Incentives from Career Concerns in a Contract Package: An Empirical Investigation

Abstract

This paper empirically studies the extent to which career concerns as part of a typical contract offer influence employees' work performance in a Japanese auto dealership firm. Since career movements and base wage adjustments rely on performance evaluation over time, we develop a dynamic structural model that allows concerns for future payoffs to impact an employee's current work effort. A reform in personnel management policies of the firm during the data period enables us to compare not only the performances across individuals, but also to compare within an individual the performance before and after the reform—this enhances the model identification. Our estimation results show that the added value from career movements on top of the monetary payoffs is more important than the monetary payoffs. Individuals respond to career movements and commissions differently, mainly due to varying cost of effort and different payoffs from career movements. Our counterfactual exercises suggest that, compared with the scenario when there is only monetary compensation, adding career movements in a contract package will greatly improve the firm's gross profit. The firm can improve its net profit by making commission and promotion more performance-based.

1. Introduction

Moral hazard arises in a firm when its employees' effort cannot be observed. To resolve this issue, firms often offer employees a contract package combining explicit incentives, in the form of a performance-related compensation scheme (via commission), and implicit incentives that address employees' career concerns (Fama 1980; Gibbons and Murphy 1992). Career concerns have two typical building blocks. First, an employee's base wage or salary (which is not related to the current performance) can adjust over time; second, there can be career movements, including promotions and demotions, within the company. Implicit incentives usually are not specified in a contract offer; instead, they are stated in the personnel management policy of firms or just indicated by past practices. Under implicit incentives, an employee's current performance will influence not only the future compensation but also the added value on top of monetary payoff (e.g., prestige or status if promoted to a higher job level); thus, implicit incentives can be a strong motivation for work effort. Combining both incentives could benefit both firms and employees. This is because an optimal compensation scheme that fully resolves the moral-hazard problem is typically difficult to implement, so career concerns can incentivize further work effort from employees. The two incentives, however, may work differently across individuals. As an example, career advancements may weigh heavily for young employees in their work decisions, but for employees who are near the age of retirement, such a long-term goal may be less relevant and compensation is the primary concern (Gibbons and Murphy 1992).

The goal of this paper is to study to what extent explicit and implicit incentives influence the work performance of an employee. Quantifying the impacts of the incentives is an essential first step for firms to design an optimal contract offer. Based on the results, researchers can investigate how to improve a firm's profit by manipulating the two incentives. To achieve this goal, we study a unique personnel dataset on car salespeople provided by an auto dealership in Japan. Several features of the data make it ideal for our research objective. First, the firm uses commissions and career concerns as incentives for every salesperson. Our data contain detailed descriptions of how a salesperson's income, including his base wage and commission, adjusts over time, as well as his career movements for about eight years. Second, we observe the revenue and profit from car sales—which, from the firm's perspective, are the most relevant measures of work performance—for every salesperson in each month. These data allow us to directly test the relationship between the incentives and performance. Finally, as improved performance typically leads to higher commission and promotion opportunity simultaneously, separating the effects of explicit and implicit incentives is challenging for empirical researchers. During the data period, the firm initiated a reform in personnel management policies that drastically restructured how a salesperson is compensated and how his future base wage is adjusted. There was also a change in career movement policies. This reform enables us to compare not only the performances across salespeople, but also the performances before and after the reform within each salesperson, which enhances the identification of our model.

To study the effects of career concerns, a dynamic framework is required. This is because career movements and wage adjustments typically rely on the performance evaluation over time, and so the effects are long-term. We develop a dynamic structural model that allows concerns for future payoffs to influence an employee's current work effort. Furthermore, since career movements involve changes in job task, work environment, and prestige, our model allows individuals to value career movements based on both the monetary return and the added value on top of that. It also allows for the possibility that, when facing a negative outcome in the career path, an employee can quit to seek opportunities in the external labor market. Finally, we use a latent class model to capture the different intrinsic abilities of salespeople. Although we focus on one particular empirical setting, our model can be applied to study other compensation schemes and career movement policies. Researchers can use the same modeling approach to investigate the effectiveness of alternative incentives.

Estimation results show that the added value on top of monetary payoffs from promotions and transfers is more important to the sales employees than monetary payoffs. Quitting is costly but less so for experienced salespeople. There are two segments of salespeople. One has lower effort cost for selling, and salespeople of this segment are more responsive to the changes in commissions. The other segment values promotions highly, and salespeople of this segment are more motivated by career concerns. We use counterfactuals to show that both commissions and career movements are important incentives in our empirical setting, and they can complement each other to improve employees' performance. Compared with the scenario when there is only monetary compensation, adding career movements in a contract package will greatly improve the firm's gross profit. The incentive from base wage adjustments, on the other hand, is less powerful, as a salesperson's gross profit will be much lower if the firm offers only base wage in the contract. Finally, we find that the firm can further improve its net profit by enhancing the current monetary and non-monetary incentives currently provided by the company.

Our research is related to several streams of literature. The most relevant stream is the salesforce management literature in marketing. On the theory side, research has mainly focused on the design and implementation of compensation plans 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). On the empirical side, due to the increased data availability at the individual level, the past two decades also witnessed a rapid growth of research that empirically identifies the relationship between various compensation schemes and employees' productivity (e.g., Paarsch and Shearer 1999, 2000; Lazear 2000; Shearer 2004; Bandiera, Barankay, and Rasul 2007; Chan, Li, and Pierce 2014). Misra (2019) provides an excellent review of the literature.

In recent years, some researchers have used dynamic structural models to quantify the dynamic effects of compensation schemes. For example, Misra and Nair (2011) present an empirical framework to evaluate the effectiveness of a compensation plan with quota and ceiling, and they demonstrate the external validity of the dynamic structural model via a field experiment. Chung, Steenburgh, and Sudhir (2014) also use a dynamic structural model to study the effectiveness of bonus in motivating salespeople. Our model is similar to Misra and Nair (2011) and Chung et al. (2014) due to the dynamic nature of our empirical setting, and we contribute to this literature by studying how implicit incentives, including wage and career movements within a firm, together with compensation, affect employees' productivity.

There is a large stream of theoretical literature in economics aiming to explain the existence of implicit incentives or career concerns in a company. Holmstrom (1999) models how a person's concern for a future career may influence his/her current effort decisions on the job if firms need to learn the ability of employees. Furthermore, the positive relationship between earning and age can be explained by human-capital investments (e.g., Becker 1962; Hashimoto 1981; Prendergast 1993) and can provide additional incentive to workers when the worker output or effort is hard to monitor (e.g., Lazear 1979; Hutchens 1987). Pearce and Stacchetti (1998) argue that implicit incentives mitigate the tradeoff between incentive and insurance, whereas Baker, Gibbons, and Murphy (1994) show the role of implicit incentives in improving efficiency by using information revealed *ex post*. The tournament theory (Lazear and Rosen 1981; Zabojnik and Bernhardt 2001; Waldman 2013) holds that wage increase after a promotion could induce higher work effort from employees, and the theory has been used to study the optimal incentive scheme (e.g., Meyer 1992). Unlike the above theoretical works that focus on explaining the existence of implicit incentives, the objective of our study is to empirically investigate the effects of implicit and explicit incentives on workers' performance. Furthermore, while those papers generally assume that the observed contracts are optimally determined by the firm, a partial equilibrium model is more reasonable in our setting. In other words, we assume that the firm is bounded rational, and we can provide suggestions on profit-increasing incentive schemes. This is consistent with our empirical setting, as we will elaborate later in section 2. [1]

Since we study how career movements incentivize employees' work effort, our modeling framework is more related to the tournament theory. Our choice of the modeling

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[1] Based on our conversations with the firm's managers, the firm does not know what the optimal policy should be. Therefore, they are willing to share the data with us in exchange for advice. Besides, we would not have observed the reforms if the firm had always behaved optimally. In marketing literature, it is common to make the partial equilibrium assumption and suggest better policies (e.g., Chung et al. (2014); Misra and Nair (2011)).

framework is also motivated by the reform of the focal firm, for which the primary reason was to strengthen the incentives for better employee performance. In tournament theory, the incentive due to career concerns comes from the wage increase upon promotion. A typical career movement (promotion or demotion), however, is often associated with changes in job tasks, which could involve additional benefits and costs on top of the monetary payoff. It is uncertain *a priori* that career concerns are an effective incentive in a more realistic empirical setting. In addition, firms often offer explicit incentives simultaneously with implicit incentives; therefore, it is also unclear how career concerns work with the compensation scheme as a contract package (Gibbons and Murphy 1992). Our study aims to fill this gap in the literature.[2]

Most empirical works in the literature of career concerns are descriptive in nature. Documented findings include the pattern of job transitions (e.g., Baker, Gibbs, and Holmstrom 1994a), fast tracks (e.g., Chiappori, Salanie, and Valentin 1996), wage and position changes (e.g., Baker, Gibbs, and Holmstrom 1994b), and performance evaluations (e.g., Medoff and Abraham 1980, 1981). Some findings are consistent with the predictions from existing theories, but some are not. While there is a stream of literature in structural labor economics that model one's career decisions, they mostly focus on the external market. For example, Keane and Wolpin (1997) studies schooling, work, and occupational choice decisions of young men from the 1979 youth cohort of the National Longitudinal Survey of Labor Market Experience (NLSY). More recently, Gayle, Golan, and Miller

[2] Our model differs from tournament theory in several other aspects. Due to the empirical observation from data (which will be discussed later), we assume that career movements are determined by own performance of the focal worker, instead of the relative performance among workers as suggested by the theory. Furthermore, our model allows for annual base wage adjustments in career concerns that are not in the theory.

(2015) use a dynamic structural model to investigate how an executive makes job choices considering the payoffs that come from both current work and human-capital accumulation. Similar to their approach, we develop and estimate a dynamic structural model in this paper. They study the external labor market, whereas our research focuses on the internal labor market and more relevant to the firm's decisions on the design of internal incentives.[3] In another recent paper, Pastorino (2022) estimates and develops a structural model of individual career advancement within a firm. While the paper focuses on explaining how job and wage are determined with the learning about workers' ability and human capital accumulation, we focus on studying the incentives they provide to the employees.

With most previous work focused on either the compensation scheme or career concerns, a few theory papers have studied the optimal combination of both incentives in a contract package. Gibbons and Murphy (1992), for example, provide a theoretical framework to study such an optimal package. Their model predicts that explicit incentives in an optimal compensation contract should be stronger for workers close to retirement since career concerns are not relevant. They find empirical support by studying the relationship between chief executive compensation and stock market performance. Similar to their approach, explicit and implicit incentives are both at work in our model. We consider not only future wage changes as in their theory model, but also career movements that involve changes in job tasks. Our empirical focus is on common employees (i.e.,

[3] Due to the lack of performance data, Gayle et al. (2015) rely on the assumption that firms offer an optimal contract when estimating the model. Our rich data on employee performance, compensation, and career movements, however, enable us to study the relationship between incentives and performance without this assumption.

salespeople) who may be promoted or demoted within a firm, which differs from their analysis of chief executives who are already at the top of the career ladder.[4]

To sum up, our paper empirically studies an internal labor market where the firm offers both explicit and implicit incentives for employees. We use a dynamic structural model to help quantify the importance of these two types of incentives. Our paper is organized as follows: Section 2 describes the data and presents some data statistics and patterns. Section 3 specifies the model and discusses the estimation strategy. Section 4 presents results from the model estimation and counterfactuals. Finally, Section 5 concludes.

2. Data and Descriptive Analysis

2.1. Background

Our data provider is one of the largest regional auto dealers in Japan, selling and leasing cars produced by one of the world's largest auto manufacturers. The data period is from April 1998 to December 2005. As a snapshot, the firm had 74 outlets in 2004, hiring 700–800 salespeople. Most employees join the firm at young age (the average starting age is 20.8) and retire at the age of 60. Annual sales revenue in 2004 was \$1.3 billion US dollars.[5] Based on a report from *Automotive News*, this is equivalent to the 20th largest car dealer in the US as measured by sales revenue.

