thus has important economic implications. Second, for each salesperson, the data contains detailed descriptions of his compensation including the base wage and commissions, and career movements involving promotion to the managerial level or transfers to other non-sales jobs (which are equivalent to demotions), over time. It also reports the gross profit the salesperson contributes in each month which, from the firm's perspective, is an accurate measure of the worker productivity. This data nature enables us to investigate the relationship between an employee's performance and his short-term and long-term incentives. Finally, during the data period, the firm started a reform in its personnel management policies which drastically revamped the compensation structure and how salespeople are promoted or transferred, hoping that it would improve the sales performance. This policy change enhances the identification of our model, as we can use not only the data variation across salespeople who are at different points of the career path but also within each salesperson the change in the work performance after the reform to identify the effectiveness of the two types of incentives.

Estimation results show that, relative to the sales job, managerial jobs bring an employee higher monetary and non-monetary payoffs, while other non-sales jobs are worse off in both dimensions. Compared with the counterfactual scenario when there are only monetary compensations as the reward for performance, the system of career movements (after reform) increases the firm's gross profit by 85 percent, suggesting that long-term incentives are important to enhance employees' productivity. Furthermore, a decomposition of the effect of the reform, based on the estimation results, shows that about half of the profit increase has come from the increased power of the incentive from the compensation scheme, and about 40 percent from the change in the system of promotions or transfers.

We then further investigate how the two incentives work. First, we compare the effect of the incentives across salespeople. Results show that those who are close to retirement are more responsive to the compensation incentive. This is because they have a lower effort cost, probably due to the job-specific learning. For young and middle-aged salespeople, career movements are a more important incentive. This is because they have more years from reaching retirement; also, the non-monetary payoffs from promotion are larger for those salespeople. These results suggest that the two incentives work for workers of different ages. Second, we show that the sales profit of the firm from combining both incentives is higher than the sum of sales profit from a system with compensation only and another with career movements only, for all age groups, suggesting that the incentives are complements that enhances the work productivity. This result implies that combining both incentives as a package in the contract offer can be more effective than offering either incentive alone. Finally, we use the model to illustrate how the firm can further incentivize the work effort from young and middle-aged salespeople by implementing an alternative system of career movements that weights more on the work performance and by changing the current income spread between managers and salespeople.

Our paper is organized as follows: Section 2 reviews the relevant literature. Section 3 describes the data and presents some data statistics and patterns. Section 4 specifies the model and discusses the estimation strategy. Section 5 presents results from the model estimation and policy experiments. Finally Section 6 concludes.

2. Related literature

When a worker's effort cannot be directly measured, the problem of moral hazard arises. How to use incentives to solve the problem is key to contract design. Under the principal-agent framework, past theoretical works have shown that the optimal contract should be non-linear on a worker's output (e.g. Holmstrom 1979; Lazear 1986). In marketing, past research has focused on the design and implementation of compensation plan to incentivize the optimal level of effort from salespeople (e.g. Basu et al. 1985; Coughlan and Sen 1989; Rao 1990; Lal and Srinivasan 1993). A number of empirical studies have tested the relationship between worker compensation and productivity (e.g. Paarsch and Shearer 1999, 2000; Shearer 2004; Lazear 2000; Bandiera, Barankay, and Rasul 2007; Coughlan and Narasimhan 1992, Lal, Outland, and Staelin 1994, Joseph and Kalwani 1998; Misra et al. 2005; Chan, Li and Pierce 2014). The setting in these studies is static. Recently, there is a small stream of empirical works studying the dynamic effects of the compensation scheme. For example, Misra and Nair (2011) study how workers respond to a payment scheme with quotas and floors and ceilings for pay, and conclude that quotas reduce productivity. Chung et al. (2014) study the compensation scheme with quota and bonus and find that it enhances productivity. Our paper shares some similarities with these two papers by using a dynamic structural model to infer salespeople's effort and estimate their utility primitives. However, we study long-term career movements in addition to short-term monetary incentives. The hierarchical job structure of firms, together with the pay scheme, provides an incentive for better work performance if workers are forward-looking.

In the economics literature, there are several explanations underlie the existence of internal career movements. One is that for certain jobs the entry from the external job market is restricted, either by administrative rules or because of firm-specific human capital accumulation required for these jobs (Doeringer and Piore 1985, Becker 2009). Another view is that, as a firm owns the private information regarding the ability of its workers, it will use promotions to preserve such information advantage and thus create long careers within the firm (e.g. Waldman 1984, Greenwald 1986). The tournament theory, starting from the seminal work of Lazear and Rosen (1981), has also been used to explain internal career advancements. In the model, workers compete for prizes the value of which is measured by the wage difference between pre- and post-promotions. Firms use promotions to induce the optimal level of effort from the pre-promotion job. Baker, Gibbs and Holmstrom (1994a, 1994b) demonstrate in details the wage and job hierarchy structure in a medium-sized U.S. firm in a service industry over 20 years and find no clear support to the first two theories and find support to the tournament theory. The tournament theory has also been tested by a number of other empirical studies (e.g. Lazear 1992, Audas, Barmby, and Treble 2004, and DeVaro and Waldman 2006). Our paper is closely related to the theory by studying the influence of promotions and demotions on salespeople's work incentives. We develop a dynamic structural model to quantify the incentives from career movements, in addition to that from the short-term compensation. Moreover, in addition to the wage difference following job changes, we also investigate the difference in non-monetary payoffs.

One recent paper by Gayle, Golan and Miller (2015) studies the firm-size pay gap (i.e. large firm pays more than smaller firms) in the executive market. It develops a dynamic structural model to investigate how an executive makes job and effort choices considering his compensation, nonpecuniary benefits from working and future value of human capital accumulation. Unlike our study, the work performance of executives is not observed from data; thus, Gayle et al assume that the contract between an agent and a firm is optimal so that they can recover the effort choice of executives. The focus of the paper is the external labor market where executives move across firms. Our research focuses on the internal market where salespeople face a specific compensation scheme and promotion and demotion system. Our findings are more relevant to the question of how firms can offer a better contract package that will improve workers' performance.

To sum up, our paper differs from the previous literature by studying an internal labor market where the firm offers both short-term compensation and long-term career movements as incentives for employees. We use a structural dynamic model to help quantify the importance of these two types of incentives.

3. Data and Descriptive Analysis

3.1. Background

The firm that provides us data is one of the largest regional chain dealers in Japan, selling and leasing cars produced by one of the largest auto manufacturers in the world. The firm owns 74 outlets, most of which have a new car sales section, a used car sales section, and a service section, ranged from 3 salespeople at the smallest outlet to 22 at the largest. In 2004, the firm had 2,300 employees, 1/3 of them were salespeople. Most employees are hired at young age (the average starting age is 20.8), and retire at the age of 60. The annual total sales in that year was $1.3 billion US Dollar.[1] As a comparison, according to the report of Automotive News on top car dealers in the US, the firm is equivalent to the 20th largest dealer in the US as measured by total sales.

Our data period is from April 1998 to December 2005. Every month, a salesperson is paid a base wage and a commission. Base wage may be adjusted, based on the annual performance evaluation that is typically done by the manager of an outlet, in April of each year. There are movements across jobs, as a salesperson may be promoted to the managerial level or transferred to another non-sales job, such as a clerk who mainly undertakes routine administrative duties.

In October 2000, the firm launched a reform in personnel management policies, as a response to the economic recession during that period. The recession, which is referred to as the "Lost 20 Years" in Japan, lasted from 1990 to 2010 during which the country experienced stagnant economic growth. The firm's car sales also suffered for a long period. The objective of the reform is to improve salespeople's performance. We are told by the firm that the idea of the reform is to increase the incentive power for employees by relating the compensation and career movements more closely with a salesperson's performance (Lazear 2000).

Before the reform (*Period 0*, from April 1998 to September 2000), a salesperson earns in each month a fix base wage plus the commission , calculated as the gross profit, i.e., the sales revenue deducted by the cost of a car sold, multiplied by the commission rate of the

[1] We convert Japanese Yen to US Dollar throughout this paper.

car,[2] from the cars he sells in the month. The average commission rate of all the cars sold during the period is 4.5%. After the reform (from October 2000 to December 2005), the average commission rate significantly increases to 21.2%. The payment structure also changes, as a salesperson's monthly pay is the maximum of his base wage and 21.2% of his sales profit.

Figure 1: Payment structure

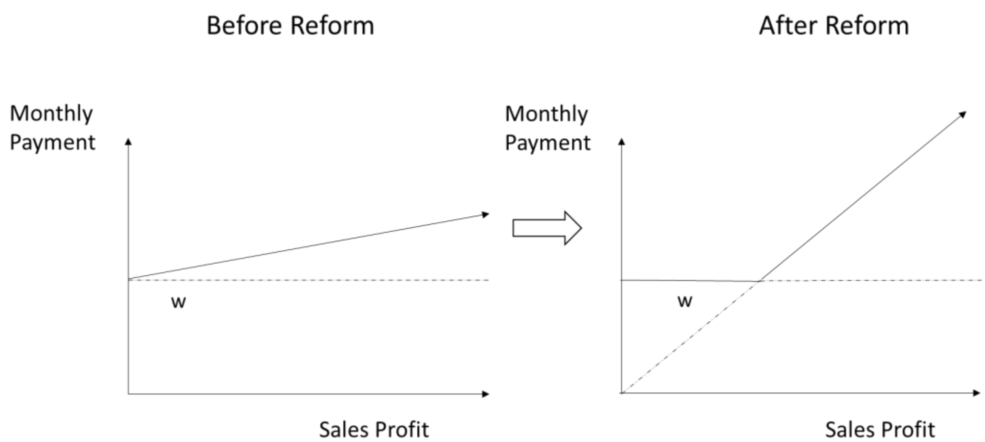


Figure 1 illustrates the comparison: Suppose that a salesperson's base wage is w. The left panel shows that, before the reform, his monthly payment increases starting from the first car he sells. The right panel shows that, after the reform, his monthly payment remains at the level of w, as long as the commission from all cars sold is below w. Above this level, the monthly payment increases much faster than the right panel due to the higher commission rate. The firm hopes that a salesperson will view the base wage as a "soft target" and the high commission rate can stimulate his effort to achieve such a target. A

[2] The cost includes the price the dealer pays to the car manufacturer, as well as the inventory-holding cost, for the car.

potential issue is that, if the base wage is set too high, the salesperson may lose the incentive since the likelihood of reaching that target is small.

In the early period after the reform (*Period 1*, from October 2000 to March 2004), the commission is calculated based on the gross profit from the cars sold in the current month. There was a concern that salespeople might game the system by manipulating the timing of sales. For example, a salesperson with low chance of getting commission above w in a month may push back the dates of sales to the next month. In the later period (*Period 2*, from April 2004 to December 2005), the payment structure further changes such that the commission in a month is calculated based on the salesperson's average gross profit of the current and the previous month. In the model which we will describe in the next section, we take account how salespeople's effort will change following this policy change, but we abstract away from the potential gaming behavior which is beyond the scope of our analysis.

