Promotion, Turnover and Compensation in the Executive Market*

George-Levi Gayle, Limor Golan, Robert A. Miller
Tepper School of Business, Carnegie Mellon University

July 2008

Abstract

This paper is an empirical study of the market for managers, more specifically the effects of agency, human capital, and preferences on their promotion, tenure, turnover and compensation. From a large longitudinal data set compiled from observations on executives and their publicly listed firms, we construct a career hierarchy and report on its main features. Our summary results motivate a dynamic competitive equilibrium model, whose parameters we identify and estimate. Controlling for heterogeneity amongst firms, which differ by size and sector, and also managers, whose backgrounds vary by age, gender and education, our estimates are used to evaluate how important moral hazard and job experience are in jointly determining promotion rates, turnover and compensation.

1 Introduction

Chief executives are paid more than their subordinates, and internal promotions with the firm are positively correlated with wage growth.[1] Since high ranking executives are almost always drawn from the lower ranks, usually from within the firm, it is tempting to conclude that part of the reward from working hard in a low rank is the chance of promotion to earn rents. Theory provides several possible explanations, ranging from human capital acquired on lower level job, to superior ability being revealed with experience leading to wage dispersion, or as the prize in a tournament played by lower ranked executives to induce hard work.[2] The premise of all these explanations is the commonly held opinion that the CEO is better off than those he supervises. Yet several studies, conducted with data on executive compensation and returns from publicly traded firms, show quite conclusively that CEO compensation is more sensitive to the excess returns of firms than the compensation of lower ranked executives.[3] Thus at the upper levels of the career ladder,

*We thank Kenneth Wolpin, the participants of Society of Labor Economists 2007, the 2008 World Congress on National Accounts and Economic Performance Measures for Nations 2008 for comments and suggestions. This research is supported by the Center for Organizational Learning, Innovation and Performance in Carnegie Mellon.

[1]See Lazear (1992), Baker, Gibbs and Holmstrom (1994a), McCue (1996)

[2]See Prendergast (1999), Gibbons and Waldman (1999) and Neal and Rosen (2000) for surveys.

[3]See Margiotta and Miller (2000) and Gayle and Miller (2008a, 2008b).

differently ranked jobs do not have the same characteristics. Whether one job is more desirable than another depends on the probability distribution of financial compensation that generates his income, as well as its nonpecuniary costs and benefits.

To the best of our knowledge, no one has attempted to quantify how much a CEO receives as a rent from human capital in management and leadership, and how much he is compensated for receiving a more volatile income. A small but growing literature on the structural estimation of moral hazard models investigates the empirical relationship between the principal's return and the agent's compensation, in order to quantify how incentives are used for inducing agents to work in the interests of their principals and truthfully revealing their hidden information.[4] These studies find that estimates of the higher risk premium necessary to compensate a CEO for a more uncertain income relative to the second in command are of the same order of magnitude as differences in expected compensation. Such findings do not resonate with common opinion, because they imply the CEO receives very little pecuniary rent from his promotion to that position. Published work does not, however, integrate human capital and its behavioral consequences into an optimal contracting framework, confounding any attempt to gauge the degree of on-the-job training provided at lower ranks relative to the nonpecuniary value of holding a job at any given rank. More generally, the empirical importance of human capital in the executive labor market, and the role of promotions in this process, is unclear.[5]

This paper is an empirical study of the effects of incentives, human capital, and preferences of managers, with goal of explaining the differences in the promotion, tenure, job turnover and compensation structure across managers.

We estimate a dynamic equilibrium model to analyze and disentangle the effects of competition in the market for managers using data on internal promotions, job turnover and the compensation of executives. Our data contain background information on executives, including age, gender, education, executive experience and the types of firms they work for, plus detailed information on their compensation and the financial returns of their firms. From the large longitudinal data set compiled from observations on executives and their publicly listed firms, we define and construct a career hierarchy and report on its main features. Our summary results motivate a dynamic competitive equilibrium model, whose parameters we identify and estimate. Controlling for heterogeneity amongst firms and managers, our estimates are used to evaluate how important moral hazard and job experience are in jointly determining promotion rates, turnover and compensation.

Our data is described in the next section, where we define the job hierarchy and wage compensation. Our measure of compensation is comprehensive, and includes salary and bonus, stock and option grants, retirement benefits, as well as income directly attributable to holding securities in the firm in lieu of a widely diversified portfolio. The compensation data is augmented with data on the titles of the executives, along with their professional and demographic background compiled from the Marquis "Who's Who" . We define a job hierarchy as the finest partition induced by a given complete and transitive preference relation over a finite set of job descriptions and population of job transitions, extending the empirical investigation of Baker, Gibbs and Holmstrom (1994) on internal promotion

[4]Ferrall and Shearer (1999), Margiotta and Miller (2000), Dubois and Vukina (2005), Bajary and Khwaja (2006), Duflo, Hanna, and Ryan (2007), D'Haultfoeviller and Fevrier (2007), Einav, Finkelstein and Schrimpf (2007), Nekipelov (2007), Gayle and Miller (2008a,b,c).

[5]Frydman (2005) finds evidence on the increase importance of general skills in executive compensation.

for a single case study firm with to promotion and turnover within and between all of the roughly 2,500 firms encompassing about 30,000 and 60 job descriptions. In contrast their data, the hierarchy induced by our data very sensitive to the precise definition of the preference relation, and consequently we used a much weaker criterion for defining differences in rank than in their seminal study. We estimated a probability transition matrix for the seven rank hierarchy we found from our sample, to determine career patterns within and between firms. Within each firm a clear pattern of advancement maps out the evolution of managerial careers independently of compensation issues, and this pattern can be extended in a natural way to job transitions between firms. We find that promotion probability rises with tenure but the probability of firm turnover declines with tenure. Overall, tenure is positively correlated with compensation, increasing in rank, and the portion of the compensation tied to the excess return also increases in tenure and rank. However, tenure has a relatively small negative effect on the compensation. MBA degree increases promotion probability, firm turnover probability and compensation. We find that executives who change firms typically move to higher ranks and are more likely to leave firms with a large number of employees. Negative firm performance also increases the likelihood of executives changing firms.

The equilibrium model is set up in Section 3. It is motivated by empirical regularities we find in the data. First the compensation of the executives are sensitive to fluctuations in the abnormal returns. In fact, the firm's excess return (over and above the market's return) is the most important determinant of managerial compensation, suggesting the importance of incentives and moral hazard. We find that in fact the higher the executive's rank in the firm, the more sensitive his compensation to the abnormal return. We also find that firm turnover is positively correlated with promotions and higher compensation. Executives choose job, firm and effort level every period. They have preferences over jobs, particularly, effort is costly. These taste parameters vary across jobs and firms. In addition, every period managers privately observe a firm-job specific taste shock. The effort level is private information as well. While working they accumulate firm-specific and general human capital. We assume human capital accumulation on a job is greater when the manager exerts effort. The rate of human capital accumulation varies across jobs and firm as well, therefore, working in some firms and jobs may increase the manager's stock of human capital. Firms offer contracts which provide incentives for managers to exert effort. Because exerting effort increases the manager's stock of human capital, future promotion prospects provide incentives[6]. Thus, variation in compensation across firms and jobs partially reflect the different opportunities to accumulate human capital and different promotion prospects. In addition, managers' age and rank imply differences in career concerns affecting the optimal compensation schemes. The markets for executives is competitive. Managers have different stocks of human capital and compensation adjusts to clear the market for each skill set.[7]

Identification and our estimation strategy are discussed in Section 4, while some preliminary estimates from the structural estimation are reported in the final section. We

[6] Gibbons and Murphy (1992) develop and empirically test a model of optimal contracts in the presence of career concerns in the marhet for CEOs.

[7] The optimal contract decentralizes, (see conditions in Fudenberg, Holmstrom and Milgrom, 1990) despite the private information. Although effort affects human capital contracts and labor market histories are observed, therefore, employers know the effort level the executives exerts given the contract.

used four metrics to assess how much agency problems in executive markets are mitigated by their career concerns. Two of these measure the impact of an executive shirking rather than working, while the other two focus on the cost of eliminating the moral hazard problem. We find that firms are prepared to pay hardly anything to eliminate the moral hazard problem at the lower ranks, but that at the upper levels, the risk premium paid to executives for accepting an uncertain income stream that depends on the firm's abnormal returns, are considerably greater. Career concerns greatly ameliorate the moral hazard problem for lower level executives, but their importance declines monotonically with promotion through the ranks. Overall our empirical findings, based on a large sample of executives employed by a broad cross section of publicly traded firms, demonstrate that the design of the hierarchy and the promotion process are important tools, used in conjunction with compensation schemes, for disciplining employees and aligning their interests to the goals of the organization.

2 Data

The data for our empirical study was compiled from three sources. First we extracted annual records on 30,614 individual executives from Standard & Poor's ExecuComp database, itemizing their compensation and describing their title, selected because they were one the top eight paid executives of 2,818 firms in the S&P 500, Midcap, and Smallcap indices in at least one year spanning the period 1992 to 2006. We coded the position of each executive in any given year by one of 37 titles listed in Table 1, which formed the basis of the hierarchy used in our empirical work and discussed in Figure 1 and Table 2. Figure 1 describes the titles (the numbered circles in each rank) included in each rank, with rank 1 being the highest rank in the hierarchy and rank 15 being the lowest rank. The arrows drawn between titles describe executives transitions (promotions and demotions) from title to title. For tractability reasons, we only drew an arrow if the percentage of executive moving from title x to title y is at least 2%. Table 2 provides descriptions of the titles in each rank. Below we define a career hierarchy, explain how and why our particular ranking schemed was adopted, depict the relationships between the original positions, the hierarchy and the sample transitions observed, and construct the transition matrix between ranks to illustrate promotion and turnover patterns.

Data on the 2,818 firms were supplemented by the S&P COMPUSTAT North America database and monthly stock price data from the Center for Securities Research (CSP) database. We also gathered background history for a sub-sample of 16,300 executives, recovered by matching the 30,614 executives from our COMPUSTAT data base using their full name, year of birth and gender with the records in Who's Who, which contains biographies of about 350,000 executives. Summary statistics for the subsample are given in Tables 3 and 4 in terms of the types of firms our sample executives work for, and the ranks they hold, by their background characteristics and job experience. The selected executives come from larger firms than those for which there is no background information, and only 1800 of the 2,818 firms in our original sample contained at least one executive listed in Who's Who. The matched data gives us unprecedented access to detailed firm characteristics, including accounting and financial data, along with their managers' characteristics, namely the main components of their compensation, including pension, salary, bonus, option and stock grants plus holdings, their socio-demographic characteristics, including age, gender, education, and a comprehensive description of their career path sequence described by their annual transitions through the 37 possible positions.

The last part of this section reports results from multinomial logit and wage regression analyses, to characterize the stylized facts about promotion, turnover, retirement and compensation, conditional on an executive's background and experience.

2.1 Hierarchy and Transitions

In this paper a career hierarchy is defined as a rational (complete and transitive) ordering over a set of jobs or positions. Thus a career hierarchy is any partition of jobs that does not contain the possibility of promotion cycles, that is any job sequence of promotions starting and ending at the same position. We follow Baker Gibbs and Holmstrom (1994), by defining the ordering on the basis of job transitions in the worker population alone, rather than factoring in other characteristics of jobs and their respective compensations as well. Their approach is particularly amenable to addressing life cycle issues and analyzing human capital.

Baker et al devised the rule that if greater than one percent of all transitions from job x were from x to job y, and more than one percent transitions from y were from y to x, then the jobs x and y are assigned to the same rank. The predominant transition flow, which defines the direction of promotion, determined the order in which jobs and ranks are listed in their job transition matrix, where jobs for which there are mainly outflows to other jobs in the sample being listed in the top left. Applying this rule to their data set, a case study involving a single firm with 17 positions and 69,840 employee years, yielded 8 ranks. Their job transition matrix is (almost) upper block triangular and therefore satisfies the transitivity property, implying their ordering is rational for the sample population. If we apply the same rule to our full data set, however, then only one rank emerges from our 37 defined positions for the 85,748 employee years in our data if transitivity is imposed as well. Our data set, containing both internal and external transitions across many firms in a more narrowly defined labor market, does not support a (nontrivial) hierarchy if such a stringent rule is used to characterize a rational ordering. For this reason we used a weaker criterion to characterize the ordering, defined as follows. Let $x \succeq y$ mean there are more transitions from y to x than x to y. Then x is ranked at least as highly as y if $x \succeq y$ and/or if $x \succeq z \succeq \ldots \succeq y$. By construction this is a rational ordering. Figure 1 illustrates the relationship between jobs, transition patterns and ranks in our data set. As Table 1 shows, this ordering supports 7 ranks.

Table 2 describes the patterns of job to job transitions within firms per year, the upper-right triangle showing promotions (yearly transitions into higher ranks) and the lower triangle showing demotions. Its diagonal elements shows that changing rank occurs only infrequently. Depending on rank, between about 80 percent and 95 percent remain in their position at the end of the year. Our definition of the ordering for jobs aggregates to ranks and hence the integer in any off-diagonal cell (i, j) of the transition matrix exceeds the number in (j, i), almost without exception. Thus promotion is more common than demotion, by construction. Thus 99 percent of Rank 2 officers remain at that level or are promoted, that is conditional on staying in the sample. However demotion is not a rare event, particularly in the middle levels, where demotion by one rank from Rank 4 is more common than promotion by one rank. Promotion to an adjacent rank is almost invariably more common than promotion to any other rank, but at lower ranks skipping a rank is more common than being promoted to the next one. Demotions are also monotone decreasing in rank, for example more than twice as many slipping one rank as opposed to three.

The last two rows in the top panel of Table 2 represent the number/percent of entries into the rank from other ranks, while the two right columns give the number/percent who exit the rank for another one, that is conditional on remaining in the sample. The two right columns are the number/percent of executives exiting the rank. For example, the highest rank, Rank 1 has 33 percent of entry but only a 12 annual exit rate yearly, Rank 2 also has more entries than exits, the differences decline in the rank, but in the lower ranks, there is more exit than entry as would be expected of entry level jobs. Our choice of the order relation is confirmed by the fact that every cell has nonzero entries, and most of the off diagonal cell numbers exceed one percent of the total number of changes, whether measured as an exit from the rank, or an entry into it.

Executive turnover rates from one firm to another are displayed in the lower panel of Table 2. Overall, transitions that involve changing firms are small relative to internal transitions, accounting for 1.6 percent of the observations. The bottom row shows that a substantial fraction of all firm-to-firm transitions are into higher ranks. Taking proportions of the bottom row elements to their corresponding rank sizes, the panel also shows that the rate declines with rank, very few executives changing firms into the lower ranks. The row entries describe the percent of transitions from a rank as a fraction of all transitions involving firm turnover from the rank. For example, 52% of executives who moved from Rank 1 move into the same rank in a different firm. The rest of the movers move into lower levels in other firms. External transition patterns are different from the internal transitions. Below Rank 2, conditional on turnover, a promotion is more likely than not, in contrast to the top panel, where the diagonal elements are dominant. A large percent of executives who change firms in Ranks 2 and 3 move to Rank 1. Comparing external moves into a rank with total moves into the same rank, more than one quarter of Rank 2 officers are brought in from outside (496 out of 1872), a much higher proportion than for any other rank. Note too, from the top panel, that conditional on remaining in the sample, Rank 2 executives have a lower hazard rate out of their job than the other ranks.

2.2 Executive and Firm Characteristics

Most of the characteristics of the executives and firms in the subsample of matched data require no (further) explanation, but the construction of several variables merit a remark. The sample of firms was initially partitioned into three industrial sectors by GICS code. Sector 1, called primary, includes firms in energy (GICS:1010), materials (1510), industrials (2010,2020,2030), and utilities (5510). Sector 2, consumer goods, comprises firms from consumer discretionary (2510,2520,2530,2540,2550) and consumer staples (3010,3020,3030). Firms in health care (3510,3520), financial services (4010,4020,4030,4040), information technology and telecommunication services (410, 4520, 4030, 4040, 5010) comprise Sector 3, which we call services. In our sample 37 percent of the firms belong to the primary sector, 28 percent to the consumer goods sector, and the remaining 35 percent to the services sector. Firm size was categorized by total employees and total assets, the median firm in each size category determining whether the other firms are called large or small. The sample mean value of total assets is \$18.2 billion (2000 US) with standard deviation \$76.2 billion, while the sample mean number of employees is 23,659 with standard deviation 65,702.