The auto dealer has three departments: new car sales, used car sales, and service. Salespeople in sales departments sell cars and auto insurance as well as lease cars. In

[4] Furthermore, Gibbons and Murphy (1992) rely on the stock market performance to measure the performance of chief executives. This may not be a precise proxy since the stock market performance is a cumulative result of the joint efforts of chief executives, managers, and other employees at lower levels. In contrast, we have a precise measure of the individual performance of every salesperson. This is important for our research objective, which is to quantify the effects of both incentives on employee performance.

[5] We convert Japanese Yen to US Dollars throughout this paper using an exchange rate of 118 Japanese Yen per USD.

addition, they make referrals to the service department to cross-sell to existing customers. Individual salespeople do not negotiate prices, although managers of an outlet have discretion over price thus can cut prices of deadstock or offer a discount for corporate customers. In order to prevent salespeople from competing with each other for the same customers, each salesperson is given his or her own sales territory where the salesperson has the priority to contact customers. Salespeople might go door-to-door to visit prospects in their territory in addition to just waiting and greeting new drop-in customers at their outlet. They also periodically make phone calls to existing customers to entice them to replace their old car or to remind them of the time of statutory vehicle inspections.[6]

A salesperson earns a base wage and a commission every month. There is adjustment (mostly upward) each year in the base wage, which is associated with the salesperson's job level. One who is low in the pay range for his/her job level can earn a large wage increase if he/she receives a high performance rating in the subjective evaluation. The same performance rating would give him/her a smaller pay increase if he/she is already high in the pay range. An employee could receive a wage cut depending on the performance rating and the current wage for the job level.

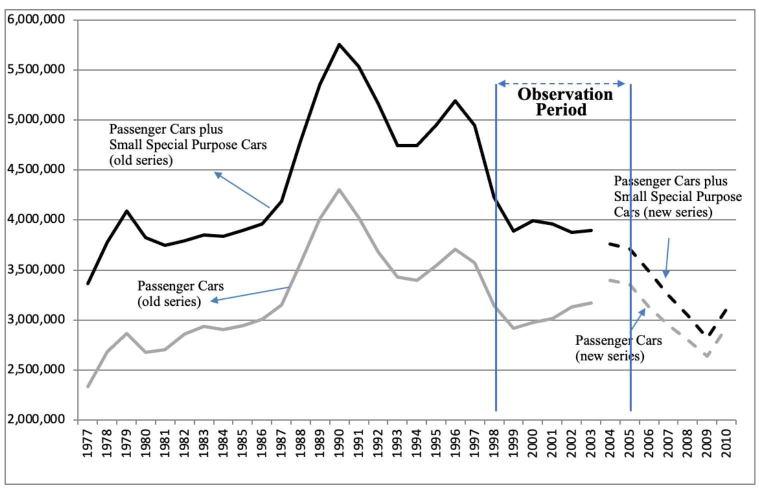
There are two types of career movements. A salesperson may be appointed as a manager of an outlet, whose main task is to supervise other employees in the outlet, or transferred to a non-sales job, such as a clerk who mainly undertakes routine administrative duties. On average a manager earns more than a salesperson, and this career change is viewed as a promotion. In contrast, after transfer to a non-sales job the salesperson will

[6] Some additional institutional background information is available in Takahashi et al. (2020).

lose a significant amount of income mainly because commission is no longer available; and this career change is generally viewed as a demotion within the organization.

Figure 1 shows the long-term trend of national car sales in Japan. New car sales in Japan rose steadily during the high-growth era until the beginning of the 1990s, when the market approached the saturation point and economic growth stalled; sales entered a downward trend.[7] However, during our observation period, the demand has been relatively stable in terms of the number of passenger and special-purpose cars sold, except for a small drop in sales in 1999.

Figure 1 National Car Sales Trend in Japan



In October 2000, in response to an economic recession during that period, the firm launched a reform in personnel management policies that included changes in both performance evaluation and compensation schemes. The recession, which is referred to as the “Lost 20 Years,” lasted from 1990 to 2010 in Japan. The firm’s sales have suffered for

[7] There is a discontinuity in 2004 for national car sales data. In the old series, the distinction between passenger cars and special-purpose cars was based on the specifications of a model’s chassis, whereas the new series uses registration number categories. As a result, vans and some SUVs were reclassified from the special-purpose car category to the passenger-car category.

some time. We are told by the firm that the objective of the reform was to increase the incentive for work effort by relating income changes and career movements more closely to a salesperson's performance. From our conversations with the firm's managers, the reform was not driven by dealer-specific factors or other time-specific shocks that are unobserved to researchers. Instead, the reform was due to the profit pressure that most Japanese firms were coping with under the long recession, which started before our sample period. Song (2010) documented that many large firms introduced performance wages during that period. In 1991 (the start of the recession), more than three-quarters of Japanese firms preferred seniority wages; however, less than one-quarter still wanted to continue using by 2000.

We now provide details on the compensation scheme and career concerns for salespeople. For compensation, before the reform (*Period 0*, from April 1998 to September 2000), a salesperson earns a base wage plus the commission from the cars he sells in each month. The commission of a car is calculated as the gross profit, i.e., the selling price minus the cost (to the firm) of the car, multiplied by the commission rate. The average commission rate of the cars sold during the period is 4.5%. The monthly payment therefore consists of a part that is performance-related (commission) and another part that is fixed (base wage). Let B_{it} be the base wage of salesperson i in month t, and r_0 be the commission rate, then the monthly income of the salesperson in Period 0 (denoted by superscript "0") is

$$w_{it}^0 = B_{it} + r_0 \cdot y_{it}, \tag{1}$$

where y_{it} is the gross profit the salesperson makes in the month.

After the reform (from October 2000 to December 2005), the average commission rate significantly increases to 21.2%. The payment structure also changes from Period 0: a salesperson's monthly payment becomes the maximum of his base wage and commission. The firm hopes that salespeople will view the base wage as a "soft target," and the higher commission rate can stimulate his effort to achieve commission higher than this target.

In the early period after the reform (*Period 1*, from October 2000 to March 2004), the commission is calculated based on y_{it}, same as Period 0. Due to the concern that salespeople might game the system by manipulating the timing of sales, the commission later (*Period 2*, from April 2004 to December 2005) was calculated based on the salesperson's average gross profit of the current and previous months. Therefore, the monthly income of the salesperson in Period 1 (denoted by superscript "1") is

$$w_{it}^1 = \max\,(B_{it}, r_1 \cdot y_{it}), \tag{2}$$

where r_1 is the higher commission rate. In Period 2 (denoted by superscript "2"), the monthly income becomes

$$w_{it}^2 = \max\left(B_{it}, r_1 \cdot \frac{(y_{it}+y_{it-1})}{2}\right). \tag{3}$$ [8]

Regarding career concerns, first, an individual's job level (within the sales job) may be adjusted, based on the performance evaluation that is typically done by the manager of an outlet in April of each year. The formal evaluation system was instituted in 2000, which started affecting the job-level adjustments in April 2001. There are multiple criteria that determine a salesperson's performance, but annual profit earned by the salesperson (including car sales and insurance sales) is the most important. Before the reform, more discretion was given to managers of outlets in terms of how and what dimensions of

[8] In the model that we describe in the next section, we take into account how salespeople's effort may change following this policy change, but we abstract away from the potential gaming behavior, which is not the focus of this study.

performance are evaluated. One's base wage monotonically increases with higher job levels. The chance of being promoted to the managerial level or transferred to a non-sales job is also influenced by the job level. The job level does not change the job task, and it is not explicitly displayed in the workplace. In fact, each job level corresponds to a specific pay range. Therefore, to simplify our analysis, we assume that the change in job level is fully captured by the change in base wage adjustments. The base wage adjustment creates interesting dynamics that can affect a salesperson's incentive in different ways. On one hand, selling more can improve the performance evaluation and thus positively impacts future income. On the other hand, if the base wage becomes very high, after the reform the salesperson may lose incentive since the likelihood of surpassing the base wage (see equations (2) and (3)) is small. Therefore, the base wage adjustment may not always enhance the incentive, especially for older salespeople whose base wage is in general higher than that of young employees.

Career movements involve promotion to the managerial level or being transferred to a non-sales job. These occur mostly at the beginning of April and October every year.[9] A manager's job task is different from the sales job and includes devising sales promotion strategies and assigning, training, motivating, and evaluating employees. Therefore, general management knowledge such as accounting and leadership, coaching, and training skills are considered in addition to selling performance in identifying candidates for

[9] Although we still observe some changes in other months, we were told that the salespeople were notified about the job changes soon after the job evaluations, which are conducted twice a year right before April and October and are used to determine job movements. Therefore, we assume that the job movements we observe between April and October were determined in the earlier month. For example, if we observe two job movements in May, we assume that they are determined in April and we do not use the salesperson's data in May, as his behavior and incentive as a salesperson could be different once he learns that he will be promoted soon.

managers (Benson, Li, and Shue 2019). As a result, the promotion process is mostly discretionary, and our analysis shows that employees with a four-year college degree are much more likely to get promoted than those with less education if the sales performance is the same. On top of the monetary payoff, non-monetary attributes of the job may be important because the manager enjoys a more comfortable environment and a higher social status inside the company. Transfer to non-sales jobs, on the other hand, is considered a punishment for low performers, because these jobs have a lower monthly income and status at the workplace.[10] Salespeople can quit the job voluntarily if their payoffs are too low or there is not enough opportunity for career advancement.[11] In this case, they will seek new jobs in the external labor market, and we no longer have their record.

2.2. Some summary statistics

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

	Before reform				After reform			
	All	Young	Mid-aged	Old	All	Young	Mid-aged	Old
Monthly gross profit (1,000 USD)	11.90	11.68	12.10	10.95	15.95	17.85	16.39	13.47
	(3.56)	(3.66)	(3.63)	(3.11)	(4.27)	(5.03)	(4.41)	(3.58)
Monthly commission (1,000 USD)	0.54	0.52	0.55	0.48	3.39	3.78	3.46	2.95
	(0.14)	(0.15)	(0.14)	(0.12)	(0.84)	(1.02)	(0.87)	(0.71)
Monthly effective commission (1,000 USD)	0.54	0.52	0.55	0.48	0.77	1.18	0.82	0.35
	(0.14)	(0.15)	(0.14)	(0.12)	(0.56)	(0.78)	(0.59)	(0.3)
Monthly base wage (1,000 USD)	3.01	2.47	3.19	3.81	3.23	2.90	3.18	3.73
	(0.1)	(0.09)	(0.07)	(0.06)	(0.07)	(0.24)	(0.04)	(0.04)
Number of salespeople (monthly average)	287	86	186	14	204	23	147	34

*Note: effective commission is the part that is greater than the base wage after the reform.

In this study, we focus on 340 salespeople who start their job in the new car department, and exclude those who work in other departments or move to the new car department from

[10] We do not consider the case of voluntary transfer to non-sales jobs, as the company said it is very rare. Since transfer is considered to be demotion, it is very unlikely that a salesperson does it voluntarily, especially in Japan where people are highly status-conscious.
[11] Layoffs are rare in Japan, as most firms provide life-long job security for employees.

other departments during the data period. Our data consist of each salesperson's gross profit from car sales in each month, base wage, career movements, and demographic information including age and education.[12]

Table 1 presents the mean and standard deviation (in parentheses) of the monthly gross profit, commission, and base wage of salespeople in our focal sample, broken down by age groups, before and after the reform.[13] We group salespeople in each month as young (age younger than 35 years), middle-aged (between 35 and 50 years), and old (above 50 years). The average gross profit after the reform significantly increased for all age groups.[14] As a result, salespeople earned a higher commission. Defining effective commission as the part of commission that is greater than the base wage after the reform, we can see that on average the effective commission after the reform is lower than the commission before the reform for old salespeople. Thus, the new payment structure may reduce the incentive of this group. The base wage for young salespeople has increased, but it has decreased for the older employees. This is because, as we will show in Table 4, the reform changed the performance evaluation to one weighted less on seniority and more on sales.

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

[12] All the salespeople are male in our data.