Career movements involve promotion to the managerial level or being transferred to other non-sales jobs. These can happen in any month, but most are at the beginning of April and October every year. A manager is normally in charge of employees in an outlet (there can be more than one manager). The promotion is considered as a reward, since the monthly payment is typically higher than that for a salesperson. Non-pecuniary benefits may also be important because managers enjoy a more comfortable workplace and a higher social status inside the company. Transfers to other non-sales jobs, on the other hand, is considered as a punishment to low performers, because these jobs have a lower monthly income and status at the workplace. The job task and payment structure for managers and non-sales jobs are completely different from those of salespeople. Salespeople may also choose to quit the job voluntarily if their pecuniary or non-pecuniary returns are too low or there is not enough opportunity for career advancement inside the firm.[3] In this case, they will seek new jobs in the external labor market and we no longer have their record.

3.2. Some summary statistics

In this study, we focus on 340 salespeople who worked in the new car department during the data period. Our data consists of each salesperson's monthly sales profit, base wage, job movements, and some demographic information including the age and education level. Table 1 presents the mean and standard deviation (in parentheses) of the monthly sales profit, commission, and base wage, broken down by age groups, before and after the reform. The average sales profit after the reform has significantly increased for all age groups. The base wage has increased for young salespeople but reduced for salespeople at older age. The reason is that, as we will show below, the reform has changed the base wage adjustment to one based more on workers' performance and less on the seniority. Still, older salespeople enjoy a higher base wage than other age groups and, partly because of that, their commission level is the lowest.

Table 1: Summary statistics for sales profit, commission and base wage

	Before reform				After reform			
	All	Age<35	35<Age<50	50<Age<60	All	Age<35	35<Age<50	50<Age<60
Monthly sales profit (1,000 USD)	11.90	11.68	12.11	11.02	15.95	18.03	16.39	13.43
	(3.68)	(3.68)	(3.63)	(3.11)	(4.27)	(5.44)	(4.4)	(3.59)
Monthly commission (1,000 USD)	0.54	0.52	0.55	0.48	0.77	1.20	0.82	0.34
	(0.15)	(0.15)	(0.14)	(0.12)	(0.56)	(0.81)	(0.58)	(0.3)
Monthly base wage (1,000 USD)	3.01	2.47	3.19	3.82	3.23	2.90	3.18	3.74
	(0.1)	(0.09)	(0.07)	(0.06)	(0.07)	(0.24)	(0.04)	(0.04)

The first three rows in Table 2 compare the monthly income of salespeople, managers and other non-sales jobs before and after the reform. The average income of managers is

[3] Layoffs are rare in Japan as most firms provide life-long job security for employees.

the highest and that of other non-sales jobs is the lowest. The reform has increased the income of managers and other non-sales jobs but the magnitude is smaller than that for the sales job. We do not have the information on the pay scheme for and work performance of managers and other non-sales jobs. Table 3 shows the results of regressing the monthly payment of each job on the age and the reform indicator. Similar to what Table 2 shows, the reform increases the income of managers and non-sales jobs. It also increases with the age at a rate faster than that for salespeople.

The last three rows of Table 2 compare the annual rate of promotions, transfers and voluntary quits. The likelihoods of these career movements are in general small. Overall there are more promotions in the data than transfers and voluntary quits. The number of promotions has increased and the number of transfers and quits have decreased after the reform.

Table 2: Summary statistics for income of different jobs and career movements

	Before reform	After reform
Monthly income of salespeople (1,000 USD)	3.6	4.0
Monthly income of other non-sales jobs (1,000 USD)	3.2	3.4
Monthly income of managers (1,000 USD)	4.2	4.4
Annual rate of transfers	3.7%	2.2%
Annual rate of promotions	2.3%	6.9%
Annual rate of quits	2.9%	0.8%

Table 3: Change of income for different jobs

	Salespeople	Non-sales jobs	Managers
Age	0.03 ***	0.05 ***	0.05 ***
	(0)	(0)	(0)
Reform	0.27 ***	0.04 ***	0.10 ***
	(0.01)	(0)	(0)
Intercept	2.46 ***	0.94 ***	1.80 ***
	(0.04)	(0.01)	(0.02)

Note: (1) Standard errors are in parentheses; (2) "*": p-value smaller than .1, "**": p-value smaller than .05, "***": p-value smaller than .01.

Career movements depend on the characteristics of salespeople, including age, education, base wage and past work performance that we observe from data. They also depend on other characteristics evaluated by the manager that we do not observe from data. Table 4 reports the statistics of some worker characteristics for (1) all salespeople, (2) salespeople who are promoted, (3) salespeople who are transferred and, (4) salespeople who quit. Performance in the table is defined as the gross profit a salesperson contributed to the firm in the past six months. Promoted salespeople are normally from 35- to 50-year-old, with a higher base wage, work performance and education level. Salespeople who are transferred or voluntarily quit have a lower base wage and work performance. Young salespeople are more likely to quit the job before the reform (as the mean age is younger than the others) but less so after the reform (as the mean age increases). In terms of education, those without a college degree are more likely to be transferred or voluntarily quit after the reform.

Table 4: Summary statistics for salespeople at different points of the career path

		Before reform				After reform			
		All	Promote	Transfer	Quit	All	Promote	Transfer	Quit
Observation		1390	16	26	20	2105	73	23	8
Age	Min.	26.75	34.83	30.42	28.42	29.25	35.33	32.92	31.08
	Median	38.67	43.62	42.29	33.17	41.83	43.50	43.50	41.96
	Mean	39.12	43.01	42.62	34.91	42.81	43.73	44.16	41.14
	Max.	59.42	50.25	58.50	46.33	60.00	53.83	56.83	51.67
Base wage ($1,000 USD)	Min.	1.95	3.18	2.03	1.95	2.09	2.64	2.44	2.30
	Median	3.06	3.50	3.12	2.53	3.27	3.51	3.35	2.98
	Mean	3.04	3.49	3.10	2.58	3.23	3.50	3.26	2.98
	Max.	4.32	3.66	3.80	3.80	4.39	4.17	3.98	3.57
Performance ($1,000 USD)	Min.	10.26	33.40	26.58	10.26	16.53	55.91	30.46	25.33
	Median	68.93	72.79	47.86	41.92	92.78	109.88	65.27	62.61
	Mean	72.20	79.15	51.29	46.61	97.83	113.92	67.78	67.54
	Max.	192.31	131.31	90.78	91.86	357.89	197.20	116.51	134.99
College	Min.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.43	0.50	0.42	0.45	0.43	0.45	0.22	0.38
	Max.	1	1	1	1	1	1	1	1

3.3. Preliminary results from reduced-form regressions

Unlike the monthly payment that is deterministic based on the base wage and gross profit, career movements and the adjustment of base wage are stochastic processes that involve uncertainties for employees. This is because the latter relies on the annual performance evaluation which may depend on factors (e.g. help for peers, work attitude, leadership etc.) that are subjectively evaluated by the manager. We will first examine what are the important factors that determine the processes. This helps us better understand what changes the reform brought to the personnel management. Some of these regression results will be used in the structural model that we will describe in the next section. We will then present some indirect evidence showing that career movements incentivize salespeople's work effort. Finally, we will present evidence on how the reform has changed the work performance of workers.

3.3.1 Change in the base wage

A salesperson's base wage is adjusted every year in April. At the beginning of each (annual) wage cycle b, the change from his current level follows the following specification:

$$\Delta B_{ib} = b_0^j + b_1^j * age_{it} + b_2^j * B_{ib-1} + b_3^j * y_{ib-1,-t} + b_4^j * edu_i + \epsilon_{ib}^j \qquad (1)$$

That is, the change in base wage (ΔB_{ib}) depends on a salesperson's age (age_{it}), current base wage (B_{ib-1}), the performance in the last year ($y_{ib-1,-t}$) and education level ($edu_i = 1$ if with college degree or $edu_i = 0$ if without).[4] Finally, the error term in the regression captures the impact from other factors that are subjectively evaluated by the manager and we as researchers do not observe. We estimate the base wage function before and after the reform ($j = 0$ or $j = 1$) separately.

Results are reported in Table 5. Before the reform, wage change heavily relies on age and not on the past work performance. After the reform, wage growth is more related to job performance and less to age. To demonstrate the relationship between the past performance and the wage change, we use scatter plots in Figure 2 to compare the predicted wage change of all salespeople in the data, before and after the reform. The left panel shows a correlation between the performance and base wage changes, as more senior salespeople on average had lower sales. The right panel shows that, after the reform, base wage change is strongly linked to the sales performance. Finally, the coefficient for the current base wage is negative, suggesting that the rate of change will slow down as a salesperson's base wage grows to a high level.

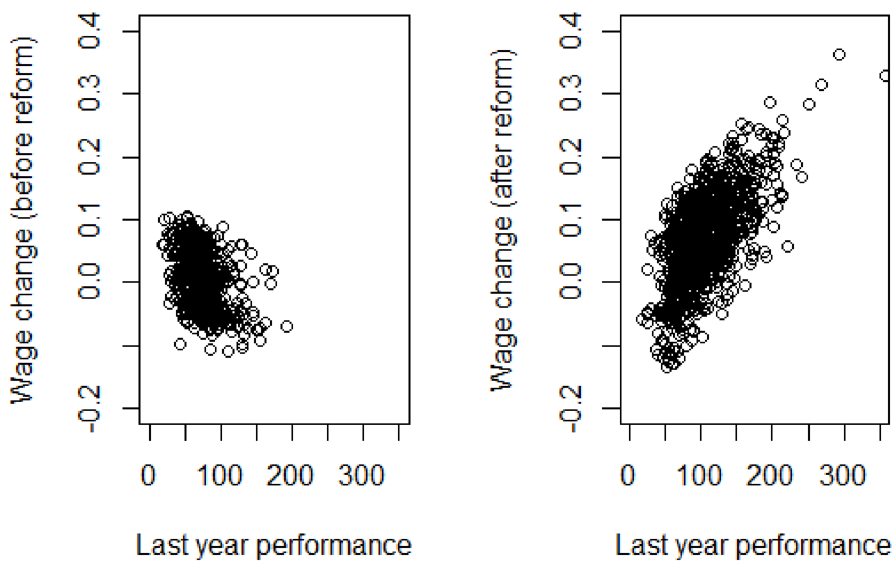
[4] We do not incorporate tenure in the regression because age and tenure are highly correlated (correlation = 0.94). In our data, almost all of the salespeople are hired by the firm at the age of early 20s.