Four measures of experience were included to capture the potential of on-the-job training. Executive experience is the number of years elapsed since the manager was first recorded as one of the top eight paid executives in the sample. Tenure is years spent working at the employee's current firm. We also tracked the number of moves the manager made throughout his career in different jobs and ranks, as well as the number of moves since becoming an executive. Promotion is a indicator variable for whether the manager was promoted recently or not.

We followed Antle and Smith (1985, 1986), Hall and Liebman (1998), Margiotta and Miller (2000) and Gayle and Miller (2008a, 2008b) by using total compensation to measure executive compensation. Total compensation is the sum of salary and bonus, the value of restricted stocks and options granted, the value of retirement and long term compensation schemes, plus changes in wealth from holding firm options, and changes in wealth from holding firm stock relative to a well diversified market portfolio instead. Changes in wealth from holding firm stock and options reflect the costs a manager incurs from not being able to fully diversify his wealth portfolio because of restrictions on stock and option sales. When forming their portfolio of real and financial assets, managers recognize that part of the return from their firm denominated securities should be attributed to aggregate factors, so they reduce their holdings of other stocks to neutralize those factors. Hence the change in wealth from holding their firms' stock is the value of the stock at the beginning of the period multiplied by the abnormal return, defined as the residual component of returns that cannot be priced by aggregate factors the manager does not control. (In our sample the mean abnormal return is -0.005 with standard deviation 0.6, and we do not reject the null hypothesis that it is uncorrelated with the stock market.)

Table 3 describes the characteristics of management by sector and firm size. At 27 percent, Rank 2 is the most commonly observed rank, which reflects the diversity of promotion schemes across firms. By way of contrast, the top and bottom ranks each only contribute 6 percent to the sample population. The distribution of ranks across the three sectors is roughly independent but small firms, as measured by either assets of employment, have a greater proportion of their executives congregating in the lower ranks, with 30 percent versus 20 in the bottom two ranks.

The mean age of executives is almost 54 years with a standard deviation of about 9. Only 4 percent of the sample are female, ranging between 3 percent in the primary sector and 5 percent in the consumer sector. Roughly speaking, formal education is uniformly distributed evenly between bachelor degree or less, professional certification (in accounting or law for example), MBA, some other Master's degree, and Ph.D. The distribution is approximately independent of firm size and sector, ranging from 15 percent with an MS/MA in the consumer sector to 27 percent in small firms by employee for professionally certified executives.

Tenure in the firm averages about 14 years, about 40 years less than age, with standard deviation of about 11, two years more. The sectors are ranked the same way with respect to age and tenure; similarly firms with small assets have both the oldest executives and the longest tenure. In these respects average age, firm sector and size are almost sufficient statistics for average tenure, giving the deceptive appearance at this level of aggregation that executives within firms follow a well defined career track. Averaging across the sample, there are two rank and/or firm turnover moves per observation, one of which has occurred since acquiring executive status. About one third of executives have been promoted within the last two years.

The most important differences between the executives across firm size and sector relate to their compensation. Regardless of which measure is used, the mean salary and bonus in small firms is about two thirds the mean in large firms, about half the total compensation, with standard deviations about one third smaller. This suggests that similarly named positions in small firms are not comparable to their analogues in large firms and may help explain differences between internal and external transitions.

Summarizing differences across firm type, the consumer sector has the lowest percent of executives with advance degrees and the highest percent of female executives, while the service sector has the lowest average tenure and the highest promotion rate and highest total compensation. Total compensation is roughly twice as large in large firms (using both measures), promotion and turnover rates are greater, tenure is lower, and there are more executives holding MBA degrees.

Table 4 describes the characteristics of executives by rank. The average age between Rank 1 and 3 declines from 60 to 52, but is more or less constant as rank falls off further. Similarly average tenure is roughly constant in the lower and middle ranks at 14 but rises to 15 and 17 for Ranks 2 and 1 respectively. The average gap between Ranks 1 and 3 in executive experience is 6 years. To summarize, relative to the lower ranks, Ranks 1 and 2 are 8 years older, with only 6 years more executive experience and just 2 years more tenure, late bloomers hired by the firm late in their career. Not that they are likely to move more than those who do not reach the top levels; although 8 years older the they average the same number of past moves, before and after becoming an executive.

Females form a very small fraction of the executive sample, and they are not uniformly distributed by rank. By a factor of two to three, females congregate in the lower executive ranks relative to males; 2 percent of the top two ranks are females, while 6 percent of Ranks 5 and 6 are female. With regard to the education background variables, the two most striking features are that there is higher percent (out of total executives in the rank) of executives with MBA degrees in the top 4 ranks, the percent of executive with another Masters degree or a Ph.D. is greater in the bottom there ranks, and there is a larger percent of executives with professional certification in the bottom 4 ranks.

Average total compensation and the salary components rise from Rank 7, are maximized at Rank 2, at levels that are more than twice as high as the corresponding figures for Rank 7, and decline. The salary component for Rank 1 is only eclipsed by Rank 2, but it is an open question whether the total financial compensation package offered for a Rank 1 position is more or less desirable than the offer for a Rank 5 position. Although the average compensation \$2.7 million for Rank 2 exceeds the Rank 5 mean by almost \$400,000, the standard deviation for the former is more than twice that of the latter. For example, if all compensation variation observed in the data was resolved before an executive accepted a position, implying the standard deviation simply reflects heterogeneity in fixed pay contracts, then there would be many Rank 5 positions that pay better than many

Rank 2 positions. Alternatively if all the variation in compensation was resolved after the executive accepted his job, implying the standard deviation is a measure of the income uncertainty, the executive would prefer Rank 5 to Rank 1 position if he was sufficiently risk averse.

2.3 Compensation

Table 5 reports OLS and LAD results from regressing how compensation varies with firms' and executives' characteristics. The (conditional) level effects are given in the first two columns of estimates, their interactions with abnormal returns in the second two. Controlling for background demographics and tenure more or less leaves intact the qualitative rank ordering on total compensation we found in Table 3. Total compensation to Ranks 6 and 7 differ by a statistically insignificant amount, and then rises with promotion, spiking at Rank 2, compensation to Rank 1 falling between Ranks 3 and 4. In contrast the unconditional means and standard deviations reported in Table 3, however, the results from the regression analysis separate the effects of excess return, which induces uncertainty to manager's total compensation, from the background variables that determine observed heterogeneity. Note that Rank 1 is more affected by excess returns than every rank except 2. Thus Rank 1 has a lower (OLS) or the same (LAD) estimated mean and more dependence on abnormal returns than Rank 3, while Rank 2 has a higher mean but more dependence than Rank 3. Therefore Rank 3 offers a superior total compensation package to Rank 1, and for sufficiently risk averse executives, a more attractive compensation package than the Rank 2. Continuing in this vein, dependence on excess returns is essentially eliminated by remaining in the middle or lower ranks; our results show that Ranks 4 though 7 are hardly affected by excess returns.

All the firm size and sector variables have significant coefficients except the OLS estimator of the level effect distinguishing the consumer from service sector. None of the background variables for executives interact significantly in the OLS regression, but almost all have significant level effects irrespective of estimator. A notable exception are the coefficients relating to gender. The OLS estimator indicates that gender has no effect on compensation level or its dependence on abnormal returns, whereas the LAD estimator implies there is a small positive level effect of $91,731 and significantly reduced dependence on abnormal returns, both factors making an executive positions more attractive to females relative to males.

With respect to education the OLS results show, that after controlling for the other observed differences, Ph.D. and MBA graduates earn more than $300,000 in excess of executives with undergraduate degrees only, who earn $386,793 more than those with professional certification only. Compensation is quadratic in age as is the case in wage regressions for many occupations. Tenure, executive experience and the number of past moves have statistically significant effects on compensation but are small and inconsequential in magnitude. More noteworthy is the large estimated sign-on bonus associated with turnover, $551,859 for LAD and $994,989 for OLS.

Overall our results suggest that after controlling for rank and firm type, there are significant returns from acquiring general human capital in formal education, but little from firm specific capital that is measured in terms of tenure within any one job and/or experience acquired at a variety of jobs. Similarly gender is not a useful predictor of wages given the other executive's and other characteristics and the nature of the job. To summarize, aside from formal education, job transitions and the abnormal returns of their own firms are the main drivers determining how wealthy executives become.

2.4 Promotion and Turnover

The coefficients on logistic regressions, reported in Table 5, indicate how the probability of internal promotion, external promotion and turnover vary with firm and individual characteristics. Accounting for executives fixed-effects or firm fixed-effects in internal promotions, where we have the most observations, does not change the correlations much. The coefficient on the ranks show that the lower the rank the higher the probability of being promoted, implying that promotions up the ranks become more infrequent and the hierarchy looks like an inverted cone.

Internal promotion is significantly higher in the service sector than the other two. Firms with many employees are more likely to promote their employees than those with few, but the probability of executives leaving firms with bigger workforce is also higher. The value of the firm's assets do not have a significant affect on promotion or turnover.

Excess returns, both current and lagged, reduce the probability of promotion, evidence that executives are not rewarded with promotion for superior firm performance. However poor financial performance also increases the probability that executives will leave the firm. Similarly executive compensation does not significantly affect promotion prospects, but is positively related to turnover. The probability of moves is non-monotonic in the executive's current rank: external promotion is more likely amongst the lower ranks and also Rank 2 than in the middle ranks.

The probability of promotion is much higher conditional on switching firms, versus staying with the existing employer. However tenure also increases the probability of internal promotion. The number of previous moves increases both the probability of internal promotion and turnover, but reduces the probability of external promotion. Managers who moved more in the past are more likely to move again. Executives who do not have a bachelor degree, and those who have professional certification are less likely to be promoted than those with other formal education. Executives with MBA degrees are more likely to move to jobs of the same or lower rank, while those with doctorates are less likely to receive an external promotion but just as likely to leave. Thus both these highly educated groups exhibit a greater willingness to take lower ranked jobs in other firms

Age is negatively correlated with internal promotion and turnover, but older executives behave the same way as their younger counterparts when it comes to outside promotions. Women are promoted at the same rate as men internally, but turn over more than men, even though they are promoted to external positions less frequently than men.

2.5 State Variables and Conditional Choice Probabilities

These findings motivate our formulation of the market for executives and their career concerns, without which we cannot disentangle the effects of human capital, the risk premium for income uncertainty induced by incentive pay, and the nonpecuniary features of managerial work. The model is identified and estimated from data on executive compensation, the firm's abnormal returns, and the transition choices executives make each period conditional on the values of their state variables, factors that affect their current and future payoffs. We denote the state variables relevant for the n^{th} manager at the time t by z_{nt}, one of $Z < \infty$ possible characteristics, the ranks by $r \in \{1, \dots, R\}$ and the firm types by $s \in \{1, \dots, S\}$. In our model $z_{n,t+1}$, the n^{th} manager's state variables in the period $t+1$, are fully determined by z_{nt}, the type of firm he transitions to, denoted s_{nt}, and his rank next period, r_{nt}, by a mapping $z_{n,t+1} \equiv f(z_{nt}, r_{nt}, s_{nt})$, which we define in the next section. Our theory models the transition of z_{nt} to $z_{n,t+1}$ through the competitive equilibrium choices of (r_{nt}, s_{nt}), a stochastic process that generates the data. The structural estimation of our theoretical framework uses as input reduced form estimates of $P(r_{nt}, s_{nt} | z_{nt})$, the probability of (r_{nt}, s_{nt}) conditional on z_{nt}.

In the final part of this section we report our estimates for the reduced form of our model. Since R and S are finite, and we assume Z is a finite set, it follows that in principle cell estimators could be used to recover $P(r_{nt}, s_{nt} | z_{nt})$. Although our sample size, 59,066, is very large compared with all previous studies of this market, the comprehensive detail that accompanies each observation also greatly magnifies the total number of cells RSZ,needed to estimate the model, so this procedure is not feasible. For example only 5 percent of the observations in our sample are female, and none of them have doctorates and head small firms. Many smoothing algorithms are asymptotically equivalent. We used multinomial logits to estimate the reduced form, because of their computational tractability in recovering the structural parameters, because the logit estimates are easy to interpret, and because they illustrate how the variation in our data is used to estimate the underlying structure. For expositional convenience we decomposed $P(r_{nt}, s_{nt} | z_{nt})$ into

$$P(r_{nt}, s_{nt} | z_{nt}) \equiv P(r_{nt} | z_{nt}, s_{nt}) P(s_{nt} | z_{nt})$$

and separately estimated $P(s_{nt} | z_{nt})$, the probability of firm type selected as a function of the state variables, from $P(r_{nt} | z_{nt}, s_{nt})$, the selection of rank conditional on both the state variables and also the firm selected.

Table 6 presents our estimates of $P(s_{nt} | z_{nt})$. The columns refer to the type of firm chosen conditional on moving from the current employer, and the state variables are defined by the rows. The omitted (column) choice is to remain employed with the current firm one more period, and the base line (row) category is a college educated Rank 1 executive employed in a firm of type 1.

MBAs go to 7. MSMAs and Ph.D.'s don't transit as much, as we saw in the previous table. controlling for other state variables we now also see that no degree executives also do not move as much as the college educated group. Female behave the same as males. Similarly tenure and male have no significant effects on the probability of an external move. Older execs are more likely to leave and conditional on leaving are less likely to go 3 than the other types.

Perhaps the most striking feature of this table is that when executives move they join firms similar to the ones they left, that is defined in terms of sector and size. Furthermore conditional on moving to a firm of different size, they are more likely to join a firm in the same sector as the one they left. Broadly speaking, the bottom rows, referring to the rank of the executive at the beginning of the period, show that highly ranked executives are less likely to move than the lower ranked ones, evident form the fact that the estimated coefficients increase in each row.

The final column of Table 6 reports on the probability of leaving the sample for at least two years and never returning, a condition we call retirement. The higher the rank the less likely the probability of retirement, indicated by the decreasing sequence of coefficients on rank. Possibly for very different reasons, executives and those without formal qualifications are more likely to exit this sample than groups with other formal education. The indicator variable for gender has a far bigger impact than any of the education variables. Mirroring female labor supply more generally, women in this highly select and lucrative market are more likely to withdraw from it than their male colleagues and competitors. Finally there are significant sector differences.

Finally our estimates of $P(r_{nt} | z_{nt}, s_{nt})$ are presented in Table 7. Many of the coefficients for the background variables on education education, age, tenure, and experience are readily comparable with the unconditional sample averages reported in Table 4. For example Table 4 shows that female executives with a doctorate are overrepresented in the lower ranks, and Table 7 shows they are more likely to select into the bottom rank. The conditional choice probability estimates shed light on the effects of tenure and age, highly correlated variables with different impacts that are masked by the sample averages reported in Table 4. Here we see that, controlling for all other state variables, last period employer, and this year's employer as well, Rank 2 executives are in fact older than Rank 1 executives, signified by the higher coefficient estimate. Just as startling is the finding that, for given values of the other observed factors, lower ranked employees have more tenure, rather than less, as the unconditional averages in Table 4 might suggest.

Similarly the rows referring to firm sector (for both the previous period and the current one) loosely match up to the first 7 elements in the Table 3 columns, while the rows referring to the ranks provide a conditional analogue to the transition matrix in Table 2. For example the highest coefficients invariably show staying in the same rank is the most likely outcome, and an executive in the lowest rank is more likely to move to Rank i than Rank $i + 1$. Similarly Rank 4 executives are more likely to be demoted than be promoted to Rank 3, evident from both the sample transition matrix of Table 2 and the estimated coefficients in Table 7. Nevertheless the conditional transition probability paints a more ambiguous picture of the career hierarchy than the Transition probability matrix displayed in Table 2. Thus following the promotion path defined in Table 1 and Figure 1 seems more problematic for Rank 2 executives in particular, who are more likely to be demoted to Ranks 3 through 5 than be promoted to Rank 1. The results in Table 7 are foreshadowed in Table 5, which shows that relative to other executives, turnover for a Rank 2 manager is more likely than external promotion.

3 Model

Our model focuses on the promotion, turnover, and executive compensation when the manager is subject to moral hazard. The promotions and career prospects vary across firms and jobs. In particular, managers accumulate human capital while working. The value of the human capital varies across jobs and firms. Executives accumulate general and firm-specific human capital while working. Firms are infinitely lived and executives are finitely lived. They can work for at most T periods. We assume that the labor market is competitive. At the beginning of each period there are contracts that specify a one-period compensation plan, which depends on the job title, firm characteristics and worker's observable characteristics. The information in the model is incomplete. Executives have private information on taste shocks which affect their utility from working in a particular job and firm. Observing their taste shocks at the beginning of each period, executives choose a contract, and then a work routine that is not observed by the directors, and also picks real consumption expenditure for the period.