[13] Due to sorting effect, the composition of salespeople may change because of promotions, transfers, and quitting. We address this issue in the model section.

[14] We run a profit regression controlling for salespeople fixed effects and seasonality. Results show that the gross profit significantly increased after the reform. The effect is stronger for young and middle-aged than old salespeople. We also find that the gross profit in Period 2 is lower than that in Period 1 across age groups.

for the sales job. The income of managers and other non-sales jobs in our data increases in general as the age grows. We do not have information on the break-down of the income and work performance of managers and other non-sales jobs.

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

	Before reform	After reform
Monthly income of salespeople (1,000 USD)	3.54	4.00
	(0.63)	(1.3)
Monthly income of non-sales jobs (1,000 USD)	3.18	3.38
	(0.75)	(0.61)
Monthly income of managers (1,000 USD)	4.21	4.38
	(0.46)	(0.47)
Annual transfer rate	3.72%	2.19%
	(0.04)	(0.02)
Annual promotion rate	2.30%	6.94%
	(0.04)	(0.06)
Annual quit rate	2.88%	0.76%
	(0.02)	(0.01)

Table 3: 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
	SD	6.22	3.58	6.85	5.37	6.74	4.25	7.24	6.60
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
	SD	0.49	0.13	0.48	0.54	0.43	0.25	0.41	0.50
Half year gross profit ($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
	SD	25.51	25.16	15.29	20.86	36.63	34.76	24.25	31.94
Average monthly income ($1,000 USD)	Min.	1.18	3.72	2.43	1.18	2.03	3.23	2.44	2.79
	Median	3.59	4.05	3.44	2.77	3.92	4.30	3.56	3.35
	Mean	3.57	4.08	3.48	2.82	4.11	4.52	3.61	3.42
	Max.	5.24	4.53	4.36	4.26	11.51	6.97	4.53	4.67
	SD	0.60	0.24	0.53	0.71	0.95	0.92	0.58	0.61
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.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	SD	0.50	0.52	0.50	0.51	0.50	0.50	0.42	0.52

The last three rows of Table 2 compare the annual rate of promotions, transfers, and voluntary quits. Contrary to the finding in Baker et al. (1994a), the transfer rate is higher than the promotion rate before the reform in our data. After the reform, the promotion rate significantly increases and is three times as high as the transfer rate. Voluntary quits have also significantly dropped.

Career movements depend on many factors including age, education, base wage (or job level), and past work performance of salespeople, as well as other factors that are subjectively evaluated and unobserved from data. Table 3 reports the statistics of some characteristics for (1) all salespeople, (2) salespeople who are promoted, (3) salespeople who are transferred, and (4) salespeople who quit. Promotions mostly are for 35- to 50-year-olds who have a high base wage, work performance, income, 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. In terms of education, those without a college degree are more likely to be transferred or voluntarily quit before and after the reform. On average, salespeople's income increases after the reform, and the increase is smaller for the group who are transferred, compared to others. This implies that the reform helps sort the less productive workers to other non-sales jobs.

2.3. Regression analyses of career concerns

Base wage adjustments and career movements are stochastic, as they rely on the performance evaluation that depends on past performances, seniority, and education level, as well as other factors (e.g., help for peers, work attitude, leadership, etc.) that are subjectively evaluated. Unlike monthly compensation discussed in section 2.1, we do not know the specific rules the firm used to determine the changes, thus we have to infer from data. In this section, we quantify the important factors that affect career concerns before and after the reform. These regression results will be used in the structural model described in the next section.

2.3.1 Base wage adjustments

A salesperson's base wage (and job level) is adjusted every year. We use a parsimonious specification to represent, in the first month (i.e., t is April) of an annual wage cycle, how his base wage changes from the previous cycle:

$$\Delta B_{it} = b_0^j + b_1^j * age_{it} + b_2^j * B_{it-1} + b_3^j * \sum_{s=t-12}^{t-1} y_{is} + b_4^j * college_i + \zeta_{it}^j \,, \tag{4}$$

where the superscript "j" represents before ($j = 0$) and after ($j = 1$) the reform. The change in the base wage depends on a salesperson's age (age_{it}),[15] his base wage (B_{it-1}), and performance defined as the total gross profit he brings in over the previous year ($\sum_{s=t-12}^{t-1} y_{is}$), as well as the education level ($college_i = 1$ if with college degree, and 0 otherwise). Finally, the error term in the regression captures the impact from other factors that are subjectively evaluated by the manager and researchers do not observe. If the month is not April, $\Delta B_{it} = 0$.

We separately estimate equation (4) before and after the reform. Results are reported in Table 4. Before the reform, base wage adjustment heavily relies on seniority (age) and not on performance. The coefficient for past performance is significantly positive after the reform, as is suggested by the adoption of a formal evaluation policy. Figure 2 graphically illustrates the predicted wage changes of all salespeople in the data, before and after the

[15] Tenure is not included in the regression because age and tenure are highly correlated (correlation = 0.94).

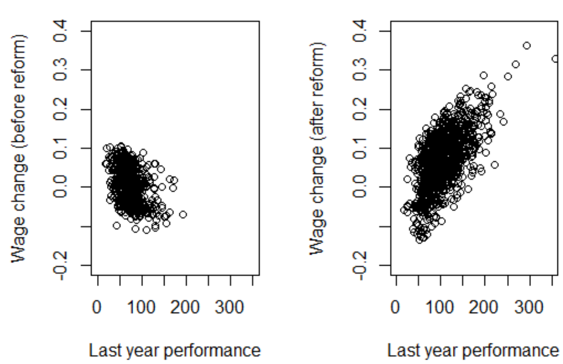
reform. There is a strong positive correlation between base wage increase and sales performance after the reform (right panel). Before the reform, however, the correlation is insignificant. Finally, the coefficient for base wage is negative, suggesting that the rate of change will slow down as a salesperson's base wage grows to a high level.[16]

Table 4: Base wage adjustment regression results

	Before reform	After reform
Age	0.0051 **	0.0014 *
	(0.0019)	(0.0008)
Previous base wage	-0.1455 ***	-0.1446 ***
	(0.0235)	(0.0122)
Previous 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: Base wage adjustment before and after the reform



[16] Our specification assumes that the effect of seniority on the wage adjustment is independent from the effect of performance, consistent with findings in Medoff and Abraham (1980, 1981). We run another regression allowing for the interaction between age and performance. The coefficient for the interaction is insignificant before the reform. Although it becomes significantly negative after the reform, the magnitude is so small that the effect is negligible.

2.3.2 Promotions and transfers

Promotions and transfers usually happen at the beginning of April and October every year. For simplicity, we assume that all the career movements that happen between April and October are determined in April, and all those between October and the next April are determined in October. We find from data that the number of promotions and transfers varies year by year, and that promotions significantly increased after the reform (see first row of Table 3). The firm confirmed with us that there is no fixed number for promotions or transfers, and that the decision is based on the evaluation of each salesperson, as well as number of retirements and business growth. Given these factors, we assume that the career movement is a function of a salesperson's age and his performance in the previous half-year period. This assumption differs from tournament theory, which assumes that the winners are determined by the ranking of the performance.[17]

We use an ordered probit regression to capture how promotions and transfers are a function of performance evaluations that are latent to researchers. In the first month of a half-yearly cycle (t is either April or October), the performance evaluation M_{it} for salesperson i (unobserved to researchers) is determined by:

$$M_{it} = c_1 * age_{it} + c_2 * age_{it}^2 + c_3 * college_i + c_4^j * B_{it-1} + c_5^j * \sum_{s=t-6}^{t-1} y_{is} + \eta_{it}^j, \quad (5)$$

[17] In tournament theory, winners are determined by the ranking of their performance. To test whether tournament theory applies in our empirical setting, we run the following analysis. For each career movement period, we rank the salespeople based on their performance over the period. Then we mark one as a top performer if their ranking is higher than or equal to the number of promotions we observe in the data for that period. For example, if we observe that during a job movement period, 5 salespeople are promoted to managers, we mark the top 5 as the top performers. If the assumption of the tournament theory is correct, 100% of the top performers should be promoted. But in fact, of the 89 top performers, only 13 (14.6%) are promoted. Similarly, we mark one as a bottom performer if their ranking is lower than or equal to the number of transfers we observe in the data for that period, and of the 49 bottom performers, only 6 (12.2%) are transferred. Since the ratios are much lower than 100%, tournament theory clearly does not apply in our empirical setting. For promotion and demotion decisions, other important factors in addition to one's performance (e.g., age, base wage, education) must also be considered. This is what we learned from our communications with the firm's managers, and confirmed from the data.

where B_{it-1} is the base wage of the salesperson at the beginning of the cycle, $\sum_{s=t-6}^{t-1} y_{is}$ is the total gross profit in the previous half year, and other variables are defined the same as in equation (4). We include base wage in the regression for two reasons: First, promotions (transfers) usually come from high (low) job levels, for which the base wage is a good proxy. Second, the decisions rely on cumulative past performances, which as equation (4) indicates, can be captured by the base wage. We also include a quadratic function of age in the regression, because we find from data that the likelihood of promotion is high for middle-aged and low for young and old salespeople. Finally, the error term $\eta_{it} \sim N(0,1)$ captures the factors unobservable to researchers.

With the performance evaluation, the probabilities of promotion ($P(P_{it} = 1)$) and transfer ($P(L_{it} = 1)$ are specified as

$P(P_{it} = 1) = P(M_{it} > u_p)$

and

$P(L_{it} = 1) = P(M_{it} < u_L)$,

where u_p and u_L are the thresholds for promotion and transfer. If the evaluation is in between, i.e., $u_p \leq M_{it} \leq u_l$, the salesperson will remain in the sales job. Since there are not many promotions and transfers in the data, a parsimonious model specification is necessary. We assume that the two thresholds and the coefficients for age and education remain unchanged, but the coefficients for B_{it-1} and y_{it-1} can be different, before and after the reform. If the month is not April or October, $P(P_{it} = 1) = 0,\ P(L_{it} = 1) = 0$.

Table 5 reports the regression results. Not surprisingly, the threshold for transfer is lower than that for promotion. The coefficient for the base wage is positive before the reform, and the magnitude significantly increases after the reform.[18] However, the coefficient for the past performance after the reform is smaller than before the reform. Results in Table 4 showing that the evolution of the base wage is heavily determined by an individual's performance suggest that the decision for promotions and transfers post-reform is weighted more on the performances of a longer past. Furthermore, age has an inverted U-shaped relationship with the performance evaluation, implying 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 performances are more likely to be promoted and less likely to be transferred.

Table 5: Regression results for promotions and transfers

Base wage (before)	0.3562 **
	(0.1575)
Past performance (before)	0.0104 ***
	(0.0026)
Base wage (after)	0.5636 ***
	(0.1558)
Past performance (after)	0.0044 ***
	(0.0016)
Age	0.1488 **
	(0.0648)
Age^2	-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.

[18] This result can also be interpreted as promotions and transfers being weighed more heavily by the job level after the reform.

To understand how career movements are correlated with performance and age, which are identified as the major determinants in the literature, we use the regression results to calculate for each salesperson his promotion and transfer probabilities in the last cycle before the reform and the first cycle after the reform. To account for the long-term effect of performance, we calculate the total probabilities over the next five years.[19] Figure 3 illustrates the relationship between the performance in the cycle and the promotion and transfer probabilities. The top two panels show that the reform has made the performance more positively correlated with promotions in the next five years. The lower two panels, however, suggest that transfers are less affected by the performance after the reform. Figure 4 illustrates how career movements correlate with age. The clear inverted-U relationship in the top two panels, and the U-shaped relationship in the bottom panels, suggest that middle-aged salespeople have the highest likelihood for promotion and lowest likelihood for transfers.