Table 5: Base wage regression results

	Before reform	After reform
Age	0.0051 **	0.0014 *
	(0.0019)	(0.0008)
Base	-0.1455 ***	-0.1446 ***
	(0.0235)	(0.0122)
Performance	0.0001	0.0010 ***
	(0.0001)	(0.0001)
College	-0.0057	-0.0061
	(0.0101)	(0.0058)
Intercept	0.2351 ***	0.2891 ***
	(0.0384)	(0.0235)

Note: (1) Standard errors are in parentheses; (2) "*": p-value smaller than .1, "**": p-value smaller than .05, "***": p-value smaller than .01.

Figure 2: Wage growth before and after the reform



3.3.2 Career movements

Promotions and transfers usually happen at the beginning of April and October every year. For simplicity, we assume that all the career movements happen between April and October are decided in April, and all those between October and the next April in October. We use an ordered probit regression to represent the career movement system: at the beginning of the first month t (i.e. April or October) of each (half-yearly) career movement cycle m, a performance evaluation M_{im} for salesperson i is determined by:

$$M_{im} = m_1 * age_{it} + m_2 * age_{it}^2 + m_3 * edu_i + m_4^j * B_{ibt} + m_5^j * y_{im-1,-t} + \epsilon_{im}^j \quad (2)$$

The probabilities of promotion ($P(P_{imt} = 1)$) and transfer ($P(L_{imt} = 1)$ conditional on the salesperson's evaluation are

$$P(P_{imt} = 1) = P(M_{im} > u_p) \quad (3)$$

and

$$P(L_{imt} = 1) = P(M_{im} < u_L) \quad (4)$$

Where u_p is the "target" for promotion, and u_L is the threshold for transfer. The stochastic term ϵ_{im} is assumed to distribute as $N(0,1)$. It captures the impact of the factors in the evaluation that are unobserved to us as researchers. If $u_p \leq M_{im} \leq u_l$, the salesperson will stay as a salesperson (i.e. $S_{imt} = 1$). Note that in equation (2) the evaluation is a function of the base wage B_{ibt}. Therefore, the adjustment in the salesperson's base wage will change not only his monthly income but also his chance of being promoted or transferred.

Table 6: Regression results for promotions and transfers

Base_before	0.3562 **
	(0.1575)
Performance_before	0.0104 ***
	(0.0026)
Base_after	0.5636 ***
	(0.1558)
Performance_after	0.0044 ***
	(0.0016)
Age	0.1488 **
	(0.0648)
Age2	-0.0019 **
	(0.0007)
College	0.1387 *
	(0.0765)
Transfer threshold	2.5400 *
	(1.301)
Promotion target	6.9690 ***
	(1.322)

Note: (1) Standard errors are in parentheses; (2) "*": p-value smaller than .1, "**": p-value smaller than .05, "***": p-value smaller than .01.

Since we do not have many observations of career movements, estimating separate regressions for before and after the reform will be inefficient. Therefore, we only allow the coefficients for B_{ibt} and $y_{im-1,-t}$ to be different before and after the reform. Table 6 reports the regression results. Age has an inverted U-shaped relationship with the performance evaluation, suggesting that salespeople at middle age are more likely to be promoted and young and old salespeople are more likely to be transferred. Salespeople with a college degree and better job performances are also more likely to be promoted and less likely to be transferred. The smaller coefficient for the past performance after the reform is due to higher sales profit. Its importance weight in the evaluation after adjusting for the change in sales profit is comparable with that before the reform. The coefficient for the base wage has increased after the reform and, as Table 5 shows, the change in the base wage becomes more related to the past performance. Combining with this indirect effect, past performance is a stronger determinant for promotions and transfers after the reform. Note that the large and significant coefficients for the base wage before and after the reform imply that career movements depend on a salesperson's long-term performance, which is reflected by the growth of the base wage.

3.3.3. Incentives from career movements

The relationship between pay schemes and workers' productivity has been documented in previous empirical studies (e.g. Paarsch and Shearer 1999, 2000; Shearer 2004; Lazear 2000; Bandiera, Barankay, and Rasul 2007). To find evidence from data that career concern is an important factor for workers' effort, however, is more challenging. This is because career movements are a long process that is based on the work performance over many periods. Our strategy is to investigate whether a salesperson's performance increases when the probability of promotion or transfer is high, after controlling for other factors. The rationale is that, assuming the salesperson discounts the payoffs from the long future more than the near future, he will be more likely to respond if promotion or transfer is more likely to occur in the near future, as long as these events have a significant impact on the welfare.

We test this argument by regressing the gross profit of salesperson i within a career cycle m as a function of the probabilities of promotion and transfer, which are first estimated via equation (2). That is,

$$y_{im} = \beta_{i0} + \beta_1 I(p1) + \beta_2 I(p2) + \beta_3 Base_{im}\big(1 - I(p0)\big) + \beta_4 ICT_{ip} + \beta_5 ICT_{it} + \epsilon_{im}$$

where β_{i0} is the individual fixed effect and $I(p0)$, $I(p1)$, $I(p2)$ are indicators for period 0 (before reform), period 1 (the first period after reform), and period 2 (the second period after reform), respectively. Base wage enters the regression after the reform (i.e. $1 - I(p0)$) because the guaranteed base wage may reduce the salesperson's work incentive. The variables ICT_{ip} and ICT_{it} are the promotion and transfer incentive indexes constructed in two ways. In the first specification, we assume

$$ICT_{ip} = p_{im-1}(P = 1) * I(High\,promotion\,probability)$$

$$ICT_{it} = p_{im-1}(L = 1) * I(High\,transfer\,probability)$$

That is, we use the promotion probability ($p_{im-1}(P = 1)$) and transfer probability ($p_{im-1}(L = 1)$) if the probabilities are high enough, as proxies for the incentives. We use different values (from the 50^{th} to the 70^{th} percentiles) to represent high promotion and transfer probabilities.

As career concerns might have a less impact on salespeople who are close to retirement, we further interact the indexes with the salesperson's years to retirement in the second specification. That is,

$$ICT_{ip} = p_{im-1}(P = 1) * I(High\,promotion\,probability) * (60 - age_{im})$$

$$ICT_{it} = p_{im-1}(L = 1) * I(High\,transfer\,probability) * (60 - age_{im})$$

where $(60 - age_{im})$ represents the number of years before retirement.

Table 7: Regression results: performance and career concerns

Specification (1)

Thresholds (percentile)	50th percentile	60th percentile	70th percentile
Base*(1-Period 0)	-8.7737 ***	-8.8799 ***	-9.0694 ***
	(2.1922)	(2.1672)	(2.1633)
ICTp	35.9720	35.3602	20.6750
	(28.4864)	(25.4583)	(24.1218)
ICTt	165.6848 ***	137.6978 ***	146.8585 ***
	(44.0452)	(39.4015)	(36.7939)
Period 1	57.1987 ***	57.1947 ***	58.1696 ***
	(6.9682)	(6.8823)	(6.8915)
Period 2	50.5786 ***	50.5817 ***	51.6200 ***
	(7.2621)	(7.181)	(7.1839)
Fix effects	Individual	Individual	Individual

Specification (2)

Thresholds (percentile)	50th percentile	60th percentile	70th percentile
Base*(1-Period 0)	-8.853 ***	-8.9922 ***	-9.3578 ***
	(2.2092)	(2.1949)	(2.2029)
ICTp	2.2876	2.6745 **	2.0991 *
	(1.4397)	(1.315)	(1.2506)
ICTt	4.7014 **	3.7335 **	4.2514 ***
	(1.8659)	(1.6976)	(1.5804)
Period 1	56.6619 ***	56.7032 ***	58.2411 ***
	(7.1217)	(7.0672)	(7.1007)
Period 2	49.9595 ***	49.9358 ***	51.5494 ***
	(7.4654)	(7.4098)	(7.4301)
Fix effects	Individual	Individual	Individual

Note: (1) Standard errors are in parentheses; (2) “*”: p-value smaller than .1, “**”: p-value smaller than .05, “***”: p-value smaller than .01.

The results of the regressions are reported in Table 7. The coefficients for ICT_{it} are significantly positive under all specifications, suggesting that, when facing a higher chance of being transferred, a salesperson will work hard to prevent the transfer. The coefficients for ICT_{ip} are also positive, however, only the estimates in the second specification are significant. This implies that the near-future promotion only has a strong effect for younger salespeople.

Overall, these results suggest that promotions and transfers have impact on the performance of salespeople, especially if they are at young age. Note that the above results do not fully capture the effect of promotions or transfers on workers' performance. Rather, they only show how salespeople respond to an increased likelihood of promotion or transfer by adjusting their effort. The true effect of promotions and transfers should be higher than the results here. For example, even though the likelihood of promotion or transfer is small for a young salesperson who is just hired by the firm, future career advancements can still be a strong motivation for him to work hard. Such an effect cannot be captured by the reduced-form regression and can only be quantified using a structural modeling approach, which we will discuss in detail in the next section.

3.3.4. Effectiveness of the reform

Next, we investigate whether the reform is effective and what is its impact on different types of salespeople. We use another regression that specifies the sales profit of salesperson i in month t as

$$y_{it} = \beta_{0i} + \beta_{1i} I(p1) + \beta_{2i} I(p2) + \beta_3 Seasonality_t + \epsilon_{it}$$

where β_{0i} is an individual fixed effect, and $I(p1)$, $I(p2)$ are indicators for the two periods after the reform. $Seasonality_t$ captures the impact of seasonality on the market demand. We use the aggregate sales in the region where the firm locates in each month from 1999 to 2004, and construct $Seasonality_t$ as $\frac{Sales\ of\ month\ t}{Sales\ of\ March}$.[5] We run four regressions: the first two regressions assume β_{0i} to be the same across salespeople, while the next two estimate the individual fixed effect. The first and the third regression assume that β_{1i} and β_{2i} are

[5] We use the sales in March as the baseline because its sales are the highest in that month.

the same across salespeople. In the second and the last regression, we allow that β_{1i} and β_{2i} are different for salespeople who are younger than 35, between 35 and 50, and older than 50, to investigate whether the reform has different effects on salespeople with different ages.

Table 8: Reduced-form regressions: the effectiveness of the reform

	Regression 1	Regression 2	Regression 3	Regression 4
Period 1	5.1783 ***		5.0767 ***	
	(0.1482)		(0.1399)	
Period 2	3.1028 ***		3.5168 ***	
	(0.1534)		(0.15)	
Period 1:20-35		6.6203 ***		5.5938 ***
		(0.3478)		(0.3153)
Period 1:35-50		5.6097 ***		5.4266 ***
		(0.22)		(0.2015)
Period 1:50-60		3.2182 ***		3.1136 ***
		(0.5809)		(0.4086)
Period 2:20-35		5.1102 ***		4.3765 ***
		(0.591)		(0.5873)
Period 2:35-50		3.9601 ***		4.2480 ***
		(0.2301)		(0.2218)
Period 2:50-60		1.7140 ***		1.3744 ***
		(0.5664)		(0.3586)
Seasonality	23.1784 ***	23.1654 ***	23.1626 ***	23.1899 ***
	(0.4426)	(0.4394)	(0.3935)	(0.3929)
Fix effects	No	Age group	Individual	Individual

Note: (1) Standard errors are in parentheses; (2) "*": p-value smaller than .1, "**": p-value smaller than .05, "***": p-value smaller than .01.