The objective of the manager is to sequentially maximize her expected lifetime utility, but she competes with other managers for her position. To convince the board that she will pursue the goal of the firm, which we assume is value maximization, the manager chooses a contract that aligns her interests with those of the firm. This alignment is embedded in the incentive compatibility constraints. We solve for Walrasian equilibrium, with rational expectations. The compensation value of the contract in equilibrium is set so that given each workers observable characteristics and the realizations of the idiosyncratic taste shock (with respect to the job), and given the available market contracts, markets clear. Given the available market contracts, no worker can increase utility by switching jobs, and no firm can increase profits by replacing executives.

3.1 Lifetime Utility

The risk-averse managers maximize expected life-time utility. ρ is the constant absolute risk aversion parameter. Denote the time period by $t \in \{0, 1, ...\}$. There are M firms in the market. Firms are indexed by $m \in [0, ..., M\}$, with $m = 0$ representing retirement. We assume retirement is an absorbing state. There are K different types of positions, index by $k \in \{1, ..., K\}$. Define $I_{mkt} \in \{0, 1\}$ to be an indicator of the mangers' choice of a job k in firm m. Note that $I_{0kt} = 1$ means the executive chooses to retire. $l_{mkt} \equiv (l_{1mkt}, l_{2mkt})$ denote the two activities for firm $m \neq 0$, in job k. Activity two requires higher effort level. Define $l_{jmkt} \in \{0, 1\}$ as the indicator for choice of effort in a particular position in a particular firm. $j \in \{1, 2\}$, firm and retirement retirement $m = 0, l_{1mkt} = l_{2mkt} = 1$ for all k and t. β is the constant subjective discount factor. Managers have permanent taste parameters α_{jmk} which define the utility parameters associated with job, firm and effort level choice: $I_{mkt} = 1$ and $l_{jmkt} = 1$. There is an individual taste shock that is indexed by time, firm, and position denoted by ε_{mkt}. If a manager retires, $m = 0$, then $\alpha_{jmk} = \alpha_0$ for all j and k; and $\varepsilon_{0kt} = \varepsilon_{0t}$ for all k. For any choice of job $m \neq 0$ we assume that the disutility associated with the job increases in the high-effort level: $\alpha_{2mk} > \alpha_{1mk}$. The life-time utility is

$$-\sum\nolimits_{t,m,k} \beta^t I_{mkt} \left[\sum\nolimits_{j=1}^{2} \alpha_{jmk} l_{jmkt} \exp(-\rho c_t) \exp(-\varepsilon_{mkt})\right]$$

3.2 Budget constraint

We assume there exists a complete set of markets for all publicly disclosed events relating to commodities, with price measure Λ_t defined on F_t and derivative λ_t. This implies that consumption by the manager is limited by a lifetime budget constraint, which reflects the opportunities she faces as a trader and the expectations she has about her compensation. The lifetime wealth constraint is endogenously determined by the manager's work activities. By assuming markets exist for consumption contingent on any public event, we effectively attribute all deviations from the law of one price to the particular market imperfections under consideration. Let e_t denote the endowment at date t. We also measure $w_{mk,t+1}$, the manager's compensation for employment at rank k for firm n in period t, in units of current consumption. To indicate the dependence of the consumption possibility set on the set of contingent plans determining labor supply and effort, we define $E_0 [\bullet |l]$ as the expectations operator conditional on work and effort level choices throughout the manager's working life. The budget constraint can then be expressed as

$$E_t(\lambda_{t+1}e_{nt+1}) + \lambda_t c_{nt} \leq \lambda_t e_{nt} + E_t(\lambda_{t+1}w_{mkt+1}|l_{jkmt}, I_{mkt}) \tag{1}$$

3.3 Output

Managers are risk averse, therefore, the optimal contract is contingent only on the returns that the manager actions affects their probability distribution. Since managers are risk averse (an assumption we test empirically), his certainty equivalent for a risk bearing security is less than the expected value of security, so shareholders would diversify amongst themselves every firm security whose returns are independent of the manager's activities, rather than use it to pay the manager. We define the abnormal returns of the firm as the residual component of returns that cannot be priced by aggregate factors the manager does not control. In an optimal contract compensation to the manager might depend on this residual in order to provide him with appropriate incentives, but it should not depend on changes in stochastic factors that originate outside the firm, which in any event can be neutralized by adjustments within his wealth portfolio through the other stocks and bonds he holds.

More specifically, letting ϑ_{mt} denote the value of the firm at time t, the gross abnormal return attributable to all the executives' actions is the residual

$$x_{mt} \equiv \frac{\vartheta_{mt} + d_{mt} + \sum_{k=1}^{K} w_{mkt}}{\vartheta_{mt-1}} - \pi_t \tag{2}$$

where π_t is the return on the market portfolio in period t and d_{mt} is the dividend. This study assumes that x_t is a random variable that depends on the managers' efforts in the previous period but, conditional on the effort vector of the executive branch $\{l_{1mkt}, l_{2mkt}\}_{k=1}^{K}$, is independently and identically distributed across both firms and periods.

3.4 Human Capital Accumulation and Managerial Skill

We assume that the rate in which the manager accumulates general and firm-specific capital depends on the type of firm and the manager's effort level. More specifically, we assume that human capital is only accumulated if the manager works diligently. The firm-specific human of a manager entering period t in firm m, where q is a finite integer, is

$$h_{mt} = \sum_{s=1}^{q} \sum_{k} I_{mkt} l_{2mkt-s}.$$

Let the general human capital of a manager be a function of her experience in all firms,

$$h_t = \sum_{s=1}^{q} l_{2mt-s}$$

Note that since l_{2mkt-s} is private information then h_t is also the private information of the manager. The executive endowed skill vector, z_l, is fixed over time.

3.5 Firms and Technology

Each firms is characterized by a vector z_f, which measure of firms size, capital structure and industrial mix. Define $f(x|l_{m1t}, ...l_{mKt}; z_f)$, as the probability density function for x_t, conditional on the effort levels of all the mangers in the firm and let $f_{m1k}(x|h_{mt}^{(-k)}; z_l^{(-k)}; h_t^{(-k)}; z_f)$ denote the probability density when all executives except the executive in the k^{th} rank exert high effort:

$$f(x|l_{m1t}, ...l_{mKt}; z_l; h_t, h_{mt}; z_f) = \begin{cases} f_{m2}(x|z_f) & \text{if } \sum_{k=1}^{K} l_{2mkt} = K \\ f_{m1k}(x|h_{mt}^{-k}; z_l^{-k}; h_t^{-k}; z_f) & \text{if } \sum_{k=1}^{K} l_{2mkt} = K-1 \text{ \& } l_{1mkt} = 1 \\ f_{m1}(x|z_f) & \text{if } \sum_{k=1}^{K} l_{2mkt} < K-1 \end{cases}$$

This specification assumes that if one manager shirks then his human capital does not have affect the output of the firm. There is no distinction in the effect of two or more than two executive shirking on the output of the firm.

Let $F_{m1}(.|.)$, $F_{m2}(.|.)$,and $F_{m1k}(.|.)$ denote the probability distribution functions, respectively, associated with $f_{m1}(.|.)$, $f_{m2}(.|.)$,and $f_{m1k}(.|.)$. In order to obtain the effect of moral hazard in this model we assume stochastic dominance, i.e.

$$F_2(x|z_f) \leq F_{1k}(x|h_{mt}^{(-k)}; z_l^{(-k)}; h_t^{(-k)}; z_f) \leq F_{m1}(x|z_f)$$

We can the define two likelihood ratio of each rank. Note that the shareholders now have three possible set of contracts to choose from. The first option is to have all managers work diligently; in that case, their returns are drawn from $F_{m2}(x|z_f)$. The second case is the case of partial diligence; in that case the return is drawn from $F_{m1}(x|h_t; h_{mt}; z_f)$. The final option is that all managers shirk, and the return is drawn from $F_{m1}(x)$. We can then define two likelihood ratio of each rank,

$$g_{m2k}(x|z_l; h_t, h_{mt}; z_f) = f_{m1k}(x|h_{mt}^{(-k)}; z_l^{(-k)}; h_t^{(-k)}; z_f)/f_{m2}(x|z_f) \tag{3}$$

and

$$g_{m2}(z_l; h_t, h_{mt}; z_f) = f_{m1}(x|z_f)/f_{m1k}(x|h_{mt}^{(-k)}; z_l^{(-k)}; h_t^{(-k)}; z_f) \tag{4}$$

Note that if the second case hold then the compensation of the executive in rank k would not vary with x. This is empirically testable and since the compensation of executives of all rank sin our study varies with returns we are going to assume that the shareholders specified that they want the return to be drawn from $F_{m2}(x|z_f)$.

3.6 Solving the Model

At the beginning of every period, executives privately observe realizations of preference shocks and choose consumption. Firms then make a one-period contract offers to executives, and executives choose one of the contracts. Each executive then chooses an effort level which he privately observed. The realization of the outcome x is revealed at the end of the period, and is a common knowledge and the executives is paid w_{mkt+1}. The complete labor market history is common knowledge.

Definition 1 *A Walrasian Market Equilibrium is a set of contracts offered for each combination of firm, job, effort level and manager characteristics. Taking beliefs about the managers' type and prices as given, the contracts maximize firms' profits, executives' choice of a contract and effort level maximize their utility. Firms' beliefs about executives' type satisfy rational expectations, and the executive market clears.*

The model is solved in stages. Managers are price takers, therefore, the manager's problem of consumption and contract choices are equivalent to a single agent dynamic choice problems. We first derive the indirect utility function for executives who retire, and then solve for optimal consumption when the manager works for at least one period and then retires. Using the valuation function that solves this problem, we then derive the optimal choice of job and firm for the worker, for any given set of contracts available in the market. We then solve for the employers' problem of offering an optimal contract for managers and choosing a combination of managers to the various position in the hierarchy; the optimal contracts circumscribe the short term contracts.

3.6.1 The Manager's Problem

In order to derive the solution to the optimal consumption decision we start out with the conditional valuation function for working one period at time t and then retiring and dying at $n+1$, where the nonpecuniary parts of utility from working are ε_{mkt} (is the expected conditional valuation of this unobserved nonpecuniary benefit, and α_k treated as a parameter, where α_0 is also estimated as a parameter. For notational ease denote by $z_{mt} = (h_{mt}, h_t)$, assume that z_{mt} has finite support $\mathbb{Z}$, let b_t denoted the period t price of a infinitely lived bond, and a_t the price of a security that pays off the (random) dividend $(\ln \lambda_s - s \ln \beta - \ln \lambda_t)$ is period s.

Lemma 2 *Substituting the optimal consumption and savings path* $\left(c_t^0, e_{t+1}^0\right)$ *which we derive from maximizing the utility subject to the budget constraint in equation 1 into the utility function we obtain the following indirect utility*

$$\begin{aligned} V_{jmkt} &= -b_t \alpha_{jmk}^{\frac{1}{bt}} (\alpha_{mkt}^{t+1,j}(z_{mt}))^{1-\frac{1}{b_t}} \exp\left(-\frac{1}{b_t}\varepsilon_{mkt}\right) \alpha_0^{\prod_{s=t+1}^{T-1}\left(1-\frac{1}{b_s}\right)} \exp\left(-\frac{a_t+\rho e_t}{b_t}\right) \\ &\quad \times E_t\left[\upsilon_{k,m,t+1} | z_{mt}, l_{k,m,j} = 1\right]^{1-\frac{1}{b_t}} \end{aligned} \tag{5}$$

where

$$\upsilon_{mkt+1} \equiv \exp\left(-\frac{\rho w_{mkt+1}}{b_{t+1}}\right)$$

is the value of the expected compensation based on period t contract, and job choice probabilities for $s > t$ are defined as

$$\Upsilon_{jmk}(z'|z_{mt}, l_{jmk}, I_{mkt}) \equiv \Pr(I_{m'k't+1} = 1, z_{m'k't+1} = z', l_{jmkt+1} = 1|z_f, z_{mt}, l_{jmk}, I_{mkt})$$

and the term $\alpha_{mkt}^{t+1,j}$ represents the life-time utility associated with each in career paths of each job

$$\begin{aligned}\alpha_{mkt}^{t+1,,j} &= \sum_z \sum_{m',k'} \alpha_{m'k't+1}^{t+2,s}(z')^{1-\frac{1}{b_{t+1}}} (\alpha_{sm'k'})^{\frac{1}{b_{t+2}}} \Upsilon_{sm'k'}(z'|z_f, z_{mt}, l_{jmkt}, I_{mkt})\times \\ &\quad E\left[\exp\left(-\frac{1}{b_{t+2}}\varepsilon_{m'k't+2}\right)|z', I_{m'k't+2}, l_{sm'k't+2}\right] E_t\left[\upsilon_{k,m,t+3}|l_{k,m,2,t+3}, = 1, z'\right]^{1-\frac{1}{b_{t+2}}}\end{aligned}$$

Next, we begin by describing the managers' optimal job choice, given the vector of available contracts. We can write the indirect utility as

$$\begin{aligned}b_t\log(-V_{jmkt}) &= b_t\log\left(\alpha_{jmk}^{\frac{1}{bt}}(\alpha_{mkt}^{t+1,j}()z_{mt})^{1-\frac{1}{b_t}} E_t\left[\upsilon_{k,m,t+1}|z_{mt}, l_{k,m,j} = 1\right]^{1-\frac{1}{b_{tn}}})\right) \\ &\quad +b_t\log\left(b_t\alpha_0^{\prod_{s=t+1}^{T-1}(1-\frac{1}{b_s})}\exp\left(-\frac{a_t+\rho e_t}{b}\right)\right) + \varepsilon_{mkt}\end{aligned}$$

By normalizing $\alpha_0 = 1$, and noting that retirement is an absorbing state, we can express the indirect utility function for all $m \neq 0$ as

$$\begin{aligned}&b_t\log(-V_{jmkt}) = b_t\log\left(\alpha_{jmk}^{\frac{1}{bt}}(\alpha_{mkt}^{t+1,,j}(z_{mt}))^{1-\frac{1}{b_t}} E_t\left[\upsilon_{k,m,t+1}|z_{mt}, l_{k,m,j} = 1\right]^{1-\frac{1}{b_{t\overline{n}}}}\right) \\ &+b_t\log\left(b_t\exp\left(-\frac{a_t+\rho e_t}{b_t}\right)\right) + \varepsilon_{mkt}\end{aligned}$$

and for the retirement $m = 0$,

$$b_t\log(-V_{0t}) = b_t\log\left(b_t\exp\left(-\frac{a_t+\rho e_t}{b_t}\right)\right) + \varepsilon_{0t}$$

Therefore, given a vector of contracts an executive faces and given the distribution of the preferences shocks, the conditional choice probabilities of each job is given by

$$\Pr(I_{mkt}^0 = 1|l_{k,m,2} = 1, z_{mt}, z_f) = \Pr\left(-b_t\log(-V_{2mkt}) \geq -b_t\log(-V_{2m'k't})\ |z_{mt}, z_f\right), \forall(m,k) \neq (m',k')$$

Under the assumption that ε_{mkt} are independently and identically distributed type I extreme value we get that the choice probability if each job is

$$\begin{aligned}&\Pr\left(I_{mkt}^0 = 1|l_{k,m,2} = 1, z_{mt}, z_f\right) = \\ &\frac{\alpha_{2mk}(\alpha_{mkt}^{t+1,2}(z_{mt}))^{(b_t-1)} E_t\left[\upsilon_{k,m,t+1}|l_{k,m,2} = 1\right]^{(b_t-1)}}{1+\sum_{m'=1}^M\sum_{k'=1}^K \alpha_{2m'k'}(\alpha_{m'k't}^{t+1,2}(z_{m't}))^{(b_t-1)} E_t\left[\upsilon_{k',m',t+1}|l_{k',m',2} = 1\right]^{(b_t-1)}}\end{aligned} \tag{6}$$

and the choice of retirement is

$$\Pr\left(I^0_{0t}=1|z_{mt},z_f\right)= \tag{7}$$
$$\frac{1}{1+\sum_{m'=1}^{M}\sum_{k'=1}^{K}\alpha_{2m'k'}(\alpha^{t+1,2}_{m'k't}(z_{m't}))^{(b_t-1)}E_t\left[\upsilon_{k',m',t+1}|l_{k',m',2}=1\right]^{(b_t-1)}}$$

3.6.2 The Firm's Maximization Problem

The firm chooses, period by period, the managers' effort level and offer them contracts that minimize the sum of the discounted expected wage bill $\sum_{k=1}^{K}E_t(w_{mkt+1})$ or equivalently, maximizes $\sum_{k=1}^{K}E_t(\ln\upsilon_{mkt+1})$. First, shareholders compare the costs and benefits of an incentive compatible compensation package that elicits diligent work versus a (lower cost) scheme that provides some or all managers with the nonpecuniary benefit of low effort. Second, contract offers for managerial skills imply probability distribution of hiring different types of managers to a certain position, these contracts maximize the firm's profits, given the market contracts.