One assumption we make is that the error terms in the above policy functions are uncorrelated with the independent variables, especially sales performance. Our result might be biased if the assumption is violated. We believe that the assumption is reasonable in our empirical setting. For example, helping and leading peers (which could be one component of the error terms) is unlikely to substitute for, or complement sales performance, since a salesperson can only undertake these activities when he is not serving a customer. However, the company has a territory system, under which each salesperson has to serve the customer if a customer from his territory arrives. Therefore, it is unlikely that a salesperson can

[19] To make a fair comparison, we assume that the performances of salespeople are different only in the first half-year cycle, and their performances in subsequent periods are equal to the average level in our data. The calculations therefore represent the relationship between current performances and promotions and transfers in the next five years.

substitute sales for helping or leading his peers. Furthermore, selling cars and leadership are different abilities, therefore, we believe them to be independent.

Figure 3: Relationship between career movements and performance

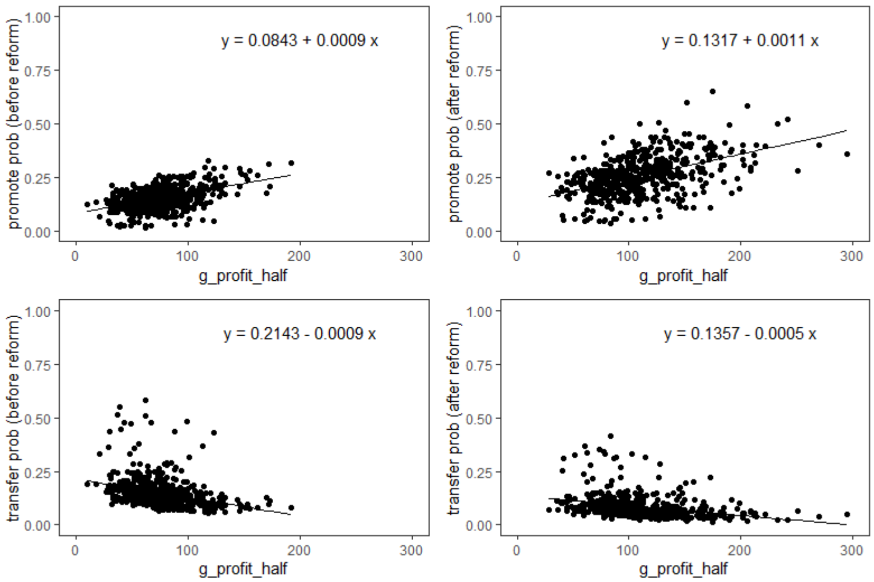


Figure 4: Relationship between career movements and age

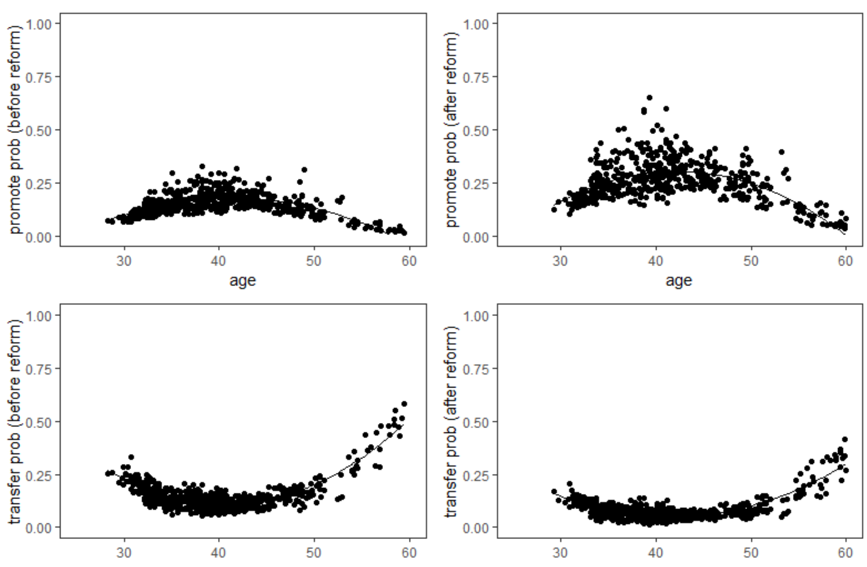


Table 6 summarizes key differences in compensation, base wage adjustment, and career movements before and after the reform.

Table 6 Comparison of the rules before and after the reform

	Before reform (Period 0)	After reform (Period 1 and Period 2)
Monthly payment	$Base\ wage_t + r_0 \cdot\ Profit_t$	Period 1: $max\ (base\ wage_t, r_1 \cdot Profit_t)$ Period 2: $max\ (base\ wage_t, r_1 \cdot \frac{Profit_{t-1}+Profit_t}{2})$
Base wage adjustment	Mainly related to age, not related to performance	Less related to age, mainly related to performance
Promotion and transfer	Mainly determined by base wage, performance, and other individual characteristics	Since base wage is more related to performance, promotion and transfer are also more related to long-term performance.

2.4. Heterogeneous effects of the reform

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

$$y_{it} = \beta_{0i} + \beta_{1i} I(p1) + \beta_{2i} I(p2) + \beta_3 Seasonality_t + \epsilon_{it}\ , \tag{6}$$

where β_{0i} is an individual fixed effect, and $I(p1), I(p2)$ are indicators for the two periods after the reform (Period 1: the first period after the reform, and Period 2: the second period after the second reform, Period 0 is the baseline). $Seasonality_t$ captures the impact of seasonality on the market demand. We construct this index using the aggregate sales in the region where the firm is located in each month from 1999 to 2004, and calculate $Seasonality_t$ as $\frac{aggregates\ sales\ in\ month\ t}{aggregate\ sales\ in\ March}$.[20] We run four regressions: the first two regressions assume β_{0i} to be the same across salespeople, while the next two estimate the

[20] We use the sales in March as the baseline, when sales are typically the highest (before tax).

individual fixed effect. The first and the third regression assume that β_{1i} and β_{2i} are the same across salespeople. In the second and the last regression, we allow β_{1i} and β_{2i} to be 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 7: 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)
Fixed 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 7 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 shows that the reform has heterogeneous effects on different salespeople, and career concerns could play an important role here. Since young salespeople are further away from retirement, they may care more about future career movements. For older salespeople, however, promotions are less likely and thus are less relevant. The reform on compensation structure, however, is more universal.[21] So even though the reform affected both compensation and career concerns, the heterogeneous effects on different people due to the dynamic nature of the setting, together with the structural model, allow us to disentangle the two effects.

3. Model and Estimation

We build a dynamic model of salesforce response to wage changes and career concerns. The sequence of decisions that salesperson *i* makes in month *t* in the model is as follows: If t is at the beginning of a half-yearly career movement cycle (April or October), the salesperson first decides whether or not to quit the firm. Conditional on the salesperson staying, the firm then decides whether to promote or transfer the salesperson, or let him remain at the sales job. If the latter, and if month *t* is at the beginning of an annual wage cycle (April), the firm also decides how the salesperson's base wage should be adjusted. Finally, the salesperson decides his selling effort for the month, then his work performance will be realized at the end of the month. This process will repeat every month, until the salesperson quits, is promoted or transferred, or retires at the age of 60.

3.1. Work performance and the salesperson utility

The salesperson's work performance, measured by his monthly gross sales profit (y_{it}), is a function of his effort e_{it}:

$$y_{it} = Seasonality_t \cdot e_{it} + \epsilon_{it}, \tag{7}$$

[21] An alternative explanation of the result is that older salespeople overall have higher base wages, so it is less likely that their sales commission can exceed their base wage, which may reduce the effect of the reform for them. We found that by further including base wage terms (main effect and interactions with reform indicators), the result is still robust.

where $Seasonality_t$ is an index reflecting how seasonality influences the demand. We use the aggregate sales in the region where the firm is located in each month during the sample period, and construct the index as $Seasonality_t = \frac{aggregates\ sales\ in\ month\ t}{aggregate\ sales\ in\ March}$.[22] The stochastic component ϵ_{it} is assumed to be distributed as $N(0, \sigma_j^2)$, where *j = 0, 1,* or *2* and denotes the period before the reform, the first period, and the second period after the reform, respectively.

Note that since effort is unobservable, we have to assume a parametric relationship between effort and sales.[23] Equation (7) holds that, given the type of a salesperson and his effort level, the deterministic function of his productivity is only a function of seasonality. The probability that one belongs to a type is a function of individual characteristics, as we will discuss later.

Effort is costly to the salesperson. The cost function is specified as

$$c_{it} = \frac{1}{2} c_i \cdot e_{it}^2, \tag{8}$$

where c_i is an individual-specific parameter. If it is positive, the cost is a convex-increasing function of effort. Since effort is unobservable, a strictly monotonic parametric relationship between sales and effort is necessary for the identification purpose.

Let U_{it}^j be the salesperson's utility in the month. Following Chung et al. (2014) and Misra and Nair (2011), we specify U_{it}^j as

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[22] We use the sales in March as the baseline, when sales are typically the highest (before tax). We do not include the aggregate demand changes across years in the specification because we observe that regional (prefectural-level) sales are stable across years, similar to the pattern we observe for national sales. While we are not allowed to disclose the prefecture, disguised data can be provided upon request.

[23] Misra and Nair (2011) provided a discussion on why the parameterization is necessary.

$$U_{it}^{j} = E\left(w_{it}^{j}\right) - a_i var[w_{it}^{j}] - c_{it}, \qquad (9)[24]$$

where w_{it}^{j} is the salesperson's monetary income in period j, as defined in equations (1) to (3). Note that w_{it}^{j} is determined by not only the commission but also the base wage. As the base wage adjusts in the future, the utility will also change. There may be other benefits and costs (in addition to the work effort) associated with the sales job, the sum of which is normalized to zero in this specification. We also allow the individual to be risk averse, and a_i is the risk aversion parameter.

3.2. Values from career movements

Let n_{it} be the number of months from month t to the salesperson's retirement at age 60. After promotion, the utility of the individual in each month s includes not only the monthly income but also the additional benefits and costs, such as new job tasks, effort, responsibilities, status, and work environment. Furthermore, there can be a change in the option value, as the individual's likelihood of further promotion to the executive level within the firm is enhanced. We therefore specify the value of promotion in month t as the discounted value of the stream of the monetary payoff and added value as a manager on top of the monetary payoff in all future months until his retirement as

$$V_{it}^{p} = \Sigma_{k=1}^{n_{it}} \delta^{k-1} * \left(w^p\left(Z_{i,t+k-1}, \theta_w^p\right) + u^p\left(Z_{i,t+k-1}, \theta_{i,u}^{p,j}\right)\right), \qquad (10)$$

[24] Note that there is no coefficient in front of the monetary income w_{it}^{j} for identification reasons. In equation (8), c_i captures how a salesperson is willing to exert effort in return for monetary payoff. A small effort cost could represent either a salesperson who is very capable and efficient at exerting sales effort, or one who derives very high value from money and is willing to work hard for that. These two effects are not separately identified. If we re-specify equation (9) as $U_{it}^{j} = \omega * E\left(w_{it}^{j}\right) - a_i var\left[w_{it}^{j}\right] - c_{it}$, where ω represents the monetary value of a salesperson, then it is equivalent to $U'^{j}_{it} = E\left(w_{it}^{j}\right) - \frac{a_i}{\omega} var\left[w_{it}^{j}\right] - c_{it}'$, and $c'_{it} = \frac{1}{2}\frac{c_i}{\omega} \cdot e_{it}^2$. Therefore, only $\frac{c_i}{\omega}$ can be identified in our model.

where the superscript "p" denotes promotion, and δ is the monthly discount rate.[25] The monetary payoff $w^p(\cdot)$ and the added value as a manager on top of the monetary payoff $u^p(\cdot)$, both as functions of the individual's attributes $Z_{i,t+k-1}$(age and education level), are estimated in a reduced-form way from data. Parameters θ_w^p capture the impact of $Z_{i,t+k-1}$ on the monetary payoff, and parameters $\theta_{i,u}^{p,j}$ capture how $Z_{i,t+k-1}$ affects the added value as a manager, which may vary before and after the reform.[26] Note that, conditional on the individual's optimal effort under the incentive system for managers (which is unobserved from data), u^p can be either positive or negative.