Results in Table 8 show that the reform is overall effective in improving salespeople's performance, and the effect is robust under different specifications. Another robust finding is that the effect is the strongest for young salespeople. This finding can have several explanations. First, older salespeople overall have higher base wages, so it is less likely that their sales commission can exceed their base wage. This may reduce the effect of the reform. Second, since young salespeople are further away from retirement, they may be more incentivized by future career movements. For older salespeople, however, promotions are less likely and thus are less relevant. As career movements are more related to job performance after the reform, the effect is thus stronger for young salespeople. We will use a structural model to separately identify these two effects.

4. Model

Based on the institutional details of the firm and the data patterns we observe, we build a dynamic model of salesforce response to wage changes and career movements. The sequence of decisions in the model are as follows:

1. At the beginning of a career movement cycle *m* (April for the cycle between April and September, and October for the cycle between October and the next March) of a year, salesperson *i* decides whether to quit or not by comparing his expected utility of staying and quitting. Conditional on the salesperson stays, the firm decides whether to promote or to transfer the salesperson.
2. Conditional on the salesperson stays (not quit, promoted or transferred), at the beginning of a wage cycle *b* (every April) of a year, the firm decides the salesperson's base wage of this cycle.
3. Conditional on the worker remains at the sales job, at the beginning of a month *t*, a salesperson observes all his current states and exerts selling effort in a dynamically optimal manner. An idiosyncratic sales shock, which is known by the salesperson up to the distribution, is realized.
4. Conditional on the salesperson stays, step 1-3 repeat until the salesperson retire at age 60.

4.1 Sales response function and salesperson per period utility

We model salesperson i's work performance in month t, which is measured by his monthly gross sales profit (y_{it}), as a function of his effort e_{it}

$$y_{it} = Seasonality_t * e_{it} + \epsilon_{it} \tag{5}$$

where $Seasonality_t$ is the seasonality index we construct from regional sales data, as discussed in 3.3.4. It can be treated as a proxy of market potential, and when exerting the same level of effort, a salesperson's sales profit is on average higher when the market potential is larger. ϵ_{it} is a stochastic component of sales profit that is assumed to be distributed as $N(0, \sigma_j^2)$.

Putting effort in selling cars is costly to a salesperson. The cost function is specified as the following:

$$c_{it} = \frac{1}{2}\beta_i e_{it}^2 \tag{6}$$

where β_i is restricted to be positive; that is, cost is a convex-increasing function of effort. Since effort is unobservable, a strictly monotonic parametric relationship between sales and effort is necessary for identification purposes. The individual-specific parameter β_i is a function of salesperson's demographics (age and education level).

Let j denote the period before the reform (0), first period (1), or second period (2), after the reform. Salesperson i's utility in month t, U_{it}^j, is his monetary income w_{it}^j minus his selling effort c_{it}, which is

$$U_{it}^j = w_{it}^j - c_{it} \tag{7}$$

The monetary income is calculated differently for different period j due to the reform. More specifically, before the reform ($j = 0$),

$$w_{it}^{0} = B_{ib} + r_0 y_{it} \tag{8}$$

First period after the reform ($j = 1$),

$$w_{it}^{1} = \max(B_{ib}, r_1 y_{it}) \tag{9}$$

Second period after the reform ($j = 2$),

$$w_{it}^{2} = \max(B_{ib}, r_2 \frac{(y_{it}+y_{it-1})}{2}) \tag{10}$$

where B_{ib} is salesperson i's base wage in wage cycle b,r_0, r_1 and r_2 are commission rates of the three periods, where $r_1 = r_2$.

4.2 Salesperson utility from career movements

As discussed in Section 3, we use linear regression and ordered probit regression to represent the wage growths and career movements. That is, salesperson i's wage change from previous wage cycle, ΔB_{ib}, is determined as in equation (1), and promotion and transfer are based on the evaluation measurement, M_{im}, which is determined by equation (2), and the probabilities that a salesperson is promoted and transferred are (9) and (10).

For simplicity, we further assume that once promoted or transferred, the salesperson stays as a manager or in another department until retirement. Let n_{it} denote the month left from month t to the salesperson's retirement (at age 60). The value of promotion at month t is the discounted value of the stream of utility as a manager in all future months until retirement, which is specified as the following:

$$V_{imt}^{p} = \Sigma_{k=1}^{n_{it}} \delta^{k-1} * (w_{i,t+k-1}^{p} + u_{i,t+k-1}^{p}) \tag{11}$$

where δ is the monthly discount rate (fixed at 0.98); $w^{p}_{i,t+k-1}$ is the monetary payoff as a manager that is approximated using the regression results in Table 3; $u^{p}_{i,t+k-1}$ is the non-monetary utility of a manager that is a function of the manager's demographics (age and education level) that is estimated from the data. Note that ex-ante, u^{p} can be either positive or negative as it is the difference between the non-monetary benefits of a manager, e.g. better work environment and prestige, and his effort cost assuming that the manager put in the optimal effort in each month, conditional on the incentive system after promotion.

Similarly, the value associated with lateral transfer is specified as

$$V^{L}_{imt} = \Sigma_{k=1}^{n_{it}} \delta^{k-1} * (w^{L}_{i,t+k-1} + u^{L}_{i,t+k-1}) \tag{12}$$

where $w^{L}_{i,t+k-1}$ is the monetary payoff after transfer that is approximated using the regression results in Table 3; $u^{L}_{i,t+k-1}$ is the non-monetary utility after transfer that is a function of salesperson's demographics and is estimated from the data, assuming that the worker put in the optimal effort in each month, conditional on the incentive system after transfer.

Besides being promoted or transferred, a salesperson can also quit the job. Different from promotions and transfers which are decisions of the firm, whether to quit the company is a voluntary decision of a salesperson. Though a salesperson can quit at any time, we assume that a salesperson only considers whether to quit at the beginning of a career movement cycle before P or L is realized. We make this simplified assumption as we only observe 28 quits and it is infeasible for us to identify the reason for quitting in different months. If the salesperson quits, he will not return to the company. The value of quitting is specified as

$$V_{imt}^{Q} = \Sigma_{k=1}^{n_{it}} \delta^{k-1} * u_{i,t+k-1}^{Q} + \epsilon_{imt}^{Q} \quad (13)$$

where $u_{i,t+k-1}^{Q}$ is the expected utility (includes both monetary and non-monetary utilities) from an outside job at period $t+k-1$. We again allow $u_{i,t+k-1}^{Q}$ to be a function of salesperson's demographics. In addition, $\epsilon_{imt}^{Q} \sim (0, \sigma_q^2)$ is a one-time shock that rationalizes the stochastic decision to quit.

4.3 Life-time value and optimal decisions

Follow our previous discussions, the key state variables (X_{it}) evolve as follows:

1. Age

$$Age_{it} = Age_{it-1} + \frac{1}{12}$$

2. Month

$$Z_{it} = \begin{cases} Z_{it-1} + 1, & if\ Z_{it-1} < 12 \\ 1, & if\ Z_{it-1} = 12 \end{cases}$$

3. Base wage

$$B_{ibt} = \begin{cases} B_{ib-1t-1} + \Delta B_{ib}, & if\ Z_{it} = 4 \\ B_{ibt-1}, & otherwise \end{cases}$$

4. Accumulated sales within this wage cycle

$$y_{ib,-t} = \begin{cases} 0, & if\ Z_{it} = 4 \\ y_{ib,-(t-1)} + y_{it-1}, & otherwise \end{cases}$$

5. Accumulated sales within this career movement cycle

$$y_{im,-t} = \begin{cases} 0, & if\ Z_{it} = 4\ or\ Z_{it} = 10 \\ y_{im,-(t-1)} + y_{it-1}, & otherwise \end{cases}$$

6. Sales of last period: y_{it-1}

The first two states evolve in a deterministic manner while the latter four evolve in a stochastic manner. Besides, sales of last period is a relevant state only for months in the second period of the reform.

A salesperson, at the beginning of each month, needs to make the *continuous choice of how much effort to invest*. In addition, at the beginning of April and October, before knowing whether he is promoted or transferred, the salesperson needs to make the *discrete choice of whether to quit the job*. Conditional on staying, he will know whether he is promoted, transferred, or remains as a salesperson. Both his continuous choice of effort and discrete choice of quit/stay are made with the objective of maximizing the stream of expected future utilities, conditional on the current state variables.

In period j, let $\Psi^j(X_{it})$ be the value under the worker's optimal quit (quit is a possibility only if it is a career movement month) and effort choices, before P or L is realized, as a function of X_{it}. Also, let $V^j(X_{it})$ be the value under the worker's effort optimal choices conditional on that the worker stays as a salesperson for month t, also as a function of X_{it}. Based on the above discussion, we can write down the value functions:

$$\Psi^j(X_{it}) = \begin{cases} max\{V_{imt}^Q(X_{it}), V_{imt}^P * E^j[\{P_{it} = 1\}|X_{it}] + V_{imt}^L * E^j[\{L_{it} = 1\}|X_{it}] \\ +\left(1 - E^j[\{P_{it} = 1\}|X_{it}] - E^j[\{L_{it} = 1\}|X_{it}]\right) * V^j(X_{it})\}, & \text{If t is April or October} \\ V^j(X_{it}) & \text{, Otherwise} \end{cases} \tag{14}$$

where E^j is an j-specific expectation operator conditional on current state variables, X_{it}, and

$$V^j(X_{it}) = \max_{e_{it}}\{E^j[U_{it}^j|X_{it}, e_{it}] + \delta * E^j[\Psi^j(X_{it+1})|X_{it}, e_{st}]\} \tag{15}$$

Note that in equation (15) E^j is conditional on not only X_{it} but also the work effort e_{st}. The value function $V^j(X_{it})$ can be re-specified as

$$V^j(X_{it}) = \max_{e_{it}}[\, E^j[U_{it}^j|X_{it}, e_{it}] + E^j[\sum_{n=t+1}^{t+n_{it}} \delta^{n-t}(V_{imn}^Q * Pr(Q_{in} = 1) + V_{imn}^P * Pr(P_{in} = 1) + V_{imn}^L * Pr(L_{in} = 1) + (1 - Pr(Q_{in} = 1) - Pr(P_{in} = 1) - Pr(L_{in} = 1)) * U_{in}^j) * \prod_{n'=t+1}^{n-1}(1 - Pr(Q_{in'} = 1) - Pr(P_{in'} = 1) - Pr(L_{in'} = 1))\, |X_{it}, e_{it}] \tag{16}$$

Equation (16) expresses $V^j(X_{it})$ as the discounted value of a stream of future utilities generated from Q, P, L, and e of all future months. The expression $\prod_{n'=t+1}^{n-1}(1 - Pr(Q_{in'} = 1) - Pr(P_{in'} = 1) - Pr(L_{in'} = 1))$ in the summation is the probability that the worker has not been promoted, transferred, or decided to quit in any of the previous months. Note that these are expected future utilities conditional on the current states.