We begin by deriving the cost minimizing contract that elicits high effort from any possible manager, firm and job. The manager's continuation value from shirking is weakly smaller than the continuation value associated with diligent work. That is $V_{2mkt}\geq V_{1mkt}$,

Lemma 3 *The cost minimizing contract which implements high-effort is given by*

$$E_t\left[\upsilon_{k,m,t+1}(x)\{g_{m2k}(z_{mt},z_f)-(\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha^{t+1,2}_{mkt}(z_{mt})/\alpha^{t+1,1}_{mkt}(z_{mt}))\}|l_{k,m,2}=1\right]\geq 0 \tag{8}$$

The compensation required to elicit high effort depends on the taste for effort in each firm and job the likelihood ratio. This is standard in moral hazard models. The likelihood ratio in our model, however, depends on firm characteristics, the manager's skill and his general– and firm-specific human capital. The ratio $\alpha^{t+1,2}_{mkt}/\alpha^{t+1,1}_{mkt}$ captures future effect of differences in human capital accumulated from diligent work versus shirking on productivity. That is, in firms and jobs in which the value of human capital has large effect on promotion and future compensation, the pay required to elicit diligence is smaller. This ratio also depends on the manager's characteristics. It is larger, for example, the longer the career horizon and may vary by the current stock of human capital and the manager's skill.

Next, suppose $P^E_{mk}(z_m)$, is the firms' beliefs about probability of hiring when a contract $\upsilon_{k,m,t+1}(z_{mt},z_f)$ is offered. Then the cost minimizing contract for a given effort level satisfies the following condition,

$$\begin{aligned}&\alpha_{2mk}(\alpha^{t+1,2}_{mkt}(z_m))^{(b_t-1)}E_t\left[\upsilon^*_{k,m,t+1}|l_{k,m,j}=1\right]^{(b_t-1)} \\ =&\left(\frac{P^E_{mk}(z_m)}{1-P^E_{mk}(z_m)}\right)\left(1+\sum_{\substack{m'=1\\(m,k)\neq(m',k')}}^{M}\sum_{k'=1}^{K}\alpha_{jm'k'}(\alpha^{E,t+1,j}_{m'k't}(z_{m'}))^{(b_t-1)}E^E_t\left[\upsilon_{k',m',t+1}|l_{k',m',j}=1\right]^{(b_t-1)}\right)\end{aligned} \tag{9}$$

The left hand side of the above condition is the expected continuation value (over the individual taste shocks) from accepting the contract. It depends on the job-firm taste parameters, and the implied continuation values of working in the job. It increases in the implied promotion probabilities and expected future earning (low $\alpha_{mkt}^{t+1,2}$) The right hand side is a function of the expected outside option available to the manager and its implied continuation values.

The Lagrangian for the problem in which the firm elicits diligent work can be written as

$$\sum_{k=1}^{K} E_t[\ln(\upsilon_{k,m,t+1})|z_{mt},z_f] + \sum_{k=1}^{K}\eta_{1k}\left[\frac{1}{\alpha_{mkt}^{t+1,2}}\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right)^{1/(b_t-1)} - \sum_{k=1}^{K}E_t[\upsilon_{k,m,t+1}|,z_{mt}]\right]$$
$$+\sum_{k=1}^{K}\eta_{2k}E_t\left[\upsilon_{k,m,t+1}\left\{g_{2mk}(x|z_m)-(\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_{mt})/\alpha_{mkt}^{t+1,1}(z_{mt}))\right\}|z_{mt}\right] \quad (10)$$

Lemma 4 *In the equilibrium where all size of firms elicit high effort for all managers in the hierarchy, the optimal contract is*

$$w_{2mkt+1}(x,z_m) = \frac{b_{t+1}}{\rho(b_t-1}\log\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right) \quad (11)$$
$$+(b_{t+1}/\rho)\log\left[1+\eta_k\left\{(\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_{mt})/\alpha_{mkt}^{t+1,1}(z_{mt}))-g_{2mk}(x|z_{mt},z_{mt},z_f)\right\}\right]$$

where

$$U_{mk}^{E}(z_m)\equiv$$
$$\left(\frac{P_{mk}^{E}(z_m)}{1-P_{mk}^{E}(z_m)}\right)\times\left(1+\sum_{\substack{m'=1\\(m,k)\neq(m',k')}}^{M}\sum_{k'=1}^{K}\alpha_{jm'k'}(\alpha_{m'k't}^{E,t+1,j}(z'))^{(b_t-1)}E_t^{E}\left[\upsilon_{k',m',t+1}|l_{k',m',j}=1\right]^{(b_t-1)}\right)$$

and η_k *is the unique positive root to*

$$\int\left[\frac{f_{2m}(x|z_f)}{\eta_k\left\{(\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_{mt})/\alpha_{mkt}^{t+1,1}(z_{mt}))-g_{2mk}(x|z_{mt},z_{mt},z_f)\right\}}\right]dx=1$$

See the proof in the Appendix. Equation 11 implies an expected utility level $U_{mk}^{E}(z_{mt})$ required to attract a manager with characteristics z_m to a job k in firm m with probability $P_{mk}^{E}(z_{mt})$. The expected utility increases in the outside options of the manager. As discussed above, the expected costs to the firm depends on the promotion probabilities and the continuation value attached to the job relative to the continuation values of working in other jobs. Firm-specific human capital accumulated on the job, should increase the value of working in the firm relative to the outside options and therefore, reduces the expected cost of the contract to the firm. General human capital increases the outside option.

Given rational expectations by firms, their beliefs about the hiring probabilities are consistent with the manager's choice probabilities

$$\Pr\left(I_{mkt}^{0}=1|l_{k,m,2}=1,z_{mt}\right)=P_{mk}^{E}(z_{mt})$$

Since the contracts clear the market we have:

$$\sum_{m=0}^{M}\sum_{k=1}^{K}\sum_{z} P_{mk}^{E}(z_{mt}) = 1$$

That is, given the market contracts managers are either hired to a position or retire.

4 Identification and Estimation

The taste parameters in our model are $2MK + 1$ positive real numbers, $2MK$ scalars indicating utility losses for high and low effort, generically denoted by α_{2mk} and α_{1mk} respectively, plus a parameter for risk aversion ρ. In this paper we assume these parameters do not depend on the executive's background variables, but as the subscripts indicate, α_{jmk} is sector $m \in \{1,\ldots,M\}$ and rank $k \in \{1,\ldots,K\}$ specific for $j \in \{1,2\}$.[8] There are three functions governing the firms' excess returns, the probability density function of abnormal returns when every manager is diligent, denoted $f_{m2}(x\,|z_f)$, the density when only one of the k^{th} ranked executive officers shirks, denoted $f_{m1k}(x\,|z_f)$, and the density when more than one executive shirks, $f_{m1}(x\,|z_f)$. Outcomes from the $f_{m2}(x\,|z_f)$ density are observed in the data, and inferences about $f_{m1k}(x\,|z_f)$ can be made from the estimated compensation schedule using restrictions implied by the equilibrium contract. However there is no information about $f_{m1}(x\,|z_f)$, because the outcomes from this distribution are not directly observed, and none of the agents consider this distribution when making their own choices.

Since $f_{m2}(x\,|z_f)$ can be estimated using standard nonparametric methods with data (or in our case consistent estimates of) excess returns, and $f_{m1}(x\,|z_f)$ is not identified, we focus our discussion of identification and estimation on the taste parameters mentioned above, and the likelihood ratio $g_{2mk}(x|z_f) \equiv f_{m1k}(x\,|z_f)\,/f_{m2}(x\,|z_f)$. This section analyzes identification and describes an algorithm for sequentially estimating the model from the panel data using background information on the managers, their firm type, compensation and rank. We imposed a regularity condition on $g_{2mk}(x|z_f)$ that for all (m,k,z_f) there exists some finite return $\overline{x}$ such that $g_{2mk}(x'|z_f) = 0$ for all $x' > \overline{x}$. This assumption implies that, should the firm performance at the end of the period be truly outstanding, then shareholders would be certain that all the executives had worked diligently during the period. Given the minimal movement in bond prices over this period, we also assumed simplified several of the formulas by assuming, the bond price is constant, setting $b_t = b$. Finally we assume that the privately observed taste shock ε_{mkt} is independently and identically distributed extreme value Type 1.

Estimation proceeded sequentially in five steps:

1. Sample analogues of the equilibrium choice probabilities $P_{mk}^{E}(z)$ for each sector $m \in \{1,\ldots,M\}$, rank $k \in \{1,\ldots,K\}$ and background characteristics of the firm and executive $z \in Z$, were formed from a reduced form multinomial logit model.

2. We estimated annual excess returns for firms in equation 2 from the data, and then computed, conditional on the state variables, a nonparametric estimator of total

[8] Recall that without loss of generality we normalized the taste parameter for retirement to $\alpha_0 = 1$.

compensation from our imputed values compiled from the data, which we assume is the sum of true compensation and independent measurement error. We used Kernel methods to nonparametrically estimate $w^o_{2mk}(x,z)$, the compensation schedule for diligent work, for each (m,k,z) as:

$$w^{(N)}_{2mk}(x,z) = \frac{\sum_{s=1,s\neq n}^{N}\sum_{t=1}^{T} w_{st} I\{I_{mkst}=1, z_{st}=z,\} K\left(\frac{x_{mt}-x}{\delta_{xN}}\right)}{\sum_{s=1,s\neq n}^{N}\sum_{t=1}^{T} I\{I_{mkst}=1, z_{st}=z,\} K\left(\frac{x_{mt}-x}{\delta_{xN}}\right)}$$

3. Substituting the estimators for $P^E_{mk}(z)$ and $w^o_{2mk}(z)$ into

$$E_t\left[\frac{1}{\alpha^{t+1,2}_{mkt}(z)}\left(U^E_{mk}(z)/\alpha_{2mk}\right)^{1/(b_t-1)} - \upsilon_{k,m,t+1}(x,z)\,|z\right]=0$$

   which holds for all (m,k,z), we exploited the restrictions of the competitive selection embodied in the market clearing condition to obtain estimates of α_{2mk} for each (m,k) and the risk aversion parameter ρ, a step we discuss below in more detail.

4. Substituting in the estimated wage functions and the estimated risk aversion parameter into the right side of we estimated likelihood ratio $g_{2mk}(x|z_f)$ nonparametrically from the slope of the wage compensation schedule with respect to abnormal returns off the equation

$$g_{2mk}(x|z) = \frac{\upsilon^{-1}_{k,m,t+1}(\overline{x},z) - \upsilon^{-1}_{k,m,t+1}(x,z)}{\upsilon^{-1}_{k,m,t+1}(\overline{x},z) - E_t[\upsilon^{-1}_{k,m,t+1}(x,z)|z]}$$

5. Finally the taste parameters for shirking α_{1mk} for each (m,k) were inferred from the restrictions implied by the incentive compatibility condition

$$E_t\left[\upsilon_{k,m,t+1}(x,z)\left\{g_{m2k}(z_{mt},z_f) - \left(\frac{\alpha_{2mk}}{\alpha_{1mk}}\right)^{1/(b_t-1)}\frac{\alpha^{t+1,2}_{mkt}(z)}{\alpha^{t+1,1}_{mkt}(z)}\right\}|l_{k,m,2}=1\right]=0$$

Since a detailed description and the empirical results of the first step is given in the data section, the second step is routine, Gayle and Miller (2008a, 2008c) analyze the fourth step and its derivation, this only leaves the third and fifth steps to comment upon now. Making $(\alpha_{2mk}/\alpha_{1mk})$ the subject of the incentive compatibility condition, and substituting in the expression for $g_{2mk}(x|z)$ establishes

$$\begin{aligned}\alpha_{1mk}/\alpha_{2mk} &= \left\{\alpha^{t+1,1}_{mkt}(z)/\alpha^{t+1,2}_{mkt}(z)\,E\left[\upsilon_{k,m,t+1}(x,z)g_{2mk}(x,z)\,|l_{km2}=1\right]\right\}^{1-b_t}\\ &= \left\{\alpha^{t+1,1}_{mkt}(z)/\alpha^{t+1,2}_{mkt}(z)\left[\frac{E\left[\upsilon_{k,m,t+1}(x,z)\,|l_{km2}=1\right]\upsilon^{-1}_{k,m,t+1}(\overline{x},z)-1}{\upsilon^{-1}_{k,m,t+1}(\overline{x},z)-E_t[\upsilon^{-1}_{k,m,t+1}(x,z)|z]}\right]\right\}^{1-b_t}\end{aligned}$$

This expression for $(\alpha_{2mk}/\alpha_{1mk})$ proves that if $\alpha^{t+1,1}_{mkt}(z)/\alpha^{t+1,2}_{mkt}(z)$ is identified, then $(\alpha_{2mk}/\alpha_{1mk})$ is separately identified for each background set of variables z.

Thus identification of the model reduces to recovering α_{2mk} for each (m,k) and ρ from the market clearing condition in the third stage, a total of $MK+1$ parameters. Note that the market clearing condition holds for every rank k, for every background z, and in every firm type m, meaning there are MKZ competitive selection conditions (retirement ensuring Walras' law, market clearance, is satisfied). Consequently all $MK+1$ parameters are identified subject to the usual rank conditions if there is observed heterogeneity amongst the executives that does not affect their preferences. In our application we assume the taste parameters are not functions of tenure, executive experience and age, but that these variables have differential effects on promotions and other transitions.

Our estimator of the α_{2mk} parameters and the ρ, based on the competitive selection equations, is $\sqrt{NT}$ consistent and asymptotically normal, the covariance differing from the standard formula only because the choice probabilities and the compensation schedule are estimated in the first two steps. We have three remarks about its implementation. First, rather than form MKZ orthogonality conditions from the conditional expectation functions, we formed a GMM estimator from the implied covariances

$$E\left\{\left[\frac{1}{\alpha_{mkt}^{t+1,2}(z)}\left(\widehat{U}_{mk}^{E}(z)/\alpha_{2mk}\right)^{1/(b_t-1)}-\upsilon_{k,m,t+1}(x,z)\right]z\right\}=0$$

using the counting variables, tenure, executive experience and age as instruments, after substituting in an approximating function $\widehat{U}_{mk}^{E}(z)$ for $U_{mk}^{E}(z)$. The former differs from the latter only because consistent estimators for $P_{mk}^{E}(z_m)$ and $w_{2mk}^{o}(z)$ are used instead of their true values. The remaining background variables, categorical variables signifying educational background and gender, were also used as conditioning variables in forming the orthogonality functions for the estimator. Second, when forming the recursion that defines $\alpha_{mkt}^{t+1,j}(z)$, used in the definitions of $\widehat{U}_{mk}^{E}(z)$ and $U_{mk}^{E}(z)$, we exploited the fact that, given the manager's choice, the transition of z_{nt} to z_{nt+1} is deterministic. From the definition of $\Upsilon_{2'm'k'}(z'|z_{nt},l_{jmk},I_{mkt}):$

$$\begin{aligned}
&\Upsilon_{2'm'k'}\left(z'|z_{nt},l_{jmk},I_{mkt}\right)\\
\equiv\;&\Pr\left[I_{m'k't+1}=1,z_{nt+1}=z'|z_{nt},I_{mkt}=1,l_{jmk}=1\right]\\
=\;&\Pr\left[I_{m'k't+1}=1\left|z_{nt+1}=z',z_{nt},I_{mkt}=1,l_{jmk}=1\right.\right]\Pr\left[z_{nt+1}=z'|z_{nt},I_{mkt}=1,l_{jmk}=1\right]\\
=\;&\Pr\left[I_{m'k't+1}=1\left|z_{nt+1}=z',z_{nt},I_{mkt}=1,l_{jmk}=1\right.\right]I\left\{z_{nt+1}=z'|z_{nt},I_{mkt}=1,l_{jmk}=1\right\}
\end{aligned}$$

Third, the Type 1 extreme value assumption for ε_{mkt} is by no means critical for the viability of our empirical approach, but simplifies the formula for its conditional expectation, as indicated by the following Lemma, proved in the appendix.