There are also monetary and additional benefits and costs associated with the job task after a transfer. The value from the transfer is similarly specified as

$$V_{it}^L = \Sigma_{k=1}^{n_{it}} \delta^{k-1} * \left(w^L\left(Z_{i,t+k-1}, \theta_w^L\right) + u^L\left(Z_{i,t+k-1}, \theta_{i,u}^{L,j}\right)\right), \tag{11}$$

where the superscript "L" denotes lateral transfer.[27] Similar to promotion, we allow the non-monetary payoff of transfer to be different before and after the reform.

Different from promotions and transfers that are decided by the firm, whether to quit from the firm is a decision made by the salesperson. Though the salesperson can quit at any time, we assume that he makes the decision at the beginning of a career movement cycle. We make this simplified assumption as we observe only 28 instances of quitting,

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[25] We fix δ to 0.98 in the model estimation. More discussions about the discount factor can be found in Section 5.

[26] We allow $\theta_{i,u}^p$ to be heterogeneous among salespeople. However, to reduce the computational burden in the model estimation, we assume that θ_w^p is the same across individuals. Similar assumptions are made for transfers and quits from the firm.

[27] The firm calls the career movement a "lateral" transfer although, judged from the decrease in monthly income and status within the firm, it is the same as a demotion.

which makes it difficult to estimate the outcome in each month. The salesperson will not return if he quits. The value of the decision is specified as

$$V_{it}^{Q} = \Sigma_{k=1}^{n_{it}} \delta^{k-1} * u^{Q}\left(Z_{i,t+k-1}, \theta_{i,u}^{Q,j}\right). \tag{12}$$

The expected utility u^{Q} represents the total value from an outside job (since we do not observe the monetary payoff). It is a function of the individual's attributes $Z_{i,t+k-1}$. For example, it may decrease with age, as it is more difficult for an older salesperson to find a job with equal pay. Similar to promotion, we allow the non-monetary payoff of quitting to be different before and after the reform.

Note that we allow model parameters in the above equations to be heterogeneous across salespeople. Allowing for such heterogeneity helps control for the sorting effects due to promotions, transfers, and decisions to quit.

3.3. Value function of the sales job and optimal choices

Suppose month *t* is within a career movement cycle *m* and base wage cycle *n*. At the beginning of the month, salesperson *i* has to make two choices: First, if *t* is the beginning month of the career movement cycle (April or October), he decides whether or not to quit the job. Second, if *t* is not the beginning month, or the salesperson stays with the firm and continues the sales job, he will decide how much selling effort to invest in the month. Following the previous discussion of the model details, the state variables (X_{it}) that will affect his choices include: (1) the salesperson's demographics Z_{it} (age and education level); (2) month of the year, $month_t$, which captures not only the seasonality index in equation (7) but also how many months are left before the next career movement cycle or wage cycle starts; (3) base wage B_{it}; (4) accumulated sales within the wage cycle, $y_{in,-t}$, which is defined as total gross profit the salesperson made from April (the beginning month of an annual wage cycle) to month *t-1*; (5) accumulated sales within the career movement cycle, $y_{im,-t}$, which is defined as the total gross profit the salesperson made from April or October to month *t-1*; and (6) sales in the last month y_{it-1}. Age and month evolve in a deterministic manner, but state variables (3) to (6) are stochastic. The salesperson makes the quit-or-stay decision and the effort choice to maximize the stream of expected future utilities, conditional on the state variables X_{it}. The last state variable y_{it-1} is only relevant in Period 2 after the reform.

Assume that month *t* is in period *j* (where *j = 0, 1,* or *2* and denotes the period before the reform, the first period, and the second period after the reform). Conditional on *i* continuing as a salesperson, let $V^j(X_{it})$ be the period-specific value function under *i*'s optimal effort choice. Also let $\Psi^j(X_{it})$ be the value function under *i*'s optimal quit-or-stay decision. We can write down the value functions as the following Bellman's equations:

$$V^j(X_{it}) = \max_{e_{it}}\left\{E^j\left[U_{it}^j \middle| X_{it}, e_{it}\right] + \delta * E^j\left[\Psi^j(X_{it+1})\middle| X_{it}, e_{it}\right]\right\}, \quad (13)$$

where E^j is a j-specific expectation operator, and

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

(14)

where P_{it} (L_{it}) is an indicator function that is equal to 1 if the salesperson is promoted (transferred) and 0 otherwise, and V_{it}^P, V_{it}^L, and V_{it}^Q are the value functions defined in equations (10) to (12), respectively. Note that in equation (13), E^j is conditional on not only X_{it} but also the work effort e_{it}. Finally, a stochastic term ε_{it}^{Q} is added to V_{it}^{Q} to rationalize the decision to quit in each cycle observed from data.

From equation (13), the optimal service effort, e_{it}^{*}, will satisfy the following first-order condition:

$$\frac{\partial}{\partial e_{it}} E^{j}\left[U_{it}^{j} \middle| X_{it}, e_{it}^{*}\right] + \delta \frac{\partial}{\partial e_{it}} E^{j}\left[\Psi^{j}\left(X_{i,t+1}\right) \middle| X_{it}, e_{it}^{*}\right] = 0. \tag{15}$$

From equation (14), the optimal quit-or-stay decision is

$$Q_{it}^{*} = \begin{cases} 1, \; if \; V_{it}^{Q} + \varepsilon_{it}^{Q} > V_{it}^{P} * E^{j}[\{P_{it} = 1\}|X_{it}] + V_{it}^{L} * E^{j}[\{L_{it} = 1\}|X_{it}\,] \\ \quad\quad +\left(1 - E^{j}[\{P_{it} = 1\}|X_{it}] - E^{j}[\{L_{it} = 1\}|X_{it}]\right) * V^{j}(X_{it}) \\ 0, \quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad otherwise \end{cases} \tag{16}$$

3.4. Estimating the dynamic model

A salesperson's work effort is unobserved from data; however, equation (7) shows the monotonic one-to-one mapping from effort to performance. Work effort is also a continuous control variable. To estimate the dynamic structural model with continuous controls, we adopt the approach in Pakes (1991) using Euler equations when the impact of the control on future state variables is stochastic. The idea is represented by equation (15), in which work effort has a small perturbation from the optimal effort e_{it}^{*}. After period *t*, the salesperson will return to the optimal policies (and thus the value function continues to be $\Psi^{j}\left(X_{i,t+1}\right)$ in *t+1*). Substituting equations (7) to (9) into equation (15), and defining $\widehat{y_{it}^{j}} = Seasonality_{t} * e_{it}^{*}$, the expected sales profit under the optimal effort of salesperson i at time t in Period j, we can derive the sales function under the optimal effort choice as the following (Period 0, 1, and 2 are denoted by the superscript):

in Period 0 (the period before the reform)

$$y_{it}^{0} = r_0 \frac{Seasonality_t^2}{c_i} - a_i \frac{\frac{\partial}{e_{it}} Var[w_{it}^{0}]}{c_i} + \delta \frac{Seasonality_t}{c_i} \left(\frac{\partial}{e_{it}} \left(E^0 \left[\Psi^0 (X_{it+1}) \middle| X_{it}, \widehat{y_{it}^{0}} \right] \right) \right) + \epsilon_{it}^{0}; \tag{17}$$

in Period 1 (the first period after the reform),

$$y_{it}^{1} = r_1 \frac{Seasonality_t^2}{c_i} \Phi \left(\frac{r_1 \widehat{y_{it}^{1}} - B_{it}}{r_1 \sigma_1} \right) - a_i \frac{\frac{\partial}{e_{it}} Var[w_{it}^{1}]}{c_i} +$$

$$\delta \frac{Seasonality_t}{c_i} \left(\frac{\partial}{e_{it}} \left(E^1 \left[\Psi^1 (X_{it+1}) \middle| X_{it}, \widehat{y_{it}^{1}} \right] \right) \right) + \epsilon_{it}^{1}; \tag{18}$$

and in Period 2 (the second period after the reform):

$$y_{it}^{2} = r_1 \frac{Seasonality_t^2}{2c_i} \Phi \left(\frac{r_1 (y_{it-1}^{2} + \widehat{y_{it}^{2}}) - 2B_{it}}{r_1 \sigma_2} \right) - a_i \frac{\frac{\partial}{e_{it}} Var[w_{it}^{2}]}{c_i} +$$

$$\delta \frac{Seasonality_t}{c_i} \left(\frac{\partial}{e_{it}} \left(E^2 \left[\Psi^2 (X_{it+1}) \middle| X_{it}, \widehat{y_{it}^{2}} \right] \right) \right) + \epsilon_{it}^{2}. \tag{19}$$ [28]

The above equations indicate the impacts of explicit and implicit incentives. The first term on the right side represents how the explicit incentive (i.e., commission) affects the salesperson's performance. It is straightforward to show that the performance increases with the commission rate, before and after the reform. The second term on the right term represents the impact of risk aversion. The third term on the right side represents the impact from implicit incentives, which include changes in the base wage and career movements that will affect $E^j \left[\Psi^j (X_{it+1}) \middle| X_{it}, \widehat{y_{it}^{j}} \right]$ in the next period. The relationship between base wage changes or career movements and the salesperson's current performance is represented by the derivative $\frac{\partial}{e_{it}} E^j \left[\Psi^j (X_{it+1}) \middle| X_{it}, \widehat{y_{it}^{j}} \right]$. The salesperson's performance will increase as the relationship

[28] We use ϵ_{it}^{j} to represent the stochastic component in the sales function in each period.

becomes more positive. If there are no changes in the base wage and career movements, the salesperson's decision-making will be mainly static.[29]

We assume that ε_{it}^{Q} in equation (16) is normally distributed with a standard deviation σ_Q. Therefore, under the optimal quit-or-stay decision,

$$Pr(Q_{it} = 1) = 1 - \Phi\left(\frac{\begin{array}{c} V_{it}^{P} * E^{j}[\{P_{it} = 1\}|X_{it}] + V_{it}^{L} * E^{j}[\{L_{it} = 1\}|X_{it}\ ] \\ +\big(1 - E^{j}[\{P_{it} = 1\}|X_{it}] - E^{j}[\{L_{it} = 1\}|X_{it}]\big) * V^{j}(X_{it}) - V_{it}^{Q} \end{array}}{\sigma_Q}\right). \tag{20}$$

We estimate our structural parameters Θ_i, which include β_i in the effort cost function, risk aversion parameter a_i, and parameters θ_i's associated with the utilities from promotions (equation 10), transfers (equation 11), and quitting (equation 12), from the above equations.

Ψ^j and V^j as functions of state variables X_{it} in equations (17) to (20) have to be numerically computed. This poses a big challenge for the model estimation due to the well-known "curse of dimensionality": with a large dimension of state variables, the number of value functions that has to be computed in the estimation is exceedingly high. The computational burden makes it difficult to apply a standard method such as the nested fixed-point algorithm (Rust 1987, 1996). To tackle the issue, we use a two-step approach modified from Hotz and Miller (1993) and Hotz et al. (1994) to estimate the model.

A useful way to illustrate the estimation approach is to re-specify $V^j(X_{it})$ in equation (13) as the discounted expected value of a stream of future utilities. Given effort level e_{it},

[29] The exception is in Period 2 after the reform, during which the current performance will affect the commission in the next period.

$$V^j(X_{it}, e_{it}) = E^j\left[U_{it}^j \middle| X_{it}, e_{it}\right] + E^j\Big[\sum_{s=t+1}^{t+n_{it}} \delta^{s-t}\big(V_{is}^Q * Pr(Q_{is} = 1) + V_{is}^P * Pr(P_{is} = 1) + V_{is}^L * Pr(L_{is} = 1) + \big(1 - Pr(Q_{is} = 1) - Pr(P_{is} = 1) - Pr(L_{is} = 1)\big) * U_{is}^j\big) * \prod_{s'=t+1}^{s-1}(1 - Pr(Q_{is'} = 1) - Pr(P_{is'} = 1) - Pr(L_{is'} = 1)) \,|X_{it}, e_{it}\Big], \quad (21)$$

where the function $\prod_{s'=t+1}^{s-1}(1 - Pr(Q_{is'} = 1) - Pr(P_{is'} = 1) - Pr(L_{is'} = 1))$ is the probability that the individual continues as a salesperson in all previous months. Future utilities are conditional on the state variables X_{it} and work effort e_{it}.