The value function $\Psi^j(X_{it})$ in equation (14) can also be similarly expressed by substituting $V^j(X_{it})$ from equation (16) to (14). These expressions are useful for model estimation as we will detail below.

The optimal quit/stay decision from equation (14) is that

$$Q_{it}^* = \begin{cases} 1, \; if \; V_{imt}^Q + \epsilon_{imt}^Q > V_{imt}^P * E^j[\{P_{it} = 1\}|X_{it}] + V_{imt}^L * E^j[\{L_{it} = 1\}|X_{it}\,] \\ \qquad + (1 - E^j[\{P_{it} = 1\}|X_{it}] - E^j[\{L_{it} = 1\}|X_{it}]) * V^j(X_{it}) \\ 0, \qquad\qquad otherwise \end{cases} ; \tag{17}$$

Conditional on remaining as salesperson, the worker's optimal service effort, e_{it}^*, can be derived from equation (18) using the first-order condition of equation (15):

$$\frac{\partial}{\partial e_{it}} E^{j}\left[U_{it}^{j} \middle| X_{it}, e_{it}^{*}\right] + \delta \frac{\partial}{\partial e_{it}} E^{j}\left[\Psi^{j}\left(X_{i,t+1}\right) \middle| X_{it}, e_{st}^{*}\right] = 0 \tag{18}$$

Given value functions $\Psi^{j}(X_{it})$ and $V^{j}(X_{it})$, Q_{it}^{*} and e_{it}^{*} can be solved (numerically) conditional on structural parameters.

We assume that salespeople did not expect the changes in period 1 and period 2, so their expected utilities for all future years follow the evolutions of state variables that are the same as in current period. Since some salespeople may be partially informed about the changes and thus change their expectations, we exclude the data two months before the changes for model estimation.

4.4 Estimating the Dynamic Model

Standard dynamic model estimation uses a nested procedure (e.g. Rust 1987, 1996). Conditional on structural model parameters and different combinations of state variables, researchers numerically compute the value functions. This "inner" algorithm uses the property in the Bellman's equations (14) and (15) to obtain the value functions through forward iterations. The "outer" algorithm will then estimate structural parameters by matching the computed optimal decisions with observed via the GMM or ML method.

The biggest challenge of this standard procedure is the well-known "curse of dimensionality" problem. With a large dimension of state variables, the number of value functions that needs to be computed will explode. Consequently, the model estimation will have a high computational burden and take very long time. To tackle such a computational problem, we use a two-step model estimation strategy modified from the approach proposed in Hotz and Miller (1993, 1994), as discussed below.

(a) First stage estimation:

We have estimated the wage change function and the career movement function in (8)-(11). Thus, the expected base wage, the probability of promotion, and the probability of lateral transfer can be written as functions of relevant state variables: $B_{ibt}^{j} = B^{j}(X_{it})$, $Pr(P_{imt} = 1|X_{it}) = P^{j}(X_{it})$ and $Pr(L_{imt} = 1|X_{it}) = L^{j}(X_{it})$.

Then, we approximate the policy functions using Chebyshev polynomials of relevant state variables. The probability of quitting the job under the optimal quit/stay decision is approximated using first-order Chebyshev polynomials (we do not extend to higher orders as the number of quits is small in our data)

$$Pr(Q_{imt} = 1|X_{it}) = Q_{it}^{j}(X_{it}) \tag{19}$$

Based on equation (5), we estimate the sales function (and equivalently the effort function if we divide the sales function by $Index_{it}$) using second-order Chebyshev polynomials.

$$y_{it}^{j} = Index_{it} * e^{j}(X_{it}) + \epsilon_{it} = y^{j}(X_{it}) + \epsilon_{it} \tag{20}$$

Assuming that we have the right model, this procedure will give us the consistent estimate of expected sales $\widehat{y^{j}(X_{it})}$ and the probability of quit $\widehat{Q_{it}^{j}(X_{it})}$ under optimal effort and quit decisions, which we can use in the next step.

(b) Second stage estimation:

In the second stage, we use the first stage estimates (optimal effort and quit decisions) to simulate the value functions V^{j} and Ψ^{j}conditional on the structural parameters. Then we estimate the structural parameters using maximum likelihood. We detail the simulation and estimation procedures below.

Since a salesperson makes two type of decisions, we will search for the structural parameters to justify the two types of observations in the data:

1. Whether a salesperson quits or stays at the beginning of each career movement cycle given his current states.

2. Conditional on staying as a salesperson, a salesperson's monthly sales profit given his current states.

To use the observations of quits/stay, we derive the probability that the worker will quit, from equation (17) as

$$Pr(Q_{it}=1) = 1 - \Phi\left(\frac{\begin{array}{c} V_{imt}^{p} * Pr(P_{imt}=1|X_{it}) + V_{imt}^{L} * Pr(L_{imt}=1|X_{it}) \\ +(1-Pr(P_{imt}=1|X_{it}) - Pr(L_{imt}=1|X_{it})) * V^{j}(X_{it}) - V_{imt}^{Q} \end{array}}{\sigma_Q}\right) \tag{21}$$

To use the observations of sales profit, we derive the sales function under optimal effort decisions from equation (18) as follows:

Pre-reform Period 0:

$$y_{it}^{0} = r_0 \frac{Index_t^2}{\beta_i} + \delta \frac{Index_t}{\beta_i}\left(\frac{\partial}{e_{it}}\left(E^0\left[\Psi^0(X_{it+1})\middle|X_{it}, \widehat{y^0(X_{it})}\right]\right)\right) + \epsilon_{it}^{0} \tag{22}$$

Post-reform Period 1:

$$y_{it}^{1} = r_1 \frac{Index_t^2}{\beta_i}\Phi\left(\frac{\widehat{y^1(X_{it})} - B_{ibt}}{\widehat{\sigma_1}}\right) + \delta \frac{Index_t}{\beta_i}\left(\frac{\partial}{e_{it}}\left(E^1\left[\Psi^1(X_{it+1})\middle|X_{it}, \widehat{y^1(X_{it})}\right]\right)\right) + \epsilon_{it}^{1} \tag{23}$$

Post-reform Period 2:

$$y_{it}^{2} = r_2 \frac{Index_t^2}{2\beta_i}\Phi\left(\frac{y_{it-1} + \widehat{y^1(X_{it})} - 2B_{ibt}}{\widehat{\sigma_2}}\right) + \delta \frac{Index_t}{\beta_i}\left(\frac{\partial}{e_{it}}\left(E^2\left[\Psi^2(X_{it+1})\middle|X_{it}, \widehat{y^2(X_{it})}\right]\right)\right) + \epsilon_{it}^{2}$$

(24)

Equations (21)-(24) are used to estimate the structural model.

For equation (21), we need to estimate $V^j(X_{it})$, value under the worker's optimal effort choice if the worker stays as a salesperson for month t. We use the simulation method. The simulation step is conducted as follows for each observation:

a. Start with the unconditional probability of promotion, transfer and stay at the beginning of period t as $P_{it} = 0, L_{it} = 0. S_{it} = 1$.

b. From initial state X_{it}, calculate the optimal effort as $e^j(X_{it})$ using the first stage results in (20), draw sales shocks ϵ_{it} from $f(\epsilon)$ and calculate the realized sales using $Index_{it} * e^j(X_{it}) + \epsilon_{it}$.

c. Update state X_{it+1} , both the states that evolve in a deterministic manner (age, month) and those evolve in a stochastic manner:

   - Update the accumulated sales during the wage cycle and the career movement cycle, or reset to zero if $t+1$ is the beginning of the cycles
   - Update $B_{ibt+1} = \mathrm{B}(age_{it+1}, B_{ib-1t}, y_{ib-1,-(t+1)}, edu_i) + \epsilon_{ibt+1}$ if $t+1$ is the beginning of the wage change cycle, or $B_{ibt+1} = B_{ibt}$ otherwise.
   - Update previous month sales for $t+1$ (y_{it}).

d. Calculate the unconditional probability of quit, promotion, transfer at the beginning of period $t+1$ (and no career movements before t) as $Q_{it+1} = S_{it} * Q(X_{it+1})$, $P_{it+1} = S_{it} * \left(1 - Q(X_{it+1})\right) * P(X_{it+1})$, $L_{it+1} = S_{it} * \left(1 - Q(X_{it+1})\right) * L(X_{it+1})$. ($Q(X_{it+1}), P(X_{it+1}), P(X_{it+1})$ are 0 if it period t is not the beginning of a career movement cycle.)

e. Update

$$S_{it+1} = S_{it} * \Big(1 - Q(X_{it+1}) - \big(1 - Q(X_{it+1})\big) * \big(1 - P(X_{it+1}) - L(X_{it+1})\big)\Big)$$

f. Repeat b-e until the month that the salesperson is 60.

Conditional on a trial set of parameters and these simulated variables, we can simulate the value function $V^j(X_{it})$ in equation (16). Define for each simulated path k:

$$\left[V^j(X_{it})\right]^k = \sum_{s=0}^{n_t} \delta^s * (U_{it+s}^{jk} * S_{it+s}^k + V_{imt+s}^P * P_{it+s}^k + V_{imt+s}^L * L_{it+s}^k) \qquad (25)$$

The value function $V^j(X_{ist})$ can be approximated by

$$V^j(X_{it}) = \frac{1}{K}\sum_{k=1}^{K}[V(X_{it})]^k \qquad (26)$$

For equation (22)-(24), we need to estimate $\frac{\partial}{e_{it}}\left(E^j\left[\Psi^j\left(X_{i,t+1}\right)\middle|X_{it}, \widehat{y^j(X_{it})}\right]\right)$. The steps of estimating $\Psi^j(X_{it+1})$, the value under the worker's optimal quit and effort choices next month, are similar to those of simulating $V^j(X_{it})$ we discussed above. Then the derivative term, $\frac{\partial}{e_{it}}\left(E^j\left[\Psi^j\left(X_{i,t+1}\right)\middle|X_{it}, \widehat{y^j(X_{it})}\right]\right)$, is estimated using $\frac{\Psi^j(X_{it+1}(e^j(X_{it})+\delta_e)) - \Psi^j\left(X_{it+1}(e^j(X_{it})-\delta_e)\right)}{2\delta_e}$. That is, we estimate $\Psi^j\left(X_{it+1}(e^j(X_{it}) + \delta_e)\right)$ and $\Psi^j\left(X_{it+1}(e^j(X_{it}) - \delta_e)\right)$ following similar steps in estimating $\Psi^j(X_{it+1})$ (change $e^j(X_{it})$ in step b to $e^j(X_{it}) + \delta_e$ and $e^j(X_{it}) - \delta_e$ respectively), and then use the difference of the two to estimate the derivative.