Lemma 5 *If ε_{mkt} is independently and identically distributed extreme value Type I then*

$$E[\exp\left(-\frac{\varepsilon_{mkt}}{b_{t+1}}\right)|z_{mt},I_{mkt}=1,l_{jmkt}=1]=\frac{\Pr(I_{mkt}=1|z,l_{jmkt}=1)}{b_{t+1}}\equiv\frac{P_{mk}(z_{mt})}{b_{t+1}}$$

The second and third remarks directly imply the recursion for $\alpha_{mkt}^{t+1,j}(z_{nt})$ reduces to

$$\begin{aligned}\alpha_{mkt}^{t+1,j}(z_{nt}) &= \frac{1}{b}\sum_{z'} I\left\{z_{nt+1} = z' \,|z_{nt}, I_{mkt} = 1, l_{jmk} = 1\right\} \times \\ &\left[\sum_{m',k'} \alpha_{m'k't+1}^{t+2,2}(z')^{1-1/b}\left(\alpha_{2m'k'}\right)^{1/b} P_{m'k'}^{(E)}(z')^2 E_t\left[v_{k,m,t+3}|l_{k,m,2,t+3}, = 1, z'\right]^{1-1/b}\right]\end{aligned}$$

5 Investment versus Moral Hazard

In the concluding section to this paper we assess how much agency problems in executive markets are mitigated by their career concerns. Two of the four metrics we use measure the impact of an executive shirking rather than working. We estimated how much abnormal returns would fall if shareholders failed to incentivize one of its executives but continued to pay the other according to the optimal schedule. This is one measure of how much a firm stands to lose by ignoring the moral hazard problem. The executive, on the other hand, is much more concerned with the compensating differential between diligence and shirking. We computed the compensating differential to an executive from following his interests (shirking) rather than acting according to the interests of the shareholders (working diligently). The other two metrics focus on the cost of eliminating the moral hazard problem. We report on how much the firm pays to induce diligence in the presence of human capital investment, a risk premium for eliminating the moral hazard problem. Finally we calculate how much more a firm would have to pay if executives were not motivated by career concerns, ambition that helps to internalize what would otherwise be a more substantial moral hazard problem.

Each metric was computed using the structural estimates obtained from the previous section, by executive rank, averaged over firm type and executive background. Thus successive rows in Table 9 report a sample average for the rank and its standard deviation, conditional on optimal behavior by the rest of the management team. For the purposes of comparisons with other studies in this literature we also report the estimated risk aversion parameter, the top entry. Quite plausible, and comparable to previous estimates found, we note that an executive with exponential utility and risk aversion parameter of 0.45 would be willing to pay \$217, 790 to insure against an actuarially fair gamble that offers a loss of \$1 million with probability one half and a gain of \$1 million with probability one half.

The first metric is an average over $\tau_{1mk}(z)$, the expected gross loss in the value of the firm of type m in percentage terms if a rank k executive with background z tends his own interests for one year, instead of maximizing the expected value of the firm, that is before netting out the decline in expected compensation all executives would incur from the deteriorating financial performance of the firm. When all executives work diligently, by definition abnormal returns have mean zero, meaning $E[x] = 0$. Thus $\tau_{1mk}(z)$ is found by integrating abnormal returns conditional on the executive in question shirking, when every other executive works diligently:

$$\tau_{1mk}(z) \equiv E\left\{x\left[1 - g_{mk}(x,z)\right)\right]\} = -E\left[xg_{mk}(x,z)\right]$$

We interpret $\tau_{1mk}(z)$ as a measure of the executive's span of control, because it indicates his potential impact on the firm from behaving irresponsibly. Not surprisingly we find Rank 2 executives exercise the greatest span of control; at 11 percent per year, a chief executives can drive the value of firm equity down to less than half its current value in 8 years, shareholders willing. Similarly, the result that the estimated span of control declines through the middle and lower ranks, confirms our intuition. More remarkable is our finding that executives in Ranks 2 and 3 have a greater span of control than those in Rank 1, as do many in Rank 4.

Taking the manager's perspective rather than the firm's, the compensating differential between working hard and shirking, which we denote by $\tau_{2mk}(z)$, is measured by differencing $w^0_{1mk}(z)$, the manager's reservation certainty equivalent wage to shirk, from $w^0_{2mk}(z)$, the manager's reservation certainty equivalent wage to work diligently under perfect monitoring. Derived from the participation constraint, these certainty equivalents can be expressed as:

$$w^0_{1mk}(z) = \frac{b_{t+1}}{\rho}\log(\alpha^{t+1,1}_{mkt}(z)) + \frac{b_{t+1}}{\rho(b_t-1)}\log(\alpha_{1mk}/U^E_{mk}(z_m))$$

and

$$w^0_{2mk}(z) = \frac{b_{t+1}}{\rho}\log(\alpha^{t+1,2}_{mkt}(z)) + \frac{b_{t+1}}{\rho(b_t-1)}\log(\alpha_{2mk}/U^E_{mk}(z_m))$$

Thus

$$\begin{aligned}\tau_{2mk}(z) &\equiv w^0_{2mk}(z) - w^0_{1mk}(z)\\ &= \frac{b_{t+1}}{\rho}\log(\alpha^{t+1,2}_{mkt}(z)/\alpha^{t+1,1}_{mkt}(z)) + \frac{b_{t+1}}{\rho(b_t-1)}\log\left(\alpha_{2mk}/\alpha_{1mk}\right)\end{aligned}$$

If a manager does not maximize the value of the firm, he gains utility from the nonpecuniary benefits of pursuing his own interests, but does not acquire so much human capital, and thus reduces his chances of higher wages and better positions in the future.

The first factor would also arise in a static model of pure moral hazard where there are no career concerns, and in our formulation does not depend on the executives background characteristics:

$$\tau^{PM}_{2mk} \equiv \frac{b_{t+1}}{\rho(b_t-1)}\log\left(\alpha_{2mk}/\alpha_{1mk}\right)$$

Our estimates in Table 9 show that contemporaneous nonpecuniary shirking/working benefit differential associated with the Rank 2 position, at \$2.48 million, exceed those associated with any of the other ranks, but that the annual differential from the Rank 1 position is the next highest. Thus Rank 1 has a lesser span of control than Rank 3, but more nonpecuniary benefits. Again these benefits decline through the middle and lower ranks.

The second factor determining $\tau_{2mk}(z)$ reflects those dynamic features of our framework relating to career concerns

$$\tau^{H}_{2mk}(z) \equiv \frac{b_{t+1}}{\rho}\log(\alpha^{t+1,2}_{mkt}(z)/\alpha^{t+1,1}_{mkt}(z))$$

Here we find that, on average, the benefits of human capital accumulation decline monotonically with rank, and that compared with τ^{PM}_{2mk}, are much less dispersed throughout the population of firm types and executive backgrounds. At the lower ranks these benefits are quite considerable. On average a Rank 5 executive is willing to forego \$1.88 million per year because of the greater opportunities working diligently versus shirking affords him, while a Rank 1 executive only values the human capital component of the compensating differential at \$400,000 million per year.

By inspection the compensating differential $\tau_{2mk}(z)$ is the sum of these two factors

$$\tau_{2mk}(z) = \tau^{H}_{2mk}(z) + \tau^{PM}_{2mk}$$

Our estimates imply the compensating differential for every rank except the second is about \$2 million per year, but exceeds \$3 million per year for Rank 2 executives.

How much a firm would be willing to eliminate moral hazard is measured by $\tau_{3mk}(z)$. Under a perfect monitoring scheme shareholders would pay a manager the fixed wage of $w^0_{2mk}(z)$, and thus eliminate the risk premium they pay him in the form of a favorable lottery over the outcome of abnormal returns to induce diligent work. Hence the expected value of a perfect monitor to shareholders, denoted $\tau_{3mk}(z)$, is the difference between expected compensation under the current optimal scheme and $w^0_{2mk}(z)$, or:

$$\begin{aligned}
\tau_3 &\equiv E\left[w_{mk}\left(x\right)|z\right] - w^0_{2mk}(z) \\
&= E\left[w_{mk}\left(x\right)|z\right] - \frac{b_{t+1}}{\rho}\log(\alpha^{t+1,2}_{mkt}(z)) - \frac{b_{t+1}}{\rho(b_t-1)}\log(\alpha_{2mk}/U^E_{mk}(z_m))
\end{aligned}$$

Our findings in Table 9 show that the firms are prepared to pay hardly anything to eliminate the moral hazard problem at the lower ranks, but that at the Ranks 1 and 3, the benefits of a perfect monitor are considerably more. Curiously, the average risk premium paid to Ranks 1 and 3, \$1.6 million and \$1.7 million respectively, are quite close, despite the fact that the other measures of moral hazard are not.

As one final check on the relevance of human capital to resolving moral hazard problems in the executive market, we estimated the extra premium shareholders would pay to eliminate the moral hazard problem if the benefits of acquiring human capital was ignored by an executive, say because neither the organizational structure nor the market rewarded his diligence. In our model this is represented by:

$$\tau_{4mk}(z) \equiv \frac{b_{t+1}}{\rho}\log(\alpha^{t+1,2}_{mkt}(z))$$

The estimates in Table 9 show that career concerns greatly ameliorate the moral hazard problem for lower level executives but their importance declines monotonically with promotion through the ranks, bordering on irrelevance for many Rank 1 executives.

6 Appendix

Proof of Lemma 2

The problem of working one period in k, and then retiring, for choices (c_t, e_{t+1}) yields a utility of

$$-b_t\alpha_{jmk}^{\frac{1}{b_t}}\left(\alpha_{0k}\right)^{1-\frac{1_t}{b_t}}\exp\left(-\frac{a_t+\rho_t e_t}{b_t}\right)\exp\left(-\frac{1}{b_t}\varepsilon_{mkt}\right)E_t[\upsilon_{mkt+1}|z_{mt};z_f;l_{jmkt}=1,I_{mkt}=1]^{1-\frac{1}{b_t}}$$

Extending to the case where there are multiple jobs. If a manager works in job k in period t the probability of him accepting job k' in firm m in period t is $p_{km}^{k'm'}$. Choosing (c_t, e_{t+1}) and working in job k, and then accepting job k yields utility for choices (c_t, e_{t+1}) of

$$\begin{aligned}
&-\alpha_{jmk}\beta^t \exp(-\rho c_t) \exp\left(\frac{1}{b_t}\varepsilon_{mkt}\right) - E_t\{(\alpha_0)^{1-\frac{1}{b_{nt+1}}} \exp\left(-\frac{a_{t+1}+\rho e_{t+1}}{b_{nt+1}}\right) b_{nt+1} \\
&\times \sum_{m',k',z'} \sum_{s=1}^{2} \alpha_{sm'k'}^{\frac{1}{b_{nt+1}}} E[\exp\left(\frac{1}{b_{t+1}}\varepsilon_{m'k't+1}\right)|z', I_{m'k't+1}, l_{sm'k't+1}] \\
&\times E_{t+1}[\upsilon_{mkt+2}|z', I_{m'k't+1}, l_{sm'k't+1}]^{1-\frac{1}{b_{nt+1}}} \Upsilon_{sm'k'}^{(1)}(z'|z_{mt}, l_{jmk}, I_{mkt})\}
\end{aligned}$$

where

$$\Upsilon_{jmk}^{(s)}(z'|z_{mt}, l_{jmk}, I_{mkt}) = \Pr(I_{m'k't+s} = 1, z_{m'k't+s} = z', l_{jmkt+s} = 1|z_{mt}, l_{jmk}, I_{mkt})$$

and define:

$$\begin{aligned}
\alpha_{mkT-1}^{T-2,,j}(z_{mT-2}) \equiv \\
\sum_{m',k',z'} \sum_{s=1}^{2} \alpha_{sm'k'}^{\frac{1}{b_{nT-1}}} E[\exp\left(\frac{1}{b_{T-1}}\varepsilon_{m'k'T}\right)|z', I_{m'k'T-1}, l_{sm'k'T-1}] \\
\times E_{T-1}[\upsilon_{mkT}|z', I_{m'k'T-1}, l_{sm'k'T-1}]^{1-\frac{1}{b_{T-1}}} \times \Upsilon_{sm'k'}^{(1)}(z'|z_{mT-2}, l_{jmkT-2}, I_{mkT-2})
\end{aligned} \tag{12}$$

Solving recusively, we can write the utility from working two periods and then retiring as:

$$-\alpha_{jmk}\beta^{T-2} \exp(-\rho c_{T-2}) \exp(\varepsilon_{mkT-2}) - E_t\left[\exp\left(-\frac{a_{T-1}+\rho e_{T-1}}{b_{T-1}}\right) b_{T-1} (\alpha_0)^{1-\frac{1}{b_{T-1}}} \alpha_{mkT-1}^{T-2,j}(z_{mT-2})\right] \tag{13}$$

The indirect utility is

$$-b_{T-2}(\alpha_{jmk})^{\frac{1}{b_{T-2}}} \exp\left(\frac{1}{b_{T-2}}\varepsilon_{mkT-2}\right)(\alpha_0)^{1-\frac{1}{b_{T-1}}} \alpha_{mkT-1}^{T-2,j}(z_{mT-2}))^{1-\frac{1}{bT-2}} \exp\left(-\frac{a_{T-2}+\rho e_{T-2}}{b_{T-2}}\right) \upsilon_{mkT-1}^{1-\frac{1}{b_{T-2}}}$$

$$\begin{aligned}
&-b_{T-2}(\alpha_{jmk})^{\frac{1}{b_{T-2}}} \exp\left(-\frac{1}{b_{T-2}}\varepsilon_{mkT-2}\right)(\alpha_0)^{(1-\frac{1}{b_{T-1}})(1-\frac{1}{bT-2})} \alpha_{mkT-1}^{T-2,j})^{1-\frac{1}{bT-2}} \\
&\times \exp\left(-\frac{a_{T-2}+\rho e_{T-2}}{b_{T-2}}\right) E_t\left[\upsilon_{k,mT-1}^{1-\frac{1}{b_{T-2}}}|l_{k,m,j}\right]
\end{aligned}$$

Continuing in a similar fashion, the indirect utility from three period work and retirement is

$$
\begin{aligned}
&-\alpha_{jmk}\beta^{T-3}\exp\left(-\rho c_{T-3}\right)\exp\left(\frac{1}{b_{T-3}}\varepsilon_{mkT-3}\right)\\
&-E_{T-3}\{b_{T-2}\left(\alpha_0\right)^{(1-\frac{1}{b_{T-1}})(1-\frac{1}{bT-2})}\exp\left(-\frac{a_{T-2}+\rho e_{T-2}}{b_{T-2}}\right)\times\\
&\sum_{m',k',z'}\sum_{s=1}^{2}\alpha_{m'k'T-1}^{T-2,s}(z_{mT-2})^{1-\frac{1}{b_{T-2}}}\Upsilon_{sm'k'}^{(1)}(z'|z_{mT-3},l_{jmkT-3},I_{mkT3})\left(\alpha_{sm'k'}\right)^{\frac{1}{b_{T-2}}}\\
&\times E[\exp\left(-\frac{1_{T-2}}{b_{T-2}}\varepsilon_{m'k'T-2}\right)|z',I_{m'k'T-2},l_{sm'k'T-2}]\upsilon_{m'k'T-1}^{1-\frac{1}{b_{T-2}}}\}
\end{aligned}
$$

$$
\begin{aligned}
\alpha_{mkT-2}^{T-3,,j}(z_{mT-1}) &\equiv \sum_{m',k',z'}\sum_{s=1}^{2}\alpha_{m'k'T-1}^{T-2,s}{}^{1-\frac{1}{b_{T-2}}}\Upsilon_{sm'k'}^{(1)}(z'|z_{mT-3},l_{jmkT-3},I_{mkT-3})\left(\alpha_{sm'k'}\right)^{\frac{1}{b_{T-2}}}\\
&\quad\times E[\exp\left(\frac{1}{b_{T-2}}\varepsilon_{m'k'T-2}\right)|z',I_{m'k'T-2},l_{sm'k'T-2}]\upsilon_{m'k'T-1}^{1-\frac{1}{b_{T-2}}}\}
\end{aligned}
$$

Let

$$
\begin{aligned}
\alpha_{mkt}^{t+1,,j}(z_{mt}) &= \sum_{m',k',z'}\sum_{s=1}^{2}\alpha_{m'k't+1}^{t+2,s}(z')^{1-\frac{\lambda_{t+2}}{b_{t+1}}}\left(\alpha_{sm'k'}\right)^{\frac{\lambda_{t+2}}{b_{t+2}}}\Upsilon_{sm'k'}^{(1)}(z'|z_{mt},l_{jmkt},I_{mkt})\\
&\quad\times E[\exp\left(-\frac{1}{b_{t+2}}\varepsilon_{m'k't+2}\right)|z',I_{m'k't+2},l_{sm'k't+2}]\upsilon_{m'k't+3}^{1-\frac{1}{b_{t+2}}}\}
\end{aligned}
$$