Our two-step estimation approach is as follows: In the first step, we estimate the functions of base wage change and career movements in period *j* from equations (4)-(5). The expected base wage and the probabilities of promotion and transfer as functions of state variables are expressed as

$B_{it}^j = B^j(X_{it})$, $Pr(P_{it} = 1) = P^j(X_{it})$, and $Pr(L_{it} = 1) = L^j(X_{it})$.[30]

We also regress how wages evolve after promotion (i.e., $w^p\big(Z_{i,t}, \theta_w^p\big)$ in equation (10)) or transfer (i.e., $w^L\big(Z_{i,t}, \theta_w^L\big)$ in equation (11)) as a function of demographics $Z_{i,t}$ from data.

Next, we approximate the optimal policies Q_{it} and e_{it} from data. We use the first-order approximation to regress the probability of quitting the job, under the optimal quit-or-stay decision, using first-order Chebyshev polynomials (we do not extend to higher orders, as the number of quits is small in our data):

[30] We assume that the individual does not expect policy changes in the future; thus, the evolution of future state variables is expected to remain unchanged. The firm told us that the details of the reform were determined and communicated with the salespeople not long before the reform. To alleviate the concern that salespeople might be partially informed about policy changes and thus may have changed their expectations before the changes took place, we exclude the data two months before policy changes in the model estimation.

$Pr(Q_{it} = 1) = Q^j(X_{it})$

Based on equation (7), we regress the sales function using second-order Chebyshev polynomials as the following:

$$y_{it}^j = Seasonality_t * e^j(X_{it}) + \epsilon_{it} = y^j(X_{it}) + \epsilon_{it.}^j$$

We estimate the function $y^j(X_{it})$ using second-order Chebyshev polynomials. Assuming that we have the right model, the regressions give us consistent estimates of expected sales $\widehat{y^j(X_{is})}$[31] and the probability of quitting $\widehat{Q^j(X_{is})}$ under optimal policies in each future month *s*. Furthermore, optimal effort $\widehat{e^j(X_{is})}$ is $\widehat{y^j(X_{is})}$ divided by $Seasonality_t$.

In the second step, we use the first-step estimates to simulate the value functions $V^j\left(X_{it}, \widehat{e^j(X_{is})}\right)$ in equation (21) as well as $\Psi^j(X_{it})$.[32] With the simulated value functions, we then compute the derivative $\frac{\partial}{e_{it}}\left(E^j\left[\Psi^j(X_{it+1})\middle|X_{it}, \widehat{y_{it}^j}\right]\right)$ in equations (17) to (19), at the optimal effort function $\widehat{e^j(X_{is})}$. Detailed simulation procedures are in Appendix A1. Based on equations (17) to (20), we estimate the structural parameters Θ_i using the maximum likelihood method.

Finally, we allow for heterogeneity in model parameters among salespeople by assuming that there are *K* discrete segments. That is, we assume that salesperson i belongs to a segment *k*, $k \in \{1, \dots K\}$, with model parameters $\Theta_i = \Theta_k$. The probabilities of *i* being in these segments are $q_i = \{q_{i1}, \dots q_{iK}\}$. Following Yang and Ching (2014), we model a salesperson's type as a probabilistic function of his observable characteristics. Specifically,

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[31] We also use the estimated standard deviation $\widehat{\sigma_j}$ to substitute for σ_j in the second-step estimation.
[32] By substituting the simulated $V^j(X_{it})$ into equation (14), the value function $\Psi^j(X_{it})$ can be similarly specified.

we assume $K = 2$, and that the salesperson's probability of belonging to a segment is a logit function of his age group in the first month of the data period[33] and whether he has a college education. Note that we assume the same base wage change, and promotion and transfer functions are applied for all segments, as they are firm policies that are independent from the type of salesperson.

In order to apply the two-step estimator for this latent class model, we use an expectation-maximization algorithm-based approach proposed by Arcidiacono and Miller (2011).[34] We modify it slightly for our setting to further allow the probability that one belongs to a segment to be a function of observed characteristics. The details are in Appendix A2.

3.5. Identification

As we discussed in 3.1, since effort is unobservable, we have to make a parametric assumption on the relationship between effort and sales. Misra and Nair (2011) provided a discussion on why the parameterization is necessary. With the specification, we could recover the optimal effort from the observed sales.

The identification of the parameters in the cost function in equation (8) comes from commission rates. The higher the cost, the less a salesperson's performance will respond to the increase in commission rate. The reform of the firm provides the source of identification. Not only does the average commission rate increase after the reform, the change in the commission scheme also implies that, if the cost of the effort is high,

[33] We do not assume the probability to change as age changes. Since our sample period is only several years long, very few people change age groups during the sample period.
[34] Chung et al. (2014) also use a similar procedure.

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, as we discussed in 2.4. The identification of the risk aversion parameters come from how salespeople's effort (sales) changes with changes in variance of wealth.

The identification of the added value on top of the monetary payoff for a manager (u^P) and for other non-sales jobs (u^L) is more challenging. The source comes from how salespeople respond to career movements. A key identification assumption we rely on is that salespeople use the same career movement function that we estimate from equation (5) to form the expectation for promotion and transfer. With this assumption, the utility parameters are identified from within each individual how the performance changes as he approaches different points in the career path. Suppose a salesperson's performance improves as the likelihoods of promotion and transfer increase, to a greater extent than what can be explained by the difference in incomes. This suggests that he is working harder to enhance the opportunity for promotion or to avoid being transferred, implying a positive (negative) utility u^P (u^L). Since the incentives change after the reform, we are able to identify different u^P (u^L) for before and after the reform.

Finally, after u^P and u^L are identified, the quit rate among salespeople will identify the utility function of quitting (u^Q). If the quit rate is low even for those who are very close to being transferred, this implies that the utility after quitting is more negative than the utility for other non-sales jobs. And the reform allows us to identify different u^Q for before and after the reform.

4. Estimation Results and Counterfactuals

This section presents the estimation results. A salesperson's demographics Z_{it} include his age and indicator of college education. We specify the effort cost parameter c_i as $exp(\beta_i)$ (equation (8)) to ensure that the cost of effort is positive, and we specify the risk aversion parameter a_i as $exp(\gamma_i)$ (equation (9)) to ensure that salespeople are risk averse. We assume that Z_{it} enters the payoffs (net of income) from promotion (equation (10)) and transfer (equation (11)) linearly. For quitting (equation (12)), we allow age to impact the payoff in a quadratic way. Furthermore, we assume that there are two discrete segments (i.e., $K = 2$) of salespeople, each with distinct model parameters, and the probability that one belongs to segment 1 is $q_{i1} = \frac{\exp(\alpha_0+\alpha_1 I(35<age_{i,t=0}\leq 50)+\alpha_2 I(age_{i,t=0}>50)+\alpha_3 college)}{1+\exp(\alpha_0+\alpha_1 I(35<age_{i,t=0}\leq 50)+\alpha_2 I(age_{i,t=0}>50)+\alpha_3 college)}$. To reduce the number of parameters, we assume that the changes in non-monetary payoffs (promotion/transfer/quit) after the reform are the same across segments.

To illustrate how the proposed dynamic model with career concerns better fits with data, we compare two alternative models: The first is a static model, assuming that a salesperson is myopic without considering future base wage changes and career movements. He decides whether to quit by comparing his expected utility of staying with that of leaving in the current month. The second model, a dynamic model without career movements, assumes that the salesperson considers how his current effort influences future base wage changes but not the chance of promotion or transfer.

To further validate our model, we use Period 0 (before the reform) and Period 1 (the first period after the reform) to estimate the proposed model, then use Period 2 (the second period after the reform) to validate the model by comparing the actual outcomes and predicted ones from the model estimates. Such a model validation approach has been proposed by Keane and Wolpin (2007).

Last but not least, we use the estimation results to quantify the unique impact of different contract packages on the performance. We also use counterfactuals to illustrate how the firm may further improve its profit.

4.1. Estimation results

Estimation results are presented in Table 8. For model comparison, the last two rows report the likelihood function and the BIC value. The proposed model in the last column clearly outperforms the two alternative models based on BIC, suggesting that incorporating career movements significantly improves the data fit. Also, the cost parameter estimated in the proposed model is significantly larger than that of the other models. This is because career concerns incentivize the work effort, as the payoff from promotion is significantly positive, while that for transfer is negative, for both segments of salespeople. By ignoring career concerns, the alternative models attribute a salesperson's hard work to low effort cost and, as a result, underestimate the cost.

To further assess the fit of our model, we first compare the observed sales with the estimated sales in Period 0 and Period 1 (in-sample fit), and then we conduct a validation exercise and use the model estimates to simulate the sales for Period 2 (out-of-sample fit). The results are summarized in Figure 5 below.

From Figure 5 we can see that our model predicts well the increase of sales profit after the reform. Furthermore, in the validation exercise we use the model estimates to simulate the sales of Period 2, during which the compensation policy changed again. Our model predicts that sales profit will drop after the policy change, which is consistent with our data observation in the left panel of the figure. This gives us confidence in our structural model.

Figure 5. In-sample and out-of-sample fit

Based on the model fit criterion and the validation exercise, we will focus on the results from the proposed model. The estimation of probability function of segment 1 shows that compared to younger salespeople, middle-aged and senior salespeople are more likely to belong to segment 1, which is the more capable type, although the coefficients are not statistically significant. Salespeople in segment 1 have a lower effort cost compared to segment 2, suggesting that they have a higher "selling ability." We do not find salespeople to be risk averse in our setting. This is not surprising, as Chung et al. (2014) found similar results. One possible explanation, similar to Chung et al. (2014), is that in the range of incomes earned by the sales force, risk aversion is not a serious concern, especially in Japan where job security is very high. For promotions, on top of the monetary payoff, the added value as a manager is significantly higher than that for the sales job (which is normalized to zero). The value decreases with age, probably because the chance of future promotion to the executive level decreases for older individuals. The average monetary equivalences[35] of the added value as a manager for individuals are \$4.553 thousand per month for segment 1, and significantly higher at \$17.863 thousand for segment 2, in the first month of our data. The value is even higher after the reform, probably because prestige value is higher when job movements become more related to performance after the reform. In comparison, the average monthly income of a manager is \$4.2–4.4 thousand (see Table 2), suggesting that most of the value of promotion comes from other considerations, such as the prestige and job tasks of a manager, and the opportunity for future promotion. For transfers, the added value is negative for salespeople at all ages. The monetary equivalences for individuals are -\$6.37 thousand per month for segment 1, and -\$4.247 thousand for segment 2 in the first month of our data. And the value is even more negative after the reform, probably also driven by the change in prestige value when job movements become more related to performance. In comparison, the average monthly income after transfer is \$3.2–3.4 thousand. Overall, the above results suggest the importance of the benefits and costs from career movements that cannot be measured by income changes.

[35] The added value can be interpreted as monetary value in \$1,000. We calculate the segment average by first calculating the probability of each salesperson belonging to a segment, multiply by the predicted monthly outcome, and then take the average across salespeople.