With all of the above discussions, we can write down the likelihood function for data (Q_{it}, y_{it}) to be used for estimating the structural parameters as the following:

$$\Pr(Q_{it}, y_{it}) = \left[1 - \Phi\left(\frac{V_{imt}^{p} * Pr(P_{imt} = 1|X_{it}) + V_{imt}^{L} * Pr(L_{imt} = 1|X_{it}) + (1 - Pr(P_{imt} = 1|X_{it}) - Pr(L_{imt} = 1|X_{it})) * \widehat{V^{J}(X_{\iota t})} - V_{imt}^{Q}}{\sigma_Q}\right)\right]$$

$$* \{Q_{it} = 1\}$$

$$+ \Phi\left(\frac{V_{imt}^{p} * Pr(P_{imt} = 1|X_{it}) + V_{imt}^{L} * Pr(L_{imt} = 1|X_{it}) + (1 - Pr(P_{imt} = 1|X_{it}) - Pr(L_{imt} = 1|X_{it})) * \widehat{V^{J}(X_{\iota t})} - V_{imt}^{Q}}{\sigma_Q}\right) *$$

$$* \{Q_{it} = 0\} * \phi^{j}\left(y_{it}, \widehat{\sigma}_J{}^2\right)^{\{L_{it}=0\}*\{P_{it}=0\}}$$

where in period 0,

$$\phi^0\left(y_{it}, \widehat{\sigma_0}^2\right) = \phi\left(\frac{y_{it} - \left(r_0 \frac{Index_t^2}{\beta_i} + \delta \frac{Index_t}{\beta_i}\left(\frac{\partial}{e_{\iota t}}\left(E^0\left[\Psi^0(\widehat{X_{\iota t+1})}\middle|X_{\iota t}, y^{\widehat{0}(\widehat{X_{\iota t}})}\right]\right)\right)\right)}{\widehat{\sigma_0}}\right)$$

In period 1,

$$\phi^1\left(y_{it}, \widehat{\sigma_1}^2\right)$$

$$= \phi\left(\frac{y_{it} - \left(r_1 \frac{Index_t^2}{\beta_i} \Phi\left(\frac{\widehat{y^1(X_{\iota t})} - B_{ibt}}{\widehat{\sigma_1}}\right) + \delta \frac{Index_t}{\beta_i}\left(\frac{\partial}{e_{\iota t}}\left(E^1\left[\Psi^1(\widehat{X_{\iota t+1})}\middle|X_{\iota t}, y^{\widehat{1}(\widehat{X_{\iota t}})}\right]\right)\right)\right)}{\widehat{\sigma_1}}\right)$$

In period 2,

$$\phi^2\left(y_{it},\widehat{\sigma_2}^2\right)$$

$$= \phi\left(\frac{y_{it} - \left(r_2 \frac{Index_t^2}{2\beta_i}\Phi\left(\frac{y_{it-1+}\widehat{y^1(X_{it})} - 2B_{ibt}}{\widehat{\sigma_2}}\right) + \delta\frac{Index_t}{\beta_i}\left(\frac{\partial}{e_{it}}\left(E^2\left[\widehat{\Psi^2(X_{it+1})}\middle|X_{it},\widehat{y^2(X_{it})}\right]\right)\right)\right)}{\widehat{\sigma_2}}\right)$$

We use the likelihood function to estimate our model parameters ($\beta_{it}, u_{it}^M, u_{it}^L, u_{it}^Q$).

4.5 Identification

The identification of the parameters in the cost function in equation (4) comes from the time-varying commission rates in our data. The higher the value of β_i the less a salesperson's sales profit will respond to the increase in the commission rate. Furthermore, the reform of the firm provides an additional source of identification. Not only that the average commission rate increases after the reform, the change in the structure for how commissions are calculated implies that, if the cost of the effort is high, salespeople with a high base wage are less incentivized under the new policy than those with a low base wage, as the likelihood of achieving sales higher than the bar is smaller. The variation in terms of the sales response to the reform across salespeople therefore further helps the identification. For salespeople with the same base wage, the difference in the response to the changes in the commission rate and the commission structure after the reform across ages and education levels identifies β_i as a function of the age and education of a salesperson.

The identification of the non-pecuniary component in the utility function for the managerial job (u^P) and other non-sales jobs (u^L) is more challenging. The source comes from how salespeople respond to career movements; however, promotions and transfers in our data are a long process that is based on the work performance over many periods. A key identification assumption we rely on is that salespeople use the same career movement function, before and after the reform, that we estimate from equation (2) to form the expectation for promotion and transfer. With this assumption, the utility parameters are identified from two types of data variation. The first is within each individual how the sales performance changes as he approaches different points in the career path. Suppose a salesperson's performance improves as the likelihoods of promotion and transfer increases, to an extent larger than what can be explained by the pre- and post-promotion or transfer wage difference. This suggests that he is working harder to enhance the opportunity of promotion or avoid being transferred, implying a positive (negative) non-pecuniary component in u^P (u^L). Second, as we discussed in the data section, the reform changes the career movement policy from one based on seniority to another weighted more on the performance (through how performance impacts the evolution of the base wage which will then impact promotions and transfers). Before and after the reform comparison also enhances the identification. For example, suppose after the reform young salespeople increase sales profit more than their older counterparts, to an extent that cannot be explained by the change in the compensation scheme. Our model will infer that young salespeople are responding to the higher promotion opportunity and therefore the utility for the managerial job is higher than that for the sales job. For salespeople with the same likelihoods of promotion and transfer, the difference in their responses across ages and education levels identifies u^P and u^L as a function of the age and education of a salesperson.

Finally, after u^L is identified, the quit rate among salespeople will identify the utility function of quit (u^Q). If the quit rate is low even for those who are very close to being transferred, this implies the utility after quitting is more negative than the utility for other non-sales jobs. In addition, the variation of the quit rates among salespeople with different likelihoods of being transferred helps identify the standard deviation of the error term ϵ^Q in equation (13). If the standard deviation is large, the variation of quit rates will be small.

5 Estimation Results and Counterfactuals

In this section, we first present the results from estimating the dynamic structural model described in the previous section. We also compare the results with two alternative models to illustrate how the proposed model improves the in-sample data fit. Next, we use the estimation results to quantify the impact of the two incentives currently adopted by the firm on the performance of workers under different ages. We follow up by investigating how the two incentives can complement each other in enhancing the worker performance. Finally, we illustrate the impact of alternative career movement policies that change either how performance is evaluated or the income spread between managers and salespeople on the sales profit.

5.1. Estimation results

To investigate the importance of incorporating workers' career concerns in our proposed model, we also estimate two alternative models. The first model is static, assuming that a salesperson is myopic and thus he does not consider the effect on future payoffs when making the effort decision. He decides whether to quit by comparing his expected utility of staying with the firm with the utility of leaving in the current month. This setting is equivalent to fixing the discount factor to zero in the proposed model. The second model assumes that the salesperson considers how his current effort influences the future change in the base wage. However, he does not consider the chance of promotion or transfer. This setting is equivalent to fixing the probabilities of promotions and transfers to zero in the proposed model.

Table 9. Estimation results

	Static model			Dynamic model without promotions and transfers			Dynamic model proposed		
	Estimates	90% CI		Estimates	90% CI		Estimates	90% CI	
Cost of work effort									
Intercept	**-5.7241**	[-5.8448	-5.6113]	**-5.7344**	[-5.9957	-5.3755]	**-4.0128**	[-4.8131	-3.0001]
Age	-0.0007	[-0.0033	0.0021]	-0.0013	[-0.0096	0.0042]	**-0.0259**	[-0.044	-0.0058]
College	0.0178	[-0.0171	0.049]	**0.1280**	[0.0273	0.2479]	0.1715	[-0.0689	0.3001]
Utility function Parameters									
Manager: intercept							**14.9685**	[4.2364	47.2174]
Manager: age							**-0.2359**	[-0.7862	-0.0443]
Manager: college							0.5164	[-2.2603	1.701]
Transfer: intercept							**-3.7694**	[-15.0184	-0.0737]
Transfer: age							0.0345	[-0.0706	0.179]
Transfer: college							-0.2821	[-1.8174	1.1071]
Quit: intercept	0.3084	[-0.2199	0.6236]	**4.0726**	[3.0292	11.4785]	**-9.5698**	[-32.8389	-2.1056]
Quit: age	**-0.0985**	[-0.1246	-0.052]	**-0.1595**	[-0.6136	-0.0477]	**0.4946**	[0.1669	1.3173]
Quit: age2	0.0007	[-0.0001	0.0012]	-0.0001	[-0.0062	0.0045]	**-0.0053**	[-0.0143	-0.0017]
Quit: college	-0.0057	[-0.3598	0.2365]	-0.0232	[-0.9972	1.0897]	-0.0822	[-0.3948	0.455]
Quit: sigma				**114.9286**	[55.4529	362.7942]	**17.9723**	[10.4864	35.4984]
LLH		-79319			-87481			-73860	
BIC		158712			175047			148058	

Note: Estimates that are significant at .1 significance level are in bold.

Estimation results are presented in Table 9. For each estimate, we also report the 90% confidence interval obtained from the bootstrapping procedure. For model comparison, the last two rows report the likelihood function and the BIC value. The proposed model clearly out-performs the alternative models based on BIC, suggesting that incorporating the consideration of future career movements significantly improve the in-sample data fit. More importantly, ignoring career movements will bias the estimation results. The cost of effort (*cost: intercept*) estimated in the proposed model is significantly smaller in magnitude than the other models. This is because career concerns incentivize the work effort. When they are ignored in the alternative models, we will contribute salespeople's hard work to low effort cost and, as a result, underestimate the cost. In addition, how salespeople's ability change with age (*cost: age*) is also underestimated. This is because for older salespeople career movements are less important, but they are more skillful so the cost of inserting effort to increase sales is reduced with age (as the coefficient *cost: age* in the proposed model shows). These two effects cancel out each other in the alternative models and therefore the estimated parameter become insignificant. Based on these results, we will focus on the proposed model in all of the discussions below.