The problem of working for T periods and then retiring , by induction, is:

$$
-\alpha_{jmk}\beta^{t}\exp\left(-\rho c_t\right)\exp\left(-\varepsilon_{mkt}\right)-E_t\left\{b_{t+1}\alpha_0^{1-\frac{\lambda_t}{b_{tn}}}\alpha_{mkt+1}^{T,j}\exp\left(-\frac{a_{t+1}+\rho\lambda_{t+1}e_{t+1}}{b_{t+1}}\right)\right\}
$$

Maximizing the utility subject to the budget constraint in 1 gives the following indirect utility

$$
\begin{aligned}
V_{jmkt} &= -b_t\alpha_{jmk}^{\frac{\lambda_t}{bt}}(\alpha_{mkt}^{t+1,,j}(z_{mt}))^{1-\frac{\lambda_t}{b_t}}\exp\left(-\frac{1}{b_t}\varepsilon_{mkt}\right)\alpha_0^{\prod_{s=t+1}^{T-1}(1-\frac{1}{b_s})}\exp\left(-\frac{a_t+\rho e_t}{b_t}\right)\\
&\quad\times E_t\left[\upsilon_{k,m,t+1}|l_{k,m,j}=1\right]^{1-\frac{1}{b_t}})
\end{aligned}
$$

Q.E.D

Proof of Lemma **??** Simply imposing that the value of working diligently weakly exceeds the value of shirking is

$$
\begin{aligned}
&-b_t\alpha_{2mk}^{\frac{1}{bt}}(\alpha_{mkt}^{t+1,2}(z_{mt}))^{1-\frac{1}{b_t}}\exp\left(-\frac{1}{b_t}\varepsilon_{mkt}\right)^{1-\frac{1}{b_t}}\alpha_0^{\prod_{s=t+1}^{T-1}(1-\frac{1}{b_s})}\exp\left(-\frac{a_t+\rho e_t}{b_{nt}}\right)E_t\left[\upsilon_{k,m,t+1}|l_{k,m,2}=1\right]^{1-\frac{1}{b_{t\overline{n}}}})\\
\geq\ &-b_t\alpha_{1mk}^{\frac{1}{bt}}(\alpha_{mkt}^{t+1,1}(z_{mt}))^{1-\frac{1}{b_t}}\exp\left(-\frac{1}{b_t}\varepsilon_{mkt}\right)^{1-\frac{1}{b_t}}\alpha_0^{\prod_{s=t+1}^{T-1}(1-\frac{1}{b_s})}\exp\left(-\frac{a_t+\rho e_t}{b_{nt}}\right)E_t\left[\upsilon_{k,m,t+1}|l_{k,m,1}=1\right]^{1-\frac{1}{b_{t\overline{n}}}})
\end{aligned}
$$

Simplifying, yields the condition in the Lemma. Q.E.D

CostMin. The Lagrangian can for the problem can be written as

$$\sum_{k=1}^{K} E_t[\ln(\upsilon_{k,m,t+1}|z_m] + \sum_{k=1}^{K} \eta_{1k}\left[\frac{1}{\alpha_{mkt}^{t+1,2}(z_m)}\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right)^{1_t/(b_t-1)} - \sum_{k=1}^{K} E_t[\upsilon_{k,m,t+1}|, z_m]\right]$$
$$+\sum_{k=1}^{K} \eta_{2k} E_t\left[\upsilon_{k,m,t+1}\left\{g_{2mk}(x|z_m) - (\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m))\right\}|z_m\right] \quad (14)$$

Proof. The kth first order condition is then

$$\upsilon_{k,m,t+1}^{-1} = \eta_{1k} + \eta_{2k}\left\{g_{2mk}(x|z_m) - (\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m))\right\} \quad (15)$$

multiplying both sides by $\upsilon_{k,m,t+1}$, adding and subtracting $\frac{\eta_{1k}}{\alpha_{mkt}^{t+1,2}}\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right)^{1/(b_t-1)}$ from both sides of 15 gives

$$\begin{aligned} 1 &= \eta_{1k}\left[\upsilon_{k,m,t+1} - \frac{1}{\alpha_{mkt}^{t+1,2}}\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right)^{1/(b_t-1)}\right] \\ &+\eta_{2k}\upsilon_{k,m,t+1}\left\{g_{2mk}(x|z_m) - (\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m))\right\} \quad (16) \\ &+\frac{\eta_{1k}}{\alpha_{mkt}^{t+1,2}}\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right)^{1/(b_t-1)} \quad (17) \end{aligned}$$

Taking expectation conditional on $l_{k,m,2} = 1, z_m$ and noting the the complimentary slackness condition binds gives us

$$1 = \frac{\eta_{1k}}{\alpha_{mkt}^{t+1,2}}\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right)^{1/(b_t-1)} \quad (18)$$

which implies that

$$\eta_{1k} = \alpha_{mkt}^{t+1,2}\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right)^{(b_t-\lambda_t)/\lambda_t} \quad (19)$$

Next substitute 15 into the incentive compatibility constraint we get

$$E_t\left[\frac{\eta_{2k}\left\{g_{2mk}(x|z_m) - (\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m))\right\}}{\eta_{1k} + \eta_{2k}\left\{(\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m)) - g_{2mk}(x|z_m)\right\}}\middle| z_m\right] = 0 \quad (20)$$

Define $\eta_k = \frac{\eta_{2k}}{\eta_{1k}}$ then

$$\eta_k \int \left[\frac{g_{2mk}(x|z_m) - (\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m))}{1 + \eta_k\left\{(\alpha_{2mk}/\alpha_{1mk})^{1_t/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m)) - g_{2mk}(x|z_m)\right\}}\right] f_{m2}(x|z_m)dx = 0 \quad (21)$$

or

$$\int \left[\frac{f_{m2}(x|z_m)}{\eta_k(\alpha_{2mk}/\alpha_{1mk})^{1_t/(b_t-1_t)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m)) - \eta_k g_{2mk}(x|z_m)}\right] dx = 1 \quad (22)$$

Finally, using the definition of η_k, the FOC can be written as

$$\upsilon_{k,m,t+1}^{-1} = \eta_{1k}\left[1+\eta_k\left\{g_{2mk}(x|z_m) - (\alpha_{2mk}/\alpha_{1mk})^{\lambda_t/(b_t-\lambda_t)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m))\right\}\right] \tag{23}$$

substituting for η_{1k} from equation 19 we get

$$\begin{aligned}\upsilon_{k,m,t+1}^{-1} &= \alpha_{mkt}^{t+1,2}(z_m)\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right)^{(b_t-1)} && (24)\\ &\quad\times\left[1+\eta_k\left\{g_{2mk}(x|z_m) - (\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m))\right\}\right] && (25)\end{aligned}$$

Substituting for $\upsilon_{k,m,t+1}^{-1}$ we get

$$\begin{aligned}\exp\left(\frac{\rho\lambda_{t+1}w_{mkt+1}(x,z_m)}{b_{t+1}}\right) &= \alpha_{mkt}^{t+1,2}(z_m)\left(U_{mk}^{E}(z_m)/\alpha_{2mk}\right)^{(b_t-1)}\\ &\quad\times\left[1+\eta_k\left\{g_{2mk}(x|z_m) - (\alpha_{2mk}/\alpha_{1mk})^{1/(b_t-1)}(\alpha_{mkt}^{t+1,2}(z_m)/\alpha_{mkt}^{t+1,1}(z_m))\right\}\right]\end{aligned}$$

solving to $w_{mkt+1}(x,z_m)$ we obtain the result. ■ ■

Proof of Lemma 5. Note that $I_{mkt}=1$ if $V_{jmkt}\geq V_{jm'k't}$ for all $(m,k)\neq(m',k')$ and $V_{jmkt}\geq V_{jm'k't}$ implies that

$$\begin{aligned}&-b_t\alpha_{jmk}^{\frac{1}{bt}}(\alpha_{mkt}^{t+1,j}(z_m))^{1-\frac{1}{b_t}}e^{-\frac{1}{b_t}\varepsilon_{mkt}}\alpha_0^{\prod_{s=t+1}^{T-1}(1-\frac{1}{b_s})}e^{-\frac{a_t+\rho e_t}{b_t}}E_t\left[\upsilon_{k,m,t+1}|l_{k,m,j}=1\right]^{1-\frac{1}{b_t}})\\ \geq\ &-b_t\alpha_{jm'k'}^{\frac{\lambda_t}{bt}}(\alpha_{m'k't}^{t+1,j}(z_m))^{1-\frac{1}{b_t}}e^{-\frac{1}{b_t}\varepsilon_{m'k't}}\alpha_0^{\prod_{s=t+1}^{T-1}(1-\frac{1}{b_s})}e^{-\frac{a_t+\rho e_t}{b_t}}E_t\left[\upsilon_{k',m',t+1}|l_{k',m',j}=1\right]^{1-\frac{1}{b_t}}) \qquad (26)\end{aligned}$$

or

$$\begin{aligned}&\alpha_{jmk}^{\frac{1}{bt}}(\alpha_{mkt}^{t+1,j}(z_m))^{1-\frac{1}{b_t}}e^{-\frac{1}{b_t}\varepsilon_{mkt}}E_t\left[\upsilon_{k,m,t+1}|l_{k,m,j}=1\right]^{1-\frac{1}{b_t}})\\ \leq\ &\alpha_{jm'k'}^{\frac{\lambda_t}{bt}}(\alpha_{m'k't}^{t+1,j}(z_m))^{1-\frac{\lambda_t}{b_t}}e^{-\frac{\lambda_t}{b_t}\varepsilon_{m'k't}}E_t\left[\upsilon_{k',m',t+1}|l_{k',m',j}=1\right]^{1-\frac{1}{b_t}}) \qquad (27)\end{aligned}$$

Taking logs of both sides of the above equation we get

$$\begin{aligned}&\log\left(\alpha_{jmk}^{\frac{1}{bt}}(\alpha_{mkt}^{t+1,j}(z_m))^{1-\frac{1}{b_t}}E_t\left[\upsilon_{k,m,t+1}|l_{k,m,j}=1\right]^{1-\frac{1}{b_{t\overline{n}}}}\right)-\frac{1}{b_t}\varepsilon_{mkt}\\ \leq\ &\log\left(\alpha_{jm'k'}^{\frac{1}{bt}}(\alpha_{m'k't}^{t+1,j}(z_m))^{1-\frac{1}{b_t}}E_t\left[\upsilon_{k',m',t+1}|l_{k',m',j}=1\right]^{1-\frac{1}{b_{t\overline{n}}}}\right)-\frac{1}{b_t}\varepsilon_{m'k't} \qquad (28)\end{aligned}$$

Let $\overline{V}_{jmkt}\equiv-\log\left(\alpha_{jm'k'}^{\frac{1}{bt}}(\alpha_{m'k't}^{t+1,j}(z_m))^{1-\frac{1}{b_t}}E_t\left[\upsilon_{k',m',t+1}|l_{k',m',j}=1\right]^{1-\frac{1}{b_{t\overline{n}}}}\right)$ then $I_{mkt}=1$ if $\overline{V}_{jmkt}+\frac{1}{b_t}\varepsilon_{mkt}\geq\overline{V}_{jm'k't}+\frac{1}{b_t}\varepsilon_{m'k't}$ for all $(m,k)\neq(m',k')$ or $\frac{1_t}{b_t}\varepsilon_{m'k't}-\frac{1}{b_t}\varepsilon_{mkt}\leq\overline{V}_{jmkt}-\overline{V}_{jm'k't}\vee(m,k)\neq(m',k')$. So

$$E[e^{-\frac{1}{b_{t+1}}\varepsilon_{mkt}}|z,I_{mkt}=1,l_{jmkt}=1]=E[e^{-\frac{1}{b_{t+1}}\varepsilon_{mkt}}|z,\frac{1}{b_t}\varepsilon_{m'k't}-\frac{1}{b_t}\varepsilon_{mkt}\leq\overline{V}_{jmkt}-\overline{V}_{jm'k't}\vee(m,k)\neq(m',k')] \tag{29}$$

Note that if ε_{mkt} is i.i.d. extreme value type I with no scaling parameter equal one and location parameter equals zero the $\frac{1}{b_t}\varepsilon_{mkt}$ is i.d.d. extreme value Type I with scaling parameter equals $\frac{1}{b_t}$ and location parameter zero. Therefore

$$E[e^{-\frac{1}{b_{t+1}}\varepsilon_{mkt}}|z, I_{mkt} = 1, l_{jmkt} = 1] = \frac{1}{P_{jmkt}(z)} \tag{30}$$

$$\times T\int_{-\infty}^{\infty} e^{-\frac{1}{b_{t+1}}\varepsilon} G_{jmk}(\overline{V}_{jmkt} - \overline{V}_{j01t} + \frac{1}{b_t}\varepsilon, ..., \overline{V}_{jmkt} - \overline{V}_{jMKt} + \frac{1}{b_t}\varepsilon)d\varepsilon \tag{31}$$

where $G_{jmk}(\overline{V}_{jmkt} - \overline{V}_{j01t} + \frac{\lambda_t}{b_t}\varepsilon, ..., \overline{V}_{jmkt} - \overline{V}_{jMKt} + \frac{\lambda_t}{b_t}\varepsilon)$ is the conditional density (See McFadden (1978) page 82 for details). Note that if $\frac{1_t}{b_t}\varepsilon_{mkt}$ is i.d.d. extreme value Type I with scaling parameter equals $\frac{1}{b_t}$ and location parameter zero then

$$G_{jmk}(\overline{V}_{jmkt} - \overline{V}_{j01t} + \frac{\lambda_t}{b_t}\varepsilon, ..., \overline{V}_{jmkt} - \overline{V}_{jMKt} + \frac{\lambda_t}{b_t}\varepsilon) = \exp(-A_j \exp(-\frac{\lambda_t}{b_t}\varepsilon)) \exp(-\frac{\lambda_t}{b_t}\varepsilon) \tag{32}$$

where

$$A_j = \sum_{m'=0}^{M} \sum_{k'=1}^{K} \exp(\overline{V}_{jmkt} - \overline{V}_{m'k't}) \tag{33}$$

Therefore

$$E[e^{-\frac{1}{b_{t+1}}\varepsilon_{mkt}}|z, I_{mkt} = 1, l_{jmkt} = 1] = \frac{1}{P_{jmkt}(z)} \tag{34}$$

$$\times \int_{-\infty}^{\infty} e^{-\frac{1}{b_{t+1}}\varepsilon} \exp(-A_j \exp(-\frac{1}{b_t}\varepsilon)) \exp(-\frac{1}{b_t}\varepsilon)d\varepsilon \tag{35}$$

Now Let's perform a change of variable of the type $\xi = \exp(-\frac{1}{b_t}\varepsilon)$. Then

$$d\xi = -\frac{1}{b_t} \exp(-\frac{1}{b_t}\varepsilon)d\varepsilon \tag{36}$$

and

$$-b_t d\xi = \exp(-\frac{1}{b_t}\varepsilon)d\varepsilon \tag{37}$$

Also when $\varepsilon = -\infty$ then $\xi = +\infty$ and when $\varepsilon = \infty$ then $\xi = 0$. Using this change variable we can rewrite

$$\frac{1}{P_{jmkt}(z)} \int_{-\infty}^{\infty} e^{-\frac{1}{b_t}\varepsilon} e^{-A_j e^{-\frac{1}{b_t}\varepsilon}} e^{-\frac{1}{b_t}\varepsilon} d\varepsilon = -\frac{b_t}{P_{jmkt}(z)} \int_{+\infty}^{0} \xi \exp(-A_j\xi)d\xi \tag{38}$$

$$= \frac{b_t}{P_{jmkt}(z)} \int_{0}^{+\infty} \xi \exp(-A_j\xi)d\xi \tag{39}$$

$$= \frac{b_t}{A_j P_{jmkt}(z)} \int_{0}^{+\infty} \xi A_j \exp(-A_j\xi)d\xi \tag{40}$$

Note that since $A_j > 0$ then $A_j \exp(-A_j\xi)$ is the density of the exponential distribution with scale parameterA_j therefore $\int_0^{+\infty} \xi A_j \exp(-A_j\xi)d\xi$ is the the mean of said exponential distribution, i.e.

$$E[\xi] = \int_{0}^{+\infty} \xi A_j \exp(-A_j\xi)d\xi = \frac{1}{A_j} \tag{41}$$

Also note that

$$P_{jmkt}(z) = \frac{1}{A_j}$$

Hence

$$\begin{aligned} \frac{b_t}{A_j P_{jmkt}(z)} \int_0^{+\infty} \xi A_j \exp(-A_j \xi) d\xi &= \frac{b_t P_{jmkt}(z)^2}{P_{jmkt}(z)} \\ &= b_t P_{jmkt}(z) \end{aligned}$$

Hence the result of the Lemma ■

References

[1] **Antle, R. and A. Smith** "An Empirical Investigation of the Relative performance Evaluation of Corporate Executives,"

Journal of Accounting Research, 24 pp. 1-39, 1986

[2] **Antle, R. and A. Smith** "Measuring Executive Compensation: Methods and as Application, " Journal of Accounting Research, 23 pp. 296-325, 1985

[3] **Baker, G; G., Michael and Holmstrom, B.** "The Internal Economics of the Firm: Evidence from Personnel Data," Quarterly Journal of Economics, November 1994, 109(4), pp. 881-919.