Table 8: Estimation result

	Static model		Dynamic model w/o. career movements		Proposed Dynamic Model	
	Seg1	Seg2	Seg1	Seg2	Seg1	Seg2
Probability of seg1						
Intercept	-0.384		-0.666		-0.589	
	(0.065)		(0.358)		(0.365)	
I(35<age<=50)	0.471		0.535		0.395	
	(0.061)		(0.369)		(0.365)	
I(age>50)	0.563		0.284		0.211	
	(0.147)		(0.632)		(0.631)	
College	0.013		-0.012		-0.076	
	(0.058)		(0.334)		(0.333)	
Segment Size	48.79%	51.21%	41.92%	58.08%	40.89%	59.11%
Cost parameter	0.001	0.005	0.003	0.003	0.008	0.015
	(1.859E-05)	(5.319E-05)	(1.679E-14)	(2.25E-05)	(1.187E-04)	(1.366E-04)
Risk aversion parameter	0.151	1.763E-09	8.053E-13	1.098E-10	8.22E-07	1.04E-05
	(1.227E-02)	(3.221E-02)	(1.643E-03)	(2.63E-03)	(0.006)	(0.014)
Non-monetary payoffs for promotion						
Intercept					11.232	33.753
					(0.807)	(2.787)
Age					-0.171	-0.424
					(0.017)	(0.049)
College					-0.723	-0.415
					(0.137)	(0.41)
I(reform)					2.242	
					(0.325)	
Segment Average					4.553	17.863
Non-monetary payoffs for transfer						
Intercept					0.613	1.311
					(0.798)	(0.885)
Age					-0.186	-0.158
					(0.023)	(0.022)
College					0.716	0.994
					(0.318)	(0.326)
I(reform)					-2.335	
					(0.728)	
Segment Average					-6.370	-4.247
Payoffs for quitting						
Intercept	10.000	2.291	8.594	6.562	-4.821	-15.659
	(5.62E+01)	(2.539)	(0.011)	(9.028)	(0.201)	(1.518)
Age	-0.874	-0.105	0.379	-0.161	0.272	0.777
	(0.072)	(0.132)	(3.62E-04)	(4.02E-01)	(0.01)	(0.073)
Age^2	0.010	0.001	-0.019	-3.98E-04	-0.003	-0.009
	(0.006)	(0.002)	(1.505E-05)	(2.487E-03)	(8.00E-05)	(9.00E-05)
College	5.968	-0.041	0.606	0.646	0.394	0.584
	(6.26E+01)	(0.154)	(4.28E+12)	(0.585)	(0.096)	(0.085)
I(reform)	-0.043		0.203		0.949	
	(0.174)		(0.727)		(0.094)	
Segment Average	-5.986	0.232	-9.142	-0.142	0.664	0.302
LLH	-51998		-60696		-50698	
BIC	104120		121536		101672	

*Note: standard errors are in brackets

Finally, the intercept estimate of value of quitting is significantly negative, suggesting that such a choice is costly. As a comparison, for salespeople in the first period of our data, the average utility of quitting is \$0.664 thousand and \$0.302 thousand for the two segments, respectively, while the utility of remaining as salespeople are \$2.5 thousand and \$1.925 thousand. Given the highly negative value of transfer, it is very likely that a salesperson quits to prevent a demotion. The value of quitting changes in a non-monotonic way, however, as a salesperson becomes older. The payoff is the highest in the age range of 40 to 42, suggesting that a salesperson with sufficient work experience is highly valued in the external labor market. We also find that the value of quitting becomes larger after the reform, probably because the reform also makes the salespeople more valuable in the external market.

Comparing the two segments of salespeople, we see that segment 1 has lower cost for work effort; thus, salespeople within this segment are more responsive to changes in the commission rate. In contrast, segment 2 has a higher effort cost; however, salespeople within this segment greatly value promotions. The cost of quitting is also very high. We therefore speculate that career concerns are a more important incentive for segment 2. The counterfactuals in the next section confirm this speculation.

4.2. The impacts of explicit and implicit incentives

Through a series of counterfactual exercises based on the estimation results of the proposed dynamic model, this section quantifies the impacts of commission, base wage, and career movements on the performance of employees in our empirical setting. We assume several scenarios. The first one offers only the base wage, which is adjusted annually based on the performance and tenure of an employee. The lack of career movements in the contract offer means that the employee has a secure job but there is no career ladder within the organization. The second one is a commission-only contract. The third scenario allows the base wage to be adjusted annually, together with career movements. The fourth scenario offers a base wage and additional commissions based on observable work performance. Finally, the last scenario combines the base wage, commission, and career movements, which is the one offered by the dealer firm in our empirical setting.[36]

Table 9: Average monthly gross profit per salesperson under different incentives

Profit (1,000 USD)	Seg 1	Seg 2	Weighted avg
Base wage only	1.33	0.65	0.93
Commission only	4.95	0.10	2.08
Base wage and career movements	7.28	6.71	6.96
Base wage and commission	6.52	1.02	3.26
Base wage, commission and career movements	17.23	11.05	13.59

We use all salespeople observed in the first month after the reform in data, and simulate the gross profit they bring to the firm for six months. In the first scenario, we set the commission rate and the probabilities of career movements to zero in the model; however, salespeople expect the change in base wage every year. In the second scenario, we set the probabilities of career movements to zero in the model, and base wages are not expected to change over time. Similar adjustments are made to the model for other scenarios.[37]

[36] Since the objective of this exercise is to quantify the impact of each additional policy component on the sales profit in our data, we assume that base wage policy, commission policy and career movement policy do not adjust in different scenarios if they exist. In reality, firms will adjust the base wage or commission policies if, for example, there are no future career movements.

[37] Since the outside option is defined as quitting the current job and finding another job, it remains consistent over plans and the salespeople may have higher likelihood of quitting under lower level of compensation, which leads to even lower sales. To focus on the value of incentive, we present the profit conditional on no quitting. But since we only simulate the gross profit for 6 months, the results are qualitatively the same as when there is quitting.

The counterfactual results are presented in Table 9. Each number in the table represents the average gross profit of each salesperson in a month. Several key observations are as follows: First, base wage adjustment based on performance contributes the least for the incentive of salespeople. The average gross profit in this scenario is by far the lowest. Second, compared with the base-wage-only contract, salespeople's performance under a commission-only contract is much higher. However, the increase is mainly from salespeople of segment 1 because they have a lower cost for work effort than segment 2. The average gross profit of salespeople in segment 2 has decreased. This is because after the reform, salespeople's effective commission will increase only after their commission cross the base wage. The chance is low for most individuals in segment 2 when there are no career incentives; therefore, the incentive from commissions is weakened.

Third, a quite surprising result is that if the dealer firm offers a base wage together with career movements in the contract package, the weighted average gross profit of salespeople would be even higher than the commission-only contract, suggesting that career movements are an important incentive for salespeople. In particular, offered the opportunity of a career ladder, salespeople of segment 2 are very motivated for investing the work effort. As a result, their average gross profit is similar to that of salespeople of segment 1, even though their selling ability is lower. This confirms our previous speculation about the large impact of career movements on the performance of this segment. Instead of career movements, if the dealer firm chooses to offer commissions together with base wage, the gross profit of each salesperson would also greatly increase relative to the base-wage-only contract, especially for salespeople of segment 1.

Finally, with a complete package consisting of base wage, commissions, and career movements, the gross profit per salesperson is much higher than the package that offers base wage and commissions, and the package that offers base wage and career movements, indicating that commissions and career movements are both important incentives to the salespeople in our setting. Note that the weighted average gross profit is more than the sum of that in the case of commission-only contract and in the case of base wage and career movement contract, suggesting that commissions and career movements are complementary. We believe the complementarity comes from the following (1) offering commission improves the salespeople's performances, which enhances the chance of getting promoted and in turn raises the marginal return of effort, and (2) offering the chance of promotion/transfer improves performance, which increases the chance that the performance surpasses the threshold for commission after the reform and in turn raises the marginal return of effort.

Overall, our counterfactual exercises suggest that career movements and commissions play an important role in salespeople's sales performance. Each incentive is more important for a unique type of employee; they can also complement each other to improve an employee's performance. The incentive from base wage adjustments, on the other hand, is much smaller.

4.3. Profit improvement from enhancing incentives

Conceptually, we can use the model to compute the optimal contract package, i.e., the combination of commission, base wage adjustment, promotion, and transfer as a function of a salesperson's performance that can maximize the profit for the dealer firm. However, the contract package involves multi-dimensional policy choices that are correlated with each other (e.g., changing the base wage will affect the probability of promotion and transfer, and increasing commissions can reduce the incentives from promotions). Searching for the optimal package via a dynamic framework is very complicated and time-consuming. A more challenging issue is that we do not know what type of individual is best for the managerial or other non-sales jobs from the firm's perspective. For example, although segment 1 is more productive for the sales job, segment 2 could be better managers since individuals of this segment value promotions highly. Without this information, it is infeasible to decide which contract package can maximize the firm's total profit. Because of the limitations, we restrict the scope of the analysis in this section. The question we ask is: What will happen to the firm's profit if it further enhances one incentive while holding the other components fixed? Answering this question is useful for the firm if its next step is to refine the contract package in an incremental manner.

Similar to the counterfactual exercises in the previous section, we use the salespeople observed in the first month after the reform in data to simulate their work performances for the next six months. We then calculate the firm's net profit, i.e., deducting the total income of all salespeople from the gross profit. The net profit, however, does not take into account how the productivity of managers and other non-sales jobs is affected by the policy change.

Conditional on the contract package offered in the first month of the reform, there are three counterfactual scenarios: First, the firm gradually increases the average commission rate, each time by 1%, from 21.2% to 26.2%, while the base wage adjustment and promotion and transfer policies remain unchanged. Second, the firm increases the weight of performance in the base wage adjustment in the second column of Table 4 from 0.001 to 0.0015, each time by 0.0001, while holding the commission rate and the promotion and transfer policy constant. To avoid the base increase to be too high, we adjust the constant such that the expected wage increase remains the same for a salesperson with the average sales level. Third, the firm increases the weight of performance in the promotion and transfer policy in Table 5 from 0.0044 to 0.0094, each time by 0.001, and holding the other two policies constant.[38] To avoid too many promotions or too few transfers following the policy change, we adjust the thresholds for promotions and transfers such that the likelihood of either event remains the same for a salesperson with the average sales level.

Results are shown in Figure 6. Each diagram graphically illustrates how the firm's average monthly net profit per salesperson changes when one of the incentives is further enhanced by increasing the relationship with performance. We find that there is still a lot of room for the firm to further improve its net profit. Figure 6(a) shows that the profit continues to grow, at a decreasing rate, as the firm offers a higher commission rate. Figure 6(b) shows a similar growth as the base wage adjustment is more closely linked to the performance. Finally, Figure 6(c) suggests that, compared to other scenarios, the net profit is more responsive to the increase in the weight of performance in the promotion and transfer policy.[39] Furthermore, after the performance weight increases more than 0.003, the incentive for salespeople of segment 2 becomes so strong that the net profit they bring to the firm exceeds that from salespeople of segment 1. This justifies why the firm would want to retain salespeople in segment 2, although their abilities are on average lower. With

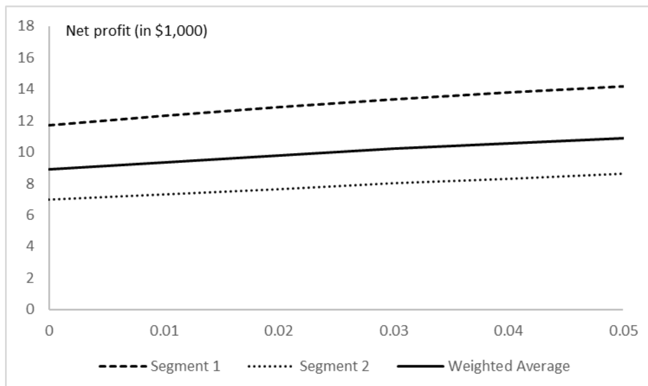
[38] Since the baseline commission rate and performance weights have different scales, we adjust the magnitude of change in each scenario accordingly.

[39] We note that a direct comparison of the three scenarios is difficult, since we use a different magnitude of change in each scenario. Suppose the firm increases the weight of performance in the promotion and transfer policy from 0.0044 to 0.0064, a magnitude of change comparable to the base wage adjustment change in Figure 6(b). The growth of net profit is still larger.

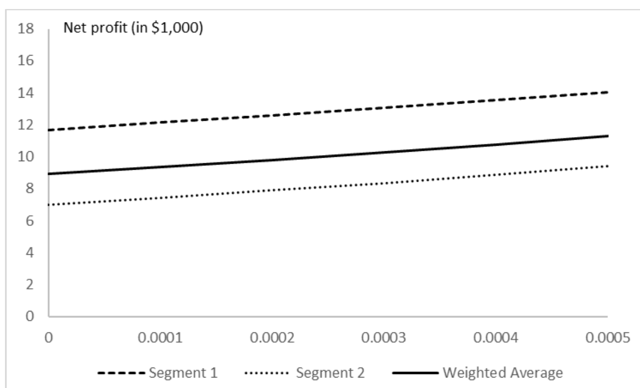
additional data, our framework can be expanded to study selection and retention of different types of salespeople, depending on weights of explicit and implicit incentives.