For the significant estimates, the cost of effort decreases with age, suggesting that job-specific learning may be significant among salespeople: as a salesperson gains more work experience, it is less costly for him to achieve higher sales. College education does not have a significant impact on the productivity for the sales job. For the managerial job, after controlling for the difference, the non-monetary payoff as a manager is significantly higher than that for the sales job (which is normalized to zero). This payoff decreases with age, probably implying that the future option value (from further promotion to even higher levels) is significantly higher for young managers. The monetary equivalence of the non-monetary payoff for employees at the age of 40, 50 and 60 are $5.5, $3.2 and $0.8 thousand per month. In comparison, the average monthly income of a manager at these ages are $3.8, $4.3 and $4.8 thousand, respectively, suggesting that the non-monetary payoff exceeds the monetary payoff for young employees. Even for a 60-year-old salesperson for whom further promotion is not in the consideration, the non-monetary payoff had he become a manager is about 17% of the monthly income, suggesting that the non-monetary benefits, such as the unique status and prestige in the workplace, are significant. The results also suggest that young employees will have a strong incentive to achieve promotion in the near future rather than waiting for long years.

For other non-sales jobs, the non-monetary payoff is significantly negative. Taking into account of the age difference (although the estimate for age is not significant), the monetary equivalence of the non-monetary payoff for employees at these jobs at the age of 40, 50 and 60 are -$2.4, -$2.1 and -$1.7 thousand per month, respectively, in comparison with the average monthly income after transfer at $3.1, $3.6 and $4.1 thousand, respectively. Overall, these results suggest the importance of the benefits and costs from career movements that cannot be measured by the change in income. The tournament theory predicts that, to incentivize the worker effort, there should be a sufficiently large spread in the pre- and post-promotion income. As we have shown, the non-monetary payoff can also be important, especially for young employees. It should not be ignored when a firm designs the optimal "prize" in the tournament.

Finally, there is a significant disutility from quitting to find new jobs in the external labor market. This is even larger than the non-pecuniary cost of being transferred. However, the disutility declines, in a non-monotonic way, as an employee ages and accumulates more sales experience. The disutility of quitting the sales job is the lowest at age 46.7, suggesting that a middle-aged salesperson with sufficient work experience is valued much higher than young or old salespeople in the external labor market.

5.2. Quantifying the impact of career movements on the worker performance

Our estimation results show that promotions and transfers are important for salespeople. We investigate in this section how the current policy adopted by the firm impact salespeople's performance. Starting from the first month after the reform, we simulate for each employed salesperson 100 paths of sales profit, wage growths, and career movements under different scenarios: (1) performance is rewarded by the new compensation scheme but there is no promotion or transfer; (2) there are promotions to the managerial level in addition to the compensation scheme; (3) there are transfers to other non-sales job in addition to the compensation scheme; (4) there are promotions and transfers but no compensation incentive;[6] and (5) there are promotions and transfers in addition to the compensation. We calculate the average sales profit of each salesperson from the 100 paths we simulate, then aggregate the profit for young (age 20-35), middle-aged (age 35-50) and old (age 50-60) salespeople. To control the difference in quits, promotions and transfers, we only look at the results in the first four months, before the actual job movements take place in the different scenarios.

Table 10. Sales performance under alternative incentive systems (per worker per month)

Profit (1,000 USD)	Sales Profit	Profit from young age	Profit from middle age	Profit from old age
Compensation	10.54	8.76	10.50	13.94
Compensation+promotion	15.45	13.77	15.99	15.58
Compensation+transfer	12.40	11.12	12.45	14.39
Promotion+transfer	5.26	5.78	5.79	1.57
Compensation+promotion+transfer	19.55	17.84	20.68	16.75

The first four-month simulated sales profits are reported in Table 10. The most notable finding is that the sum of profits in the scenarios when there are only compensations (1st row) and when there are only career movements (4th row) is smaller than the profit when compensations and career movements both exist (5th row). There is about 24% increase when both incentives are simultaneously offered, suggesting that career movements and compensation complement each other in enhancing employees' productivity. Note that

[6] For this scenario, we assume salespeople only receive the base wage and the commission rate is fixed at zero.

there is a target (base wage) in each month such that salespeople will receive commissions only after they reach the target, and another target (i.e. u^P for promotion) such that salespeople will become a manager only after their performance evaluation surpasses this target. The incentive from compensations makes salespeople work harder in each month, and thus makes it easier for salespeople to achieve the promotion target. This increases their response to the promotion. Future career movements, on the other hand, also provide additional incentive for workers to invest more effort in each month, and thus makes it easier for salespeople to achieve their sales target. It therefore also increases salespeople's response to the incentive from compensations. This complementarity implies that combining both incentives can be more effective than offering only one.

Comparing with the scenario where there is only compensation scheme, the current career movement policy increases the firm's profit by 85 percent. When there are only promotions, the profit increases by 46%, while it increases by 18% when there are transfers only, suggesting that promotion is a much stronger incentive than the fear of being transferred. This is because, when facing a negative outcome in the career path (i.e. being transferred), a salesperson has the option of getting a new job externally; therefore, the incentive from the demotion is less powerful than the incentive from the promotion. Furthermore, the profit increase, when promotions and transfers both exist (i.e. row 5 – row 1), is larger than the sum of the profit increases in the scenarios of promotions (i.e. row 2 – row 1) or transfers alone (i.e. row 3 – row 1), indicating that both types of career movements can complement each other to incentivize employees' effort. This is because when promotion opportunities exist, transfer becomes a harsher punishment to salespeople due to the loss of promotion opportunities after transfer. These results suggest that not only promotions but also demotions should be used as incentives.

Row 4 of the table suggest that, as expected, career movements have a larger influence on the work performance for young and middle-aged salespeople. For salespeople who are close to the age of retirement, however, promotions and transfers only have a marginal effect. On the other hand, the incentive from compensations is more important for older salespeople. These findings imply that it is important for the firm to offer both short-term incentives from the compensation (targeting older salespeople) and long-term incentives from career movements (targeting younger salespeople).

5.3. Decomposing the success of the reform

We investigate in this section the contribution of the various incentives to the success of the reform, as we documented in the data section through the reduced-form analysis. As shown in the data section, the reform has revamped the structure of the compensation scheme and career movement policies, including how the base wage is adjusted and how to promote or transfer salespeople. Until now, it is unclear what are the effects of these changes on the firm's profit.

We use a series of counterfactuals to decompose the effects from the reform. We assume that, starting from the first month after the reform, actual promotions and transfers follow the new policy in the first period after the reform. In scenario (1), we assume that the compensation scheme and the evolution of the base wage remain unchanged as before the reform, and salespeople assume that promotions and transfers are determined in the old way. Like the simulation procedure described in the previous section, we simulate for each salesperson 100 paths of sales profit, wage growths, and career movements, then sum up their sales profits, averaged over the 100 simulations, for the young (age 20-35), middle-aged (age 35-50) and old (age 50-60) salespeople. The total profit is denoted as $y^{(1)}$. In scenario (2), we assume that the compensation scheme has changed, but the evolution of the base wage remains unchanged and salespeople assume that promotions and transfers are determined in the old way. The total profit simulated in this scenario is denoted as $y^{(2)}$. The difference $y^{(2)} - y^{(1)}$ represents the effect from the change in the compensation scheme. In scenario (3), we change both the compensation scheme and how the base wage is adjusted, but assume that salespeople still expect promotions and transfers are as before. As the base wage is adjusted differently, the expectation for promotions and transfer will also change. To make sure that the incentive from promotions and transfers remains the same as before the reform, we assume that salespeople use a different base wage that evolves following the old way before the reform, to form the expectation for their promotions and transfers. The total profit simulated in this scenario is denoted as $y^{(3)}$. The difference $y^{(3)} - y^{(2)}$ represents the effect from the change in the policy of level movements within the sales job. Finally, in scenario (4) we assume the expectation for promotions and transfers also follow the new career movement policy. The total profit simulated in this scenario is denoted as $y^{(4)}$. The difference $y^{(4)} - y^{(3)}$ represents the effect from the change in the policies for promotions and transfers.

Table 11 reports the decomposition results that is based on the firm's profit in the six months after the reform. The upper panel reports the simulated changes in the total sales profit. The lower panel shows that 48% of the profit increase comes from the change of the compensation scheme, and 9% of the increase from the change in the way that the base wage is adjusted. In Section 3, we noted that a potential issue with the reform is that, when the base wage level is set too high, a salesperson may lose work incentive as the likelihood of reaching that level is small. The fact that the new compensation scheme significantly contributes to the profit increase suggests that it has been carefully designed such that the threshold is reachable for most salespeople and, therefore, the power of the incentive from the new scheme is enhanced.

Table 11. The decomposition of the success of the reform

Profit change(1,000 USD)	Total change	Profit change from young age	Profit change from middle age	Profit change from old age
$y^{(4)} - y^{(1)}$	13941.83	3015.01	9465.97	1460.86
$y^{(2)} - y^{(1)}$	6749.50	1275.59	4634.46	839.45
$y^{(3)} - y^{(2)}$	1205.22	278.84	457.40	468.98
$y^{(4)} - y^{(3)}$	5987.12	1460.57	4374.12	152.43

Profit change	Total change	Profit change from young age	Profit change from middle age	Profit change from old age
Ratio: $y^{(2)} - y^{(1)}$	48%	42%	49%	57%
Ratio: $y^{(3)} - y^{(2)}$	9%	9%	5%	32%
Ratio: $y^{(4)} - y^{(3)}$	43%	48%	46%	10%

The rest of the profit increase (43%) comes from the increased power of the incentive from career movements. These results suggest that the reform on career movements is also effective. The table also shows that the simulated profit increase for old salespeople is much smaller, consistent with the finding from the reduced-form analysis in Table 8. The likelihood of promotions and transfers is low for old salespeople; therefore, only 10% of the profit increase comes from the reform on promotions and transfers. The change in the compensation scheme is the key driver for the success of the reform for this age group.

5.4. Alternative career movement policies

With the estimation results, we are able to investigate how the firm's profit will change under alternative career movement policies. In this section, we use counterfactuals to study (1) how to change the way that promotions and transfers are linked to the work performance of a salesperson. (2) how to change the spread of the post- and pre-promotion monthly income. As these policies change, salespeople's effort will change and thus influence the number of quits, promotions and transfers created. Since we do not have data on the costs and benefits for the firm that are associated with the managerial and other non-sales jobs, we are unable to evaluate how the new promotions and transfers will impact the firm's net profit. To minimize the consequence of this issue on the results, we adjust the thresholds u_p and u_l in the career movement functions (see the discussion after equation (2)) in all of the counterfactuals to make sure the predicted numbers of promotions and transfers are close to that under the existing policy. This way the firm does not need to bear the new cost from creating new managerial and other non-sales job positions. Still, as the mix of salespeople who are promoted or transferred may change in the long-run, we are unable to evaluate the long-term profit impact of this change. For example, promoting a star salesperson instead of a more senior individual to the managerial level may not only reduce the total car sales but also create additional cost as the former can be a worse manager than the latter. We view this exercise below not as a way of searching for the optimal policy for career movements; rather, it quantifies how the short-term profit will change under alternative policies. The firm can use the results together with its expected benefits or costs not measured in this exercise, to decide whether the direction of those changes is beneficial for the profit maximization in the long run.