[4] **Baker, G; G., Michael and Holmstrom, B "** The Wage Policy of a Firm," Quarterly Journal of Economics, November 1994, 109(4), pp. 921-55

[5] **P. Bajary and A. Khwaja,** "Moral Hazard, Adverse Selection and Health Expenditures: A Semiparametric Analysis"

NBER Working Paper No. W12445, August 2006

[6] **D'Haultfoeviller X. and P. Fevrier,** "Identification and Estimation of Incentive Problems: Adverse Selection," Working paper, September 2007.

[7] **P. Dubois and, T. Vukina**, "Optimal Incentives under Moral Hazard and Heterogeneous Agents: Evidence from Production Contracts Data", Working paper, December 2005.

[8] **E. Duflo, R. Hanna, and S. Ryan**, "Monitoring Works: Getting Teachers to Come to School", Working paper, MIT, November 2007

[9] **L. Einav, A. Finkelstein and P. Schrimpf**, "The Welfare Cost of Asymmetric Information: Evidence from the U.K. Annuity Market," NBER Working Paper No. 13228, July 2007.

[10] **Ferrall C. and Shearer B.** "Incentives and Transactions Costs Within the Firm: Estimating an Agency Model Using Payroll Records," *Review of Economic Studies*, 66, 2, 309-338, 1999.

[11] **Frydman, Carola**. 2005. "Rising Through the Ranks: The Evolution of the Market for Corporate Executives, 1936-2003." Columbia University.

[12] **Fudenberg, Drew, Bengt Holmstrom and Paul Milgrom**. 1990. " Short-Term Contracts and Long-Term Agency Relationships." *Journal of Economic Theory*, Vol. 50, pp. 1-31.

[13] **Gayle, George-Levi and Miller, Robert A.** 2008a. "Has Moral Hazard become a More important Factor in Managerial Compensation?", Tepper School of Business, Carnegie Mellon University.

[14] **Gayle, George-Levi and Miller, Robert A.** 2008b. " The Paradox of Insider Information and Performance Pay" forthcoming, CESifo Economic Studies .

[15] **Gayle, George-Levi and Robert A. Miller.** 2008c "Identifying and Testing Generalized Moral Hazard Models of Managerial Compensation." Tepper school of Business, Carnegie Mellon University.

[16] **Gibbons R. and K. J. Murphy.** "Optimal Incentive Contract in the Presence of Career Concerns: Theory and Evidence," *Journal of Political Economy, 1992, vol. 100 (3), pp 468-505*

[17] **Gibbons, R**. **and M. Waldman** "Careers in Organizations: Theory and Evidence" *Hanbook of Labor Economics* Vol. 3b. pp 2373–2437, 1999

[18] **Hall, Brian J. and Jeffrey B. Liebman.** 1998. "Are CEOS Really Paid Like Bureaucrats?." *The Quarterly Journal of Economics,* August 1998, CXIII pp. 653-680.

[19] **Lazear E.** 1992**.** *"The job as a concept,"* in W. Bruns, ed., Performance measurement, evaluations and incentives. Harvard University Press, Boston, MA, pg.183-215

[20] **Margiotta, Marry M. and Robert A. Miller.** 2000**.** "Managerial Compensation and The Cost of Moral Hazard." *International Economic Review,* 41 (3) pp. 669-719.

[21] **Masson, R**. "Executive Motivations, Earnings, and Consequent Equity Performance." Journal of Political Economy, 79 pp. 1278-1292. 1971

[22] **McCue, K**. "Promotions and Wage Growth" Journal of Labor Economics, Vol 14(2) pp. 175-209, April, 1996.

[23] **Neal D. and S. Rosen** "Theories of the Distribution of Earnings," in Anthony Atkinson and

Francois Bourguignon, eds., *Handbook of Income Distribution.* New York: Elsevier Science, North Holland, 2000, pp. 379-427.

[24] **D. Nekipelov** (2007) "Empirical Content of a Continuous-Time Principal-Agent Model", Mimeo Duke University.

[25] **Prendergast, Canice.** 1999. "The Provision of Incentives in Firms." *Journal of Economic Literature* XXXVII pp. 7-63 (1999).

Table 1-Ranks and Titles

Rank		Title1	Title 2	TITLE 3
1	1a	chairman	& vicechair	
	2a	schairman & sceo	chairman & sother	schairman & svicechair
2	3a	chairman	& president	& ceo
	4a	ceo		
3	5a	chairman	& cfo	
	6a	chairman	& execvp	
	6b	chairman	& coo	
	7a	president	& coo	
	9c	coo		
4	8a	execvp		
	9a	execvp	& coo	
	9b	execvp	& cfo	
	10a	snrvp		
	10b	spresident		
	10d	execvp	& spresident	
5	10c	execvp	& other	
	10e	execvp & sceo	execvp & scoo	
	10f	spresident & sceo	spresident & scoo	
	11a	president	& execvp	
	12a	vp		
	12e	snrvp	& cfo	
	12f	snrvp	& spresident	
6	12b	snrvp	& other	
	12c	vp	& other	
	12d	cfo	& other	
	13d	president	& cfo	
	13c	president	& other	
	13a	snrvp	& coo	
	13b	snrvp	& sceo	
	15a	cfo		
	14c	vp	& cfo	
7	14d	vp	& spresident	
	14e	vp & sceo	vp & scoo	
	14a	other	& sceo	
	14b	scoo		

.

Figure 1: Hierarchy

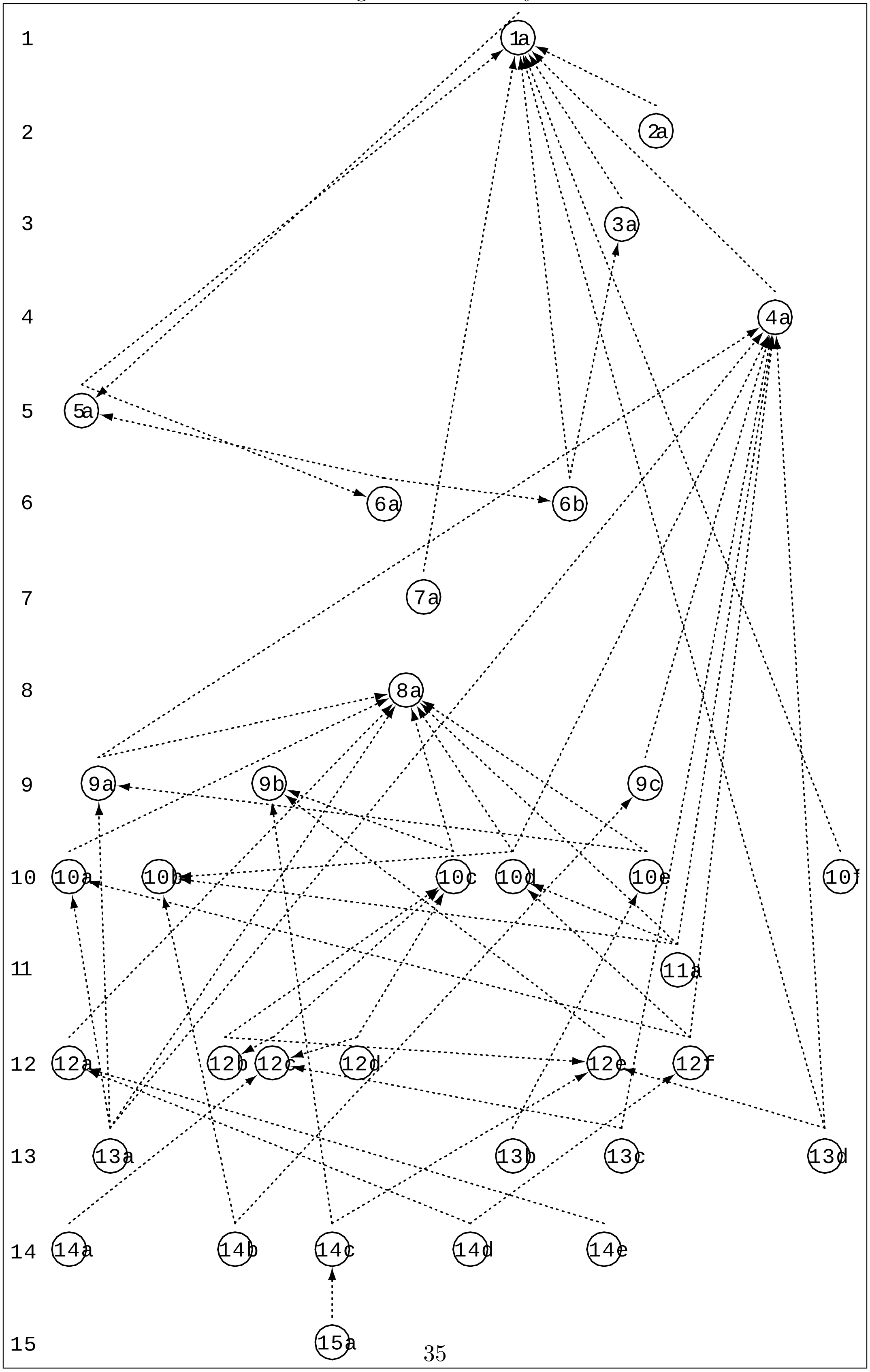

Table 2-Transitions and turnover(percent from base rank)

All	RANK 1	RANK 2	RANK 3	RANK 4	RANK 5	RANK 6	RANK 7	Size	exit	%exit
RANK 1	88	6	3	1	1	0	0	3995	487	12
RANK 2	4	95	0	0	0	0	0	20150	929	5
RANK 3	3	14	78	3	1	1	0	6272	1370	22
RANK 4	1	2	3	86	4	2	1	19359	2624	14
RANK 5	1	1	2	7	85	2	1	15781	2356	15
RANK 6	0	0	1	6	6	85	2	14646	2248	15
RANK 7	0	1	1	6	3	7	81	5581	1035	19
entries	1303	1872	1447	2634	1981	1086	726			
%entries	33	9	23	14	13	7	12			
Turnover									moves	% moves
RANK 1	52	36	8	4	1	0	0	3995	165	4.1
RANK 2	19	58	9	5	7	1	0	20150	389	1.9
RANK 3	10	40	26	14	9	1	1	6272	140	2.2
RANK 4	3	21	7	40	12	11	5	19359	281	1.5
RANK 5	2	36	10	14	34	3	1	15781	211	1.3
RANK 6	0	9	8	30	8	34	10	14646	130	0.9
RANK 7	2	13	4	30	6	19	26	5581	53	0.9
Total	188	496	141	244	160	96	44	85748	1369	1.6

Table 3: Executives Characteristics by Sector and Firm Size
Compensation and Salary are measured in Thousand of 2006US$

Variable	Service	Primary	Consumer	Asset Small	Asset Large	Employee Small	Employee Large
Rank 1	0.04	0.05	0.07	0.04	0.06	0.04	0.06
Rank 2	0.21	0.27	0.26	0.28	0.26	0.28	0.26
Rank 3	0.07	0.06	0.09	0.05	0.08	0.05	0.08
Rank 4	0.22	0.20	0.22	0.18	0.22	0.18	0.22
Rank 5	0.20	0.17	0.18	0.15	0.18	0.15	0.18
Rank 6	0.18	0.18	0.14	0.21	0.15	0.22	0.15
Rank 7	0.08	0.06	0.04	0.09	0.05	0.08	0.06
Age	52.7 (9.5)	54.8 (9.2)	53.6 (9.4)	53.9 (10.3)	53.7 (9.3)	53.7 (11.2)	53.8 (9.3)
Female	0.056	0.03	0.06	0.06	0.04	0.05	0.04
No Degree	0.20	0.18	0.26	0.23	0.21	0.21	0.21
Bachelor	0.82	0.81	0.73	0.77	0.79	0.78	0.78
MBA	0.23	0.24	0.22	0.19	0.23	0.18	0.23
MS/MA	0.22	0.19	0.15	0.24	0.18	0.23	0.19
Ph.D.	0.18	0.20	0.15	0.18	0.18	0.21	0.17
Prof. Certification	0.21	0.24	0.21	0.26	0.21	0.27	0.21
Executive Experience	18.28 (53.3)	18.7 (49.8)	17.9 (18.7)	20.6 (12.3)	17.1 (11.3)	19.4 (12.1)	17.2 (11.3)
Tenure	13.62 (10.93)	15.0 (11.5)	14.28 (11.5)	16.2 (12.07)	14.1 (11.4)	15.7 (12.1)	14.1 (11.4)
# of past moves	2.11 (1.98)	2.02 (2.01)	2.00 (2.00)	2.5 (2.2)	2.0 (2.0)	2.3 (2.1)	2.0 (2.0)
# of executive moves	0.82 (1.32)	0.82 (1.34)	0.846 (1.39)	0.93 (1.5)	0.81 (1.3)	0.86 (1.4)	0.82 (1.33)
Promotion	0.085 (0.28)	0.34 (0.47)	0.34 (0.475)	0.33 (0.47)	0.36 (0.47)	0.34 (0.47)	0.36 (0.47)
Salary	442 (271)	496 (296)	584 (392)	327 (185)	544 (334)	361 (233)	546 (334)
Total Compensation	3,270 (14,435)	1,841 (8461)	2,041 (12,153)	1,350 (10,188)	3,022 (13,858)	1,538 (11,311)	3,056 (13,753)

*Standard Deviation in Parenthesis

Table 4: Executives Characteristics
Compensation and Salary are measured in Thousand of 2006 US$

Variable	Rank1	Rank2	Rank3	Rank4	Rank5	Rank6	Rank7
Age	59.6	55.7	52.4	52.0	52.8	52.4	52.2
	(9.8)	(7.6)	(8.0)	(8.8)	(10)	(10.3)	(11.2)
Female	0.02	0.02	0.03	0.05	0.06	0.06	0.05
	(0.13)	(0.12)	(0.16)	(0.23)	(0.24)	(0.24)	(0.21)
No Degree	0.25	0.21	0.25	0.21	0.21	0.17	0.21
	(0.43)	(0.41)	(0.43)	(0.40)	(0.41)	(0.37)	(0.41)
MBA	0.24	0.26	0.23	0.27	0.19	0.18	0.22
	(0.42)	(0.44)	(0.42)	(0.44)	(0.39)	(0.39)	(0.41)
MS/MA	0.16	0.17	0.17	0.19	0.21	0.21	0.21
	(0.37)	(0.37)	(0.37)	(0.39)	(0.41)	(0.40)	(0.40)
Ph.D.	0.15	0.15	0.14	0.13	0.21	0.27	0.17
	(0.37)	(0.35)	(0.34)	(0.33)	(0.41)	(0.44)	(0.38)
Prof. Certification	0.15	0.14	0.15	0.22	0.24	0.37	0.30
	(0.36)	(0.34)	(0.35)	(0.42)	(0.43)	(0.47)	(0.45)
Executive Experience	22.3	19.8	16.1	15.9	16.6	16.5	16.9
	(13.0)	(10.5)	(10.7)	(11.0)	(12)	(11.7)	(11.7)
Tenure	17.1	15.1	13.7	13.8	14.1	13.7	14.2
	(13.5)	(11.7)	(11.4)	(11.2)	(12)	(11.0)	(10.8)
# of past moves	1.9	1.9	1.7	1.9	2.2	2.3	2.3
	(2.0)	(1.9)	(1.9)	(1.9)	(2.0)	(2.1)	(2.1)
# of Executive Moves	0.9	0.93	0.73	0.76	0.77	0.80	0.84
	(1.4)	(1.38)	(1.3)	(0.13)	(1.32)	(1.3)	(1.4)
Salary	640	767	591	438	408	323	340
	(375)	(398)	(320)	(197)	(190)	(141)	(217)
Total Compensation	2682	4199	4055	2587	2311	1598	1867
	(18229)	(20198)	(14892)	(8536)	(7319)	(5539)	(6634)