Figure 6: Changes in average monthly net profit per salesperson with enhanced incentives

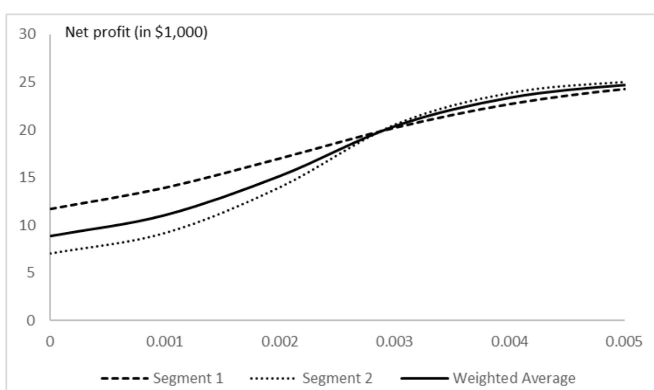
(a) Increase in commission rate



(b) Increase in the weight of performance in base wage adjustments



(c) Increase in the weight of performance in promotions and transfers



There are two potential caveats of the analysis. First, we do not know what type of individual is best for the managerial or other non-sales jobs from the firm's perspective, and therefore we cannot measure the profit impact from these jobs. Second, there are other job tasks for salespeople, such as training new workers and developing long-term relationships with customers. It is unclear to us how the changes in policy may affect these activities.[40] Therefore, our counterfactual results do not reflect the total profit change of the company.

5. Conclusion

In this paper, we study how explicit and implicit incentives influence the work performance of salespeople in a Japanese auto sales firm. We develop and estimate a dynamic structural model that allows for base wage adjustments and career movements including promotions, transfers, and quitting. Our results show that added value on top of the monetary payoffs from promotions and transfers is more important than the monetary payoff. There are two segments of salespeople, one having a lower effort cost for selling, and the other placing a higher value on promotions. We use counterfactuals to show that both commissions and career movements are important incentives in our empirical setting, and they could complement one other to improve employees' performance, depending on design of the contract package. In contrast, the incentive from base wage adjustments is less effective. Finally, we illustrate how the firm can further improve its net profit by enhancing the incentives.

Our study has several limitations that should be addressed by future research. First, we focus on how a contract package incentivizes employees' performance, and abstract away

[40] See Takahashi et al. (2020) and Kim et al. (2019) for more discussion.

from how these policies create self-selection among employees. Conceptually, a contract offer that puts more weight on job performance will attract workers with high ability and force those with low ability to leave. It is important to acknowledge how the self-selection among employees is influenced by contract offers. Furthermore, due to the data limitation we are unable to study how the performance of managers and employees of other non-sales jobs is affected by contract packages. As Benson, Li, and Shue (2019) show, it is possible that a more performance-based promotion policy could lead to more employees with less managerial capability being promoted. Other downsides of stronger incentives such as risk premium needing to be paid to risk-averse workers and distorted effort allocation for multi-tasking agents are also beyond the scope of this research. As such, we are unable to study the optimal contract package that can maximize the firm's profit. Third, we do not estimate the discount factor δ but fix it to be 0.98 to simplify our analysis. Ching and Osborne (2020) show that the identification of discount factor relies on exclusion restrictions.[41] Exclusion restrictions exist in our setting: in a typical month without career movements, the accumulated sales will affect one's future payoff but not the current payoff. We acknowledge the fixing of discount factor in our study is a limitation of our research and leave it for future research. Finally, our empirical setting is sales-related jobs. It is unclear how our findings about the importance of implicit and explicit incentives can be generalized to other types of jobs, such as chief executives or non-sales jobs. These are promising avenues for future research.

[41] There are works that take advantage of the restrictions in various empirical contexts. For instance, in Chung et al. (2014), the exclusion restriction exists as during the non-bonus periods, and the probability of achieving the quota and receiving a bonus will only affect the future payoff but not the current payoff. In Ching and Ishihara (2018), the points accumulated in the loyalty program will affect a consumer's future payoff but not current payoff. In Ching and Osborne (2020), inventory provides such exclusion restrictions.

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Appendix A1: ***Simulating Value Functions***

To simulate $V^j(X_{it})$, the value function under the worker's optimal effort choice, we use the following procedure for each observation. For a simulated career path *k*,

a. In each month *t*, start with the unconditional probability of promotion, transfer, quit, and stay as $P_{it}^k = 0,\ L_{it}^k = 0, Q_{it}^k = 0, S_{it}^k = 1$.

b. From initial state X_{it}, calculate the optimal effort as $e^j(X_{it})$ using the first-step estimate, and draw a sales shock $\epsilon_{it}^{j,k}$. Then calculate the simulated sales y_{it}^k.

c. Update state X_{it+1}^k. For variables that 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 $B_{i,t+1}^k$ based on $B^j(X_{it+1}^k)$, if $t+1$ is the beginning of the wage change cycle.

d. Calculate the unconditional probability of quit, promotion, and transfer at the beginning of month $t+1$ as $Q_{it+1}^k = S_{it}^k * Q\left(X_{it+1}^k\right)$, $P_{it+1}^k = S_{it}^k * \left(1 - Q\left(X_{it+1}^k\right)\right) * P(X_{it+1}^k)$, $L_{it+1}^k = S_{it}^k * \left(1 - Q\left(X_{it+1}^k\right)\right) * L(X_{it+1}^k)$. $Q\left(X_{it+1}^k\right)$, $P\left(X_{it+1}^k\right)$, and $L\left(X_{it+1}^k\right)$ are all 0 if t is not the beginning of a career movement cycle. Also calculate the unconditional probability of stay as $S_{it+1}^k = S_{it}^k * \left(1 - Q\left(X_{it+1}^k\right) - \left(1 - Q\left(X_{it+1}^k\right)\right) * \left(1 - P\left(X_{it+1}^k\right) - L\left(X_{it+1}^k\right)\right)\right)$.

e. Repeat steps b-d for n_{it} months, until the salesperson retires at the age of 60.

Conditional on a trial set of parameters Θ, and the simulated variables from the above procedure, we calculate the utility $U_{it+s}^{j,k}$ in each future month *t+s* to approximate the value function $V^j(X_{it})$ in equation (21). Define

$$V^j(X_{it})^k = \sum_{s=0}^{n_{it}} \delta^s * (U_{it+s}^{j,k} * S_{it+s}^k + V_{it+s}^P * P_{it+s}^k + V_{it+s}^L * L_{it+s}^k). \tag{A1}$$

We simulate *Nsim* paths for each individual in each month. The value function $V^j(X_{ist})$ is approximated by

$$V^j(X_{it}) = \frac{1}{Nsim} \sum_{k=1}^{Nsim} V^j(X_{it})^k \tag{A2}$$

We also need to compute $\frac{\partial}{e_{it}}\left(E^j\left[\Psi^j\left(X_{i,t+1}\right)\middle|X_{it}, \widehat{y^j(X_{it})}\right]\right)$ in equations (17) to (19). We approximate $\Psi^j(X_{it+1})$, the value under the worker's optimal quit and effort choices, in a similar way as we simulate $V^j(X_{it})$. Optimal effort $\widehat{e^j(X_{it})}$ is equal to $\widehat{y^j(X_{it})}$ divided by *seasonality$_t$*. We calculate the derivative using $\frac{\Psi^j(X_{it+1}(\widehat{e^j(X_{it})} + \delta_e)) - \Psi^j\left(X_{it+1}(\widehat{e^j(X_{it})} - \delta_e)\right)}{2\delta_e}$, where δ_e is a small number. In the paper, we use 1% of the difference between the highest and the lowest monthly sales in the data for δ_e.

With all of the above discussion, we can represent the likelihood function for data (Q_{it}, y_{it}), using equations (17) to (20). We use the maximum likelihood approach to estimate our model parameters.

Appendix A2: *Expectation-Maximization Algorithm-Based Approach*

The expectation-maximization algorithm-based approach is proposed by Arcidiacono and Miller (2011), and we modify it slightly for our setting to further allow the probability that one belongs to a segment to be a function of observed characteristics. Assume that salesperson i belongs to one of K segments, $k \in \{1, \dots \mathrm{K}\}$, with segment-specific model parameters Θ_k. Let the probability of salesperson i being in the segment be π_{ik}, and the probability function of one salesperson being in the segment be $\pi_k^m(X)$. Conditional on the observables X_{it} and i belongs to segment k, let $Ly_{it,k} = Pr\left(y_{it} \,|X_{it}, \Theta_k\right)$ be the likelihood of the individual's performance being y_{it} , and $LQ_{it,k} = \{Q_{it} = 1\} * Q_{it}(X_{it}|\Theta_k) + \{Q_{it} = 0\} * \left(1 - Q_{it}(X_{it}|\Theta_k)\right)$ be the likelihood of his quit/stay decision. The likelihood of the history $\left\{y_{it}\, , Q_{it}\right\}$ over time period $t = 1, \dots, T$ is

$$L_{i,k} = \prod_{t=1}^{T} Ly_{it,k} * LQ_{it,k}, \tag{A3}$$

The log-likelihood over the N sample of individuals is

$$L = \sum_{i=1}^{N} \log\left(\sum_{k=1}^{K} \pi_{ik}\left(\prod_{t=1}^{T} Ly_{it,k} * LQ_{it,k}\right)\right). \tag{A4}$$

Directly maximizing the likelihood function is computationally intensive. Another challenge is that, when T is large, the product $\prod_{t=1}^{T} Ly_{it,k} * LQ_{it,k}$ can be very close to zero, in particular when the trial parameters are still far away from the true values. Its log function thus will be undefined. Following the approach of Arcidiacono and Miller (2011), the model estimation involves two stages.

Stage-one estimation: We iteratively maximize the expected log-likelihood of the following equation:

$$\sum_{i=1}^{N}\left(\sum_{k=1}^{K} q_{ik}\left(\sum_{t=1}^{T}\log\left(Ly_{it,k}\right)+\log\left(LQ_{it,k}\right)\right)\right), \tag{A5}$$

where q_{ik} is the probability that individual i belongs to segment k, conditional on the parameter values $\Theta_1, \ldots, \Theta_k$ and the observed history $\{y_{it}, Q_{it}\}$ over time period $t = 1, \ldots, T$. It is calculated as

$$q_{ik} = \frac{L_{i,k}}{\sum_{l=1}^{K} L_{i,l}}. \tag{A6}$$

We start from the initial guess of Θ and π_{ik} obtained by slightly perturbing the parameters estimated from the same model without allowing for the unobserved heterogeneity. For each iteration *m*, given the values of Θ^{m} and π_{ik}^{m}, we update the values in iteration *m+1* by the following steps:

(i) compute q_{ik}^{m+1} based on (A6),

(ii) obtain $\Theta^{\mathrm{m+1}}$ by maximizing (A5), fixing the probability that individual *i* belongs to segment k as q_{ik}^{m+1},

(iii) update $\pi_{k}^{m+1}(X)$ by minimizing the $\sum(\pi_{k}^{m}(X_{ik}) - q_{ik}^{m+1})^2$,

(iv) update $\pi_{ik}^{m+1} = \pi_{k}^{m}(X_{ik})$.

We repeat steps (i)–(iv) until (A5) converges.

Stage-two estimation: The log likelihood function of the latent class model is given by

$$\sum_{k}^{K}\sum_{i}^{N}\pi_{ik}\sum_{\mathrm{t}=1}^{\mathrm{T}}\log\left(Ly_{it,k} * LQ_{it,k}\right) \tag{A7}$$

We estimate model parameters by maximizing the above likelihood function. Note that (A7) differs from (A4) by evaluating the sum of $\log(Ly_{it,k} * LQ_{it,k})$ over years, thus the value will not be close to zero.