In the first counterfactual, we focus on how the work performance is evaluated. Based on our understanding, each salesperson is evaluated twice a year based on various criteria including the sales profit a salesperson contributed, his base wage, demographics, and other unobserved factors. Use the regression result of the order Probit model that is reported in Table 6, we recover the weight of each factor in the performance evaluation, after the reform, using the following procedure: For factor k, we first calculate the standard deviation of the factor (SD_k) among salespeople. The weight of the factor is computed as $weight_k = \frac{m_k * SD_k}{\sum_{k'} m_{k'} * SD_{k'} + 1}$. The "1" in the denominator is the standard deviation for the unobserved factors (i.e., the standard deviation of ϵ_{im}^{j} in equation (2) that is normalized to 1). This way the total sum of the weights for all factors is equal to 100%.

Table 12. The current and alternative evaluation system

	Evaluation factor	Weight
Current	Base wage	18.17%
u_p=6.97	Sales performance in last six months	3.64%
u_L=2.54	Age and education	12.99%
	Other factors	65.20%
Alternative	Base wage	17.45%
u_p=7.26	Sales performance in last six months	7.43%
u_L=2.85	Age and education	12.48%
	Other factors	62.64%

The upper panel of Table 12 reports the weights of the various factors used in the performance evaluation after the reform. The unobserved factors have the largest weight, followed by base wage and demographics. A salesperson's sales performance in the past six months only has 3.64% of weight in the evaluation (although the heavy weight for the base wage implies that a salesperson's current sales will be accounted for in the long run). Based on this observation, we assume that the firm increases the coefficient for sales performance in the career movement function (in Table 6) by 40%, and hold the coefficient of other variables constant. We then adjust thresholds u_p and u_l so that, as salespeople respond to the new performance evaluation, the numbers of quits, promotions and transfers remain roughly the same as before. The lower panel of Table 12 reports the new weights for each of the factors used in the job evaluation. Although the weight of the sales performance in the past six months is still the smallest, it has increased by more than 100% from the current evaluation policy. As a result of this change, the weights for other factors have decreased.

Table 13. Profit under the current and new policies

	Current profit	Alternative profit	Percentage change
Total	22014.32	24813.71	12.72%
Young age	4793.90	5322.17	11.02%
Middle age	15023.23	17253.11	14.84%
Old age	2197.19	2238.43	1.88%

Table 13 reports the simulated total sales profit under the current and the new policy, and also broken down by different age groups. The new policy increases the total profit by about 13%, suggesting the benefit of increasing the power of the incentive for promotions and transfers on the sales profit. As expected, the increases among young and middle-aged salespeople are much greater than that among old salespeople.

Table 14. Percentage changes of sales profit, manager payment and net profit from current setting under alternative wage policies

Change	Sales Profit	Manager Payment	Net Profit
Manager wage +$420	3.77%	10.32%	3.67%
Manager wage -$420	-3.38%	-9.28%	-3.19%

In the second counterfactual, we focus on how to change the spread of the post- and pre-promotion monthly income. Table 2 shows that the difference in the income of salespeople and managers is only about 10% of a salesperson's income. Increasing managers' income can further incentivize the salesperson's work effort. However, this will also increase the cost for the firm. Furthermore, as the non-monetary payoffs are large across salespeople of all ages, it is unclear whether increasing the income spread can have much impact on sales. In the counterfactual, we simulate and report in Table 14 the firm's sales profit by increasing and decreasing the managers' income by $420 (which is the current difference between salespeople and managers). We then subtract the total income of all employees from the total sales profit to calculate the net profit. Similar to the previous counterfactual, we also adjust the promotion and transfer targets to make sure that in equilibrium, the number of quits, promotions and that of transfers remain close to that under the current policy. Table 14 shows that, as managers' income increases, total sales profit will increase by about 4%, though the firm has to pay 10% higher salary to managers. Reducing managers' income, in contrast, will reduce the net profit by about 3%. This exercise demonstrates that the current "prize" for promotions is too small from the perspective of maximizing the short-term profit for the firm. Again, we caution that the results from the two counterfactuals do not imply the long-term profit change.

6 Conclusion

In this paper, we develop and estimate a dynamic structural model and empirically study the effectiveness of compensation schemes and career movements on the worker productivity in a Japanese auto sales firm. The hierarchical job structure of firms, together with the payment structure, provides incentives for better work performance when employees are forward-looking. Our results show that, relative to the sales job, managerial jobs bring an employee higher monetary and non-monetary payoffs, while other non-sales jobs are worse off in both dimensions. Career concerns are important when salespeople make the work effort decision, and the impact is especially large for younger salespeople. Furthermore, such a long-term incentive can significantly complement the short-term incentive from compensations to enhance employees' productivity. We also find that about half of the profit increase from the firm's reform comes from the increased power of the incentive from the compensation scheme, and the rest from the change in the career movement policies. Finally, we illustrate how the short-term profit of the firm will change under alternative policies that place more weight on the work performance, or increase the income spread between the post- and pre-promotion jobs, to further incentivize the work effort from young and middle-aged salespeople.

This study has several limitations. First, we focus on how compensation and career movements incentivize the work performance and abstract away from how these policies create self-selection among employees through accepting contract offers and quitting jobs. Conceptually, an incentive system weighted more on job performance will attract workers with higher ability and force those with lower ability to leave. To study such effects we have to model the intrinsic ability of each worker and their job search decisions. This is out of the scope of the current study. Second, we assume that salespeople are risk-neutral. Incorporating risk-aversion in our model helps explain, for example, why the firm offers a base wage to salespeople. It is unclear whether salespeople have the same risk aversion toward the opportunities of promotion or the danger of being transferred. If such aversion exists, it is also unclear how it can be identified from the data. Third, due to data constraints we are unable to study the factors that incentivize the performance of employees at the managerial and other non-sales jobs. Finally, this study is not a direct test of the tournament theory, as we do not have the required data variation. For example, we do not observe significant changes in the difference between the pre- and post-promotion income. These are important venues for future research.

References

Audas, R., Barmby, T., & Treble, J. (2004). Luck, effort, and reward in an organizational hierarchy. *Journal of Labor Economics*, *22*(2), 379-395.

Baker, G., Gibbs, M., & Holmstrom, B. (1994). The internal economics of the firm: evidence from personnel data. *The Quarterly Journal of Economics*, 881-919.

Baker, G., Gibbs, M., & Holmstrom, B. (1994). The wage policy of a firm. *The Quarterly Journal of Economics*, 921-955.

Bandiera, O., Barankay, I., & Rasul, I. (2007). Incentives for Managers and Inequality among Workers: Evidence from a Firm-Level Experiment. *The Quarterly Journal of Economics*, *122*(2), 729-773.

Basu, A. K., Lal, R., Srinivasan, V., & Staelin, R. (1985). Salesforce compensation plans: An agency theoretic perspective. *Marketing science*,*4*(4), 267-291.

Becker, G. S. (2009). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago press.

Chan, T. Y., Li, J., & Pierce, L. (2014). Compensation and peer effects in competing sales teams. *Management Science*, *60*(8), 1965-1984.

Chung, D. J., Steenburgh, T., & Sudhir, K. (2014). Do bonuses enhance sales productivity? A dynamic structural analysis of bonus-based compensation plans. *Marketing Science*, *33*(2), 165-187.

Coughlan, A. T., & Narasimhan, C. (1992). An empirical analysis of sales-force compensation plans. *Journal of Business*, 93-121.

Coughlan, A. T., & Sen, S. K. (1989). Salesforce compensation: Theory and managerial implications. *Marketing Science*, *8*(4), 324-342.

Doeringer, P. B., & Piore, M. J. (1985). *Internal labor markets and manpower analysis*. ME Sharpe.

De Varo, J. (2006). Internal promotion competitions in firms. *RAND Journal of Economics*, 521-542.

Gibbons, R., & Murphy, K. J. (1991). *Optimal incentive contracts in the presence of career concerns: Theory and evidence* (No. w3792). National Bureau of Economic Research.

Gayle, G. L., Golan, L., & Miller, R. A. (2015). Promotion, turnover, and compensation in the executive labor market. *Econometrica*, *83*(6), 2293-2369.

Greenwald, B. C. (1986). Adverse selection in the labour market. *The Review of Economic Studies*, *53*(3), 325-347.

Hölmstrom, B. (1979). Moral hazard and observability. *The Bell journal of economics*, 74-91.

Joseph, K., & Kalwani, M. U. (1998). The role of bonus pay in salesforce compensation plans. *Industrial Marketing Management*, *27*(2), 147-159.

Kandel, E., & Lazear, E. P. (1992). Peer pressure and partnerships. *Journal of political Economy*, 801-817.

Lal, R., Outland, D., & Staelin, R. (1994). Salesforce compensation plans: an individual-level analysis. *Marketing Letters*, *5*(2), 117-130.

Lal, R., & Srinivasan, V. (1993). Compensation plans for single-and multi-product salesforces: An application of the Holmstrom-Milgrom model. *Management Science*, *39*(7), 777-793.

Lazear, E. P. (1986). Salaries and piece rates. *Journal of business*, 405-431.

Lazear, E. P. (2000). The power of incentives. *The American Economic Review*, *90*(2), 410-414.

Lazear, E. P., & Rosen, S. (1981). Rank-order tournaments as optimum labor contracts. *Journal of Political Economy*, 841‑864.

Misra, S., Coughlan, A. T., & Narasimhan, C. (2005). Salesforce compensation: An analytical and empirical examination of the agency theoretic approach. *Quantitative Marketing and Economics*, *3*(1), 5-39.

Misra, S., & Nair, H. S. (2011). A structural model of sales-force compensation dynamics: Estimation and field implementation. *Quantitative Marketing and Economics*, *9*(3), 211-257.

Paarsch, H. J., & Shearer, B. S. (1999). The response of worker effort to piece rates: evidence from the British Columbia tree-planting industry.*Journal of Human Resources*, 643-667.

Paarsch, H. J., & Shearer, B. (2000). Piece rates, fixed wages, and incentive effects: Statistical evidence from payroll records. *International Economic Review*, *41*(1), 59-92.

Rao, R. C. (1990). Compensating heterogeneous salesforces: Some explicit solutions. *Marketing Science*, *9*(4), 319-341.

Shearer, B. (2004). Piece rates, fixed wages and incentives: Evidence from a field experiment. *The Review of Economic Studies*, *71*(2), 513-534.

Waldman, M. (1984). Job assignments, signalling, and efficiency. *The RAND Journal of Economics*, *15*(2), 255-267.

Zoltners, A. A., Sinha, P., & Lorimer, S. E. (2008). Sales force effectiveness: A framework for researchers and practitioners. *Journal of Personal Selling & Sales Management*, *28*(2), 115-131.