Table 5: Compensation Regressions

Level	OLS	LAD	Slope	OLS	LAD
Constant	964.053	1,222	Excess Return	11,636.76	8,478.87
	(1,417)	(191.9)**		(967.506)**	(129.384)**
			Excess Return Square	-908.68	-238.373
				(27.210)**	(3.649)**
Consumer	-4.737	83.106	Excess Return×Consumer	2,246.78	334.718
	(161.543)	(21.863)**		(353.561)**	(47.699)**
Service	965.097	519.103	Excess Return×Service	2,694.64	1,427.43
	(149.900)**	(20.291)**		(288.870)**	(39.047)**
Assets	0.029	0.03	Excess Return×Asset	0.115	0.086
	(0.001)**	(0.000)**		(0.006)**	(0.001)**
Employees	16.82	16.613	Excess Return×Employees	34.181	32.124
	(1.346)**	(0.182)**		(4.481)**	(0.606)**
Rank 2	2,090.11	1,388.09	Excess Return×Rank 2	-388.042	1,423.73
	(289.289)**	(39.143)**		-655.597	(88.196)**
Rank 3	896.515	65.889	Excess Return×Rank 3	-7,142.15	-5,254.64
	(352.374)*	-47.683		(745.473)**	(100.422)**
Rank 4	-197.024	-767.392	Excess Return×Rank 4	-12,219.21	-8,068.44
	(302.908)	(40.986)**		(665.071)**	(89.477)**
Rank 5	-484.074	-932.005	Excess Return×Rank 5	-14,409.11	-8,921.51
	(308.492)	(41.736)**		(675.818)**	(90.755)**
Rank 6	-998.282	-1,139.54	Excess Return×Rank 6	-14,047.82	-9,188.51
	(313.464)**	(42.411)**		(670.508)**	(90.146)**
Rank 7	-783.61	-1,109.86	Excess Return×Rank 7	-13,148.96	-9,227.35
	(379.645)*	(51.357)**		(748.188)**	(100.593)**

Table 5(cont.): Compensation Regressions

Level	OLS	LAD	Slope	OLS	LAD
Age	75.732	20.155	Excess Return× Age	136.767	29.214
	(47.603)	(6.444)**		(12.835)**	(1.711)**
Age Square	-0.879	-0.155			
	(0.411)*	(0.056)**			
Female	355.209	91.731	Excess Return×Female	-377.221	-286.293
	(339.929)	(45.917)*		(607.244)	(75.045)**
No. Degree	136.194	12.363	Excess Return×No. Degree	-622.6	-68.224
	(189.753)	(25.679)		(328.146)	(44.118)
MBA	367.872	130.474	Excess Return×MBA	-249.712	234.566
	(162.991)*	(22.060)**		(314.901)	(42.495)**
MS/MA	-79.861	-74.731	Excess Return×MS/MA	-64.16	-355.654
	(165.083)	(22.344)**		(299.351)	(40.481)**
Ph.D.	309.473	32.827	Excess Return×Ph.D.	-22.42	100.848
	(172.953)	(23.409)		(312.742)	(42.259)*
Prof. Cert.	-385.793	-101.85	Excess Return×Prof. Cert.	-1,478.81	-199.566
	(160.076)*	(21.665)**			
Exec. Experience	-0.977	-0.078	Excess Return×Exec. Experience	-2.464	-1.086
	(1.582)	(0.203)		-1.891	(0.151)**
Tenure	-17.339	-4.573	Excess Return×Tenure	15.764	9.271
	(6.709)**	(0.906)**		-11.078	(1.469)**
# of past moves	-32.503	-31.781	Excess Return×# of past moves	-392.886	-80.655
	-48.569	(6.574)**		(84.423)**	(11.360)**
# of Executive Moves	52.739	21.603	Excess Return×# of Exec. moves	153.524	10.868
	(65.354)	(8.839)*		(114.343)	-15.297
First Year with firm	994.989	551.859	Excess Return× first year in firm	-579.266	-513.588
	(464.134)*	(62.789)**		(854.534)	(115.601)**

Table 6: Logit and Conditional of Promotion and Turnover

Current Variable	Promotion	Promtion Exec. F.E.	Promotion Company. F.E.	Promotion External.	Turnover
Compensation	-0.001	0.002	-0.002	0.006	0.007
	(0.001)	(0.002)	(0.001)	(0.007)	(0.003)*
Excess return	-0.21	-0.239	-0.168	-0.197	-0.422
	(0.030)**	(0.045)**	(0.034)**	(0.156)	(0.093)**
Excess return Lagged	-0.124	-0.067	-0.082	0.054	-0.229
	(0.025)**	-0.038	(0.028)**	-0.199	(0.076)**
Rank 2	-2.2	-2.282	-2.542	-2.993	-0.434
	(0.058)**	(0.113)**	(0.071)**	(0.496)**	(0.114)**
Rank 3	-0.999	-1.077	-1.209	-1.797	-0.103
	(0.066)**	(0.117)**	(0.081)**	(0.542)**	(0.146)
Rank 4	-0.99	-1.08	-1.198	-1.56	-0.263
	(0.053)**	(0.099)**	(0.068)**	(0.505)**	(0.120)*
Rank 5	-0.658	-0.926	-0.891	-0.471	-0.553
	(0.054)**	(0.102)**	(0.068)**	(0.58)	(0.134)**
Rank 6	-0.743	-0.958	-0.872	-0.963	-0.558
	(0.055)**	(0.102)**	(0.068)**	(0.552)	(0.139)**
Consumer Goods	-0.021	-0.057	0.066	0.318	-0.152
	(0.037)	(0.111)	(0.082)	(0.265)	(0.091)
Services	0.075	0.024	0.211	0.025	-0.001
	(0.034)*	-0.105	(0.078)**	(0.22)	(0.083)
Assets	0.000	0.001	0.000	0.001	0.000
	(0.000)	-0.001	(0.000)	(0.005)	(0.001)
Employees	0.001	0.002	0.001	0.008	0.001
	(0.000)**	(0.001)*	(0.001)	(0.004)*	(0.000)*
Observations	28443	17866	26708	757	30343

Standard errors in parentheses;* significant at 5%; ** significant at 1%

Table 6 (continued): Logit and Conditional of Promotion and Turnover

Current Variable	Promotion	Promtion Exec. F.E.	Promotion Company. F.E.	Promotion External.	Turnover
Executive Experience	0.000	0.001	0.000	0.002	0.000
	(0.000)	(0.001)	(0.000)	(0.004)	(0.001)
Tenure	0.011	0.04	0.018	0.000	-0.041
	(0.001)**	(0.004)**	(0.002)**	(0.011)	(0.004)**
# of Executive Moves	0.059	0.101	0.063	-0.227	0.092
	(0.014)**	(0.035)**	(0.018)**	(0.111)*	(0.037)*
# of past moves	0.016	0.058	0.01	0.095	-0.08
	-0.011	(0.025)*	(0.013)	-0.083	(0.030)**
Age	-0.107	-0.396	-0.139	0.008	0.185
	(0.010)**	(0.059)**	(0.013)**	(0.111)	(0.041)**
Age Square	0.001	0.001	0.001	0.000	-0.002
	(0.000)**	(0.001)	(0.000)**	(0.001)	(0.000)**
Female	0.053		-0.041	-1.153	0.012
	(0.071)		(0.091)	(0.483)*	(0.198)
No. Degree	-0.058		0.025	-0.562	0.181
	(0.043)		(0.057)	(0.292)	0.105)
MBA	-0.043		-0.075	-0.255	0.287
	(0.037)		(0.047)	0.235)	(0.086)**
MSMA	0.008		0.043	0.212	-0.11
	(0.037)		(0.048)	(0.26)	(0.098)
Ph.D.	-0.05		-0.04	-0.574	-0.031
	(0.039)		(0.05)	(0.274)*	(0.103)
Prof. Certification	-0.151		(0.149)	-0.538	-0.044
	(0.036)**		(0.046)**	(0.253)*	(0.094)
Turnover	2.14	3.173	2.314		
	(0.088)**	(0.153)**	(0.110)**		
Constant	3.583			3.366	-8.038
	(0.292)**			(3.188)	(1.150)**
Observations	28443	17866	26708	757	30343

Standard errors in parentheses;* significant at 5%; ** significant at 1%
in parentheses;* significant at 5%; ** significant at 1%

Table 7: Multinominal Logit of Firm Choice
(Staying with your Current Firm in the Based)

Variables	1	2	3	4	5	6	Retirement
MBA	-0.026	0.205	0.146	0.167	0.413	0.353	-0.049
	(0.200)	(0.181)	(0.140)	(0.230)	(0.280)	(0.161)*	(0.036)
MS/MA	-0.467	-0.727	-0.335	-0.145	-0.107	-0.207	-0.014
	(0.225)*	(0.238)**	(0.164)*	(0.240)	(0.314)	(0.192)	(0.035)
PhD	-0.787	-0.338	-0.316	-0.281	-0.371	-0.151	-0.080
	(0.248)**	(0.217)	(0.168)	(0.270)	(0.363)	(0.205)	(0.037)*
No Degree	-0.319	-0.436	-0.298	0.435	0.184	0.113	-0.118
	(0.246)	(0.242)	(0.184)	(0.254)	(0.332)	(0.204)	(0.041)**
Moves befere Exec.	-0.141	-0.265	-0.202	-0.046	-0.315	-0.377	0.045
	(0.063)*	(0.075)**	(0.055)**	(0.066)	(0.107)**	(0.073)**	(0.010)**
Female	0.198	0.127	-0.242	-0.173	-1.410	-0.226	0.342
	(0.365)	(0.349)	(0.328)	(0.482)	(1.021)	(0.344)	(0.073)**
Tenure	-32.248	-32.149	-32.277	-31.894	-32.262	-31.935	0.010
	(1.09e+6)	(9.9e+5)	(7.8e+5)	(9.3e+5)	(1.4e+5)	(6.8e+5)	(0.002)**
Moves after Exec.	-0.024	-0.021	0.061	-0.108	-0.123	0.003	0.062
	(0.052)	(0.050)	(0.035)	(0.067)	(0.086)	(0.044)	(0.010)**
Age	0.340	0.165	0.360	0.270	0.340	0.321	0.039
	(0.105)**	(0.075)*	(0.083)**	(0.130)*	(0.173)*	(0.101)**	(0.009)**
Age square	-0.003	-0.001	-0.003	-0.002	-0.003	-0.003	-0.000
	(0.001)**	(0.001)	(0.001)**	(0.001)	(0.002)	(0.001)**	(0.000)*
Firm Type : 2	-0.197	0.650	0.463	-0.781	-0.303	-1.182	0.291
	(0.219)	(0.230)**	(0.200)*	(0.457)	(0.473)	(0.474)*	(0.044)**
Firm Type : 3	-0.932	0.049	0.640	-1.097	-1.378	-0.262	0.232
	(0.210)**	(0.223)	(0.175)**	(0.407)**	(0.516)**	(0.298)	(0.038)**
Firm Type : 4	-1.500	-1.058	-1.096	2.048	1.587	1.452	0.673
	(0.476)**	(0.538)*	(0.441)*	(0.293)**	(0.388)**	(0.304)**	(0.048)**
Firm Type : 5	-1.954	-1.316	-2.072	0.859	1.286	1.317	0.440
	(0.603)**	(0.613)*	(0.728)**	(0.383)*	(0.426)**	(0.319)**	(0.060)**
Firm Type : 6	-1.743	-1.323	-0.729	0.846	0.573	1.828	0.339
	(0.340)**	(0.370)**	(0.254)**	(0.304)**	(0.379)	(0.254)**	(0.044)**
Previous Rank :2	-1.064	0.083	0.059	-0.176	0.239	-0.277	-1.060
	(0.422)*	(0.455)	(0.277)	(0.649)	(0.768)	(0.278)	(0.054)**
Previous Rank :3	0.186	0.810	0.535	1.170	1.478	0.065	-0.560
	(0.454)	(0.503)	(0.308)	(0.662)	(0.802)	(0.331)	(0.069)**
Previous Rank :4	0.677	1.382	0.633	1.310	1.426	0.293	-0.340
	(0.373)	(0.435)**	(0.267)*	(0.606)*	(0.742)	(0.265)	(0.048)**
Previous Rank : 5	0.857	1.134	0.391	1.746	1.329	-0.255	-0.340
	(0.391)*	(0.460)*	(0.295)	(0.611)**	(0.765)	(0.313)	(0.052)**
Constant	-12.389	-8.882	-12.618	-11.794	-14.162	-11.705	-2.918
	(2.794)**	(2.086)**	(2.208)**	(3.325)**	(4.471)**	(2.603)**	(0.281)**
Observations	59066	59066	59066	59066	59066	59066	35019

Table 8 : Multinominal Logit of Rank Choice (Rank 4 is excluded)

variables	1	2	3	5
MBA	0.232	0.232	0.011	-0.021
	(0.082)**	(0.067)**	(0.069)	(0.062)
MS/MA	-0.011	-0.131	-0.117	0.014
	(0.089)	(0.073)	(0.075)	(0.061)
PhD	-0.117	-0.094	-0.147	0.187
	(0.094)	(0.076)	(0.079)	(0.060)**
No Degree	0.198	0.142	0.144	-0.086
	(0.091)*	(0.075)	(0.075)	(0.070)
Moves befere Exec.	-0.144	-0.169	-0.117	0.038
	(0.028)**	(0.023)**	(0.023)**	(0.017)*
Female	-0.749	-0.608	-0.435	0.220
	(0.214)**	(0.162)**	(0.152)**	(0.106)*
Tenure	-0.002	-0.008	-0.006	0.001
	(0.004)	(0.003)**	(0.003)*	(0.003)
Moves after Exec.	-0.008	-0.019	-0.048	0.013
	(0.026)	(0.022)	(0.023)*	(0.019)
Age	0.156	0.226	0.060	-0.009
	(0.025)**	(0.024)**	(0.022)**	(0.015)
Age square	-0.001	-0.002	-0.001	0.000
	(0.000)**	(0.000)**	(0.000)**	(0.000)
Firm Type : 2	0.077	0.193	0.084	-0.224
	(0.104)	(0.086)*	(0.088)	(0.073)**
Firm Type : 3	0.283	0.352	0.216	-0.374
	(0.089)**	(0.075)**	(0.076)**	(0.067)**
Firm Type : 4	-0.585	-0.388	-0.324	0.020
	(0.133)**	(0.104)**	(0.110)**	(0.079)
Firm Type : 5	-0.262	-0.115	0.013	-0.152
	(0.148)	(0.118)	(0.118)	(0.099)
Firm Type : 6	0.239	0.195	0.191	-0.262
	(0.103)*	(0.086)*	(0.087)*	(0.077)**
Previous Rank :2	-2.196	3.745	-0.413	0.209
	(0.132)**	(0.144)**	(0.177)*	(0.296)
Previous Rank :3	-3.544	0.652	3.031	0.265
	(0.159)**	(0.154)**	(0.162)**	(0.309)
Previous Rank :4	-7.890	-4.656	-3.662	-1.951
	(0.124)**	(0.134)**	(0.145)**	(0.255)**
Previous Rank : 5	-7.181	-3.512	-2.402	3.922
	(0.232)**	(0.170)**	(0.168)**	(0.253)**

Table 9: Structural Estimates and Simulations
τ_2, τ_3 and τ_4 are measured in US100,000 of dollars
τ_1 is measured in percentage per year

Measure	Rank	Estimates	Standard Deviation.
ρ		0.45	
	1	5.2	3.4
	2	10.9	14
	3	8.3	2.9
τ_1	4	4.2	2.7
	5	1.6	1.2
	1	4.0	0.2
	2	9.0	0.5
τ_2^H	3	11.8	0.9
	4	16.4	1.3
	5	18.8	2.2
	1	18.6	34.7
	2	24.8	56.6
τ_2^{PM}	3	8.3	14.2
	4	2.5	8.6
	5	.9	1.2
	1	17.3	34.0
τ_3	2	32.5	45.6
	3	16.03	24.8
	4	1.2	2.5
	5	0.8	1.3
	1	0.5	1.4
	2	2.6	3.9
	3	12.0	14.3
τ_4	4	14.0	18.9
	5	18.2	22.7