Econometrica Supplementary Material

SUPPLEMENT TO "PROMOTION, TURNOVER, AND COMPENSATION IN EXECUTIVE LABOR MARKET"

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This appendix includes supplemental materials for the model, identification, estimation, data, and results discussed in Gayle, Golan, and Miller (2015). Section A contains the derivation of the formulas used in the model, identification, and estimation for Type I extreme value distributions. Section B presents details on the data constructions and summary of the main sample used in the paper. Section C presents the first-stage estimation. Section D presents additional result tables not included in the paper.

A. THE EXTREME-VALUE DISTRIBUTION

IN OUR STRUCTURAL ESTIMATION, we assume throughout that ε_t is distributed as a Type 1 extreme value. The computational advantages of parameterizing $G(\varepsilon)$ this way are most evident from Lemma A.1 below, where we provide formulas for $A_t(h)$ and $B_t(h)$, the value of human capital on and off the equilibrium path, and also an expression for marginal disturbances, $q_{jk}[p_t(h)]$.

LEMMA A.1: *If ε_{jkt} is independently and identically distributed as a Type I extreme value with location and scale parameters* $(0, 1)$, *then*

$$q_{jk}\big[p_t(h)\big] = \ln p_{0t}(h) - \ln p_{jkt}(h), \tag{S-1}$$

where $p_{0t}(h)$ is the probability that the optimal choice is retirement,

$$A_t(h) = p_{0t}(h)^{1/b_t}\Gamma\big[(b_t+1)/b_t\big], \tag{S-2}$$

and

$$B_t\big(h, h'\big) = p_{0t}\big(h, h'\big)^{1/b_t}\Gamma\big[(b_t+1)/b_t\big]. \tag{S-3}$$

The IIA property of Type 1 extreme values implies that the marginal idiosyncratic shock for a manager who is indifferent between the best job match (j, k) and retiring is the log-odds ratio of the probability that a manager with characteristics (t, h) who accepts employment in (j, k) versus retiring. The log-odds ratio does not depend on the other components of the conditional-choice probability vector. The greater the probability of retirement observed in equilibrium, the less important is the human-capital component, and the higher is the unobserved shock for the marginal person.

PROOF OF LEMMA A.1: The formula for $q_{jk}[p_t(h)]$ given by (S-1) is well known (e.g., Hotz and Miller (1993)). Denoting the probability density function of $\varepsilon^*_{jkt} \equiv d_{jk}\varepsilon_{jkt}$ by $d\overline{G}(\varepsilon^*_{jkt})$, we first derive an expression for $E[\exp(-\varepsilon^*_{jkt}/b_t)]$ and then use it in our derivation of the formula for $A_t(h_t)$:

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1. For each (j, k, t), denote the deterministic part of utility by

$$W_{jkt} \equiv \ln \alpha_{jkt} + (b_t - 1) \ln A_{t+1}\big[\overline{H}_{jk}(h)\big] + (b_t - 1) \log\big\{E_t[v_{jk,t+1}]\big\}. \tag{S-4}$$

Then (j, k) is chosen at t if $\varepsilon_{jkt} + W_{jkt}$ is maximal for all (j', k'). Let $G(\varepsilon_{11t}, \dots, \varepsilon_{JKt})$ denote the probability distribution function for $(\varepsilon_{11t}, \dots, \varepsilon_{JKt})$ and $G_{jk}(\varepsilon_{11t}, \dots, \varepsilon_{JKt})$ its derivative with respect to ε_{jkt}. Since $G(\varepsilon_{11t}, \dots, \varepsilon_{JKt})$ is the product of independently distributed standard Type 1 extreme-value probability distributions in our model,

$$G_{jk}(\varepsilon_{11t}, \dots, \varepsilon_{JKt}) = \exp(-\varepsilon_{jkt}) \prod_{(j',k')} \exp\big[-\exp(-\varepsilon_{j'k't})\big]. \tag{S-5}$$

Using the well-known fact that

$$W_{jkt} - W_{j'k't} = \log p_{jkt} - \log p_{j'k't}, \tag{S-6}$$

it now follows from (S-5) and (S-6) that

$$\begin{aligned} &G_{jk}(\varepsilon_{jkt} + W_{jkt} - W_{11t}, \dots, \varepsilon_{jkt} + W_{jkt} - W_{JKt}) \\ &\quad = \exp\big[-\varepsilon_{jkt} - \exp(-\varepsilon_{jkt} - \log p_{jkt})\big]. \end{aligned} \tag{S-7}$$

From equation (S-4) and Theorem 4.2 in the main text, the conditional-choice probability for (j, k) can be expressed as

$$p_{jkt} = \int_{-\infty}^{\infty} G_{jk}(\varepsilon_{jkt} + W_{jkt} - W_{11t}, \dots, \varepsilon_{jkt} + W_{jkt} - W_{JKt})\, \mathrm{d}\varepsilon_{jkt}. \tag{S-8}$$

Hence, the probability density function of $\varepsilon^*_{jkt} \equiv d_{jk}\varepsilon_{jkt}$ is a Type 1 extreme value with location parameter $-\log p_{jkt}$ and unit scale parameter since

$$\begin{aligned} &d\overline{G}(\varepsilon^*_{jkt}) \\ &\quad = p_{jkt}^{-1} \frac{\partial \int_{-\infty}^{\varepsilon^*_{jkt}} G_{jk}(\varepsilon_{jkt} + W_{jkt} - W_{11t}, \dots, \varepsilon_{jkt} + W_{jkt} - W_{JKt})\, \mathrm{d}\varepsilon_{jkt}}{\partial \varepsilon^*_{jkt}} \\ &\quad = \exp\big[-\varepsilon^*_{jkt} - \log p_{jkt} - \exp\big(-\varepsilon^*_{jkt} - \log p_{jkt}\big)\big]. \end{aligned}$$

To derive $E[\exp(-\varepsilon^*_{jkt}/b_t)]$, we draw from equations (15) and (17) of Chapter 21 of Johnston and Kotz (1970, pp. 277–278), who proved that the moment-generating function for ε^*_{jkt} is

$$E\big[\exp\big(t\varepsilon^*_{jkt}\big)\big] = \exp\big(-t \log p_{jkt}(h)\big)\Gamma(1 - t).$$

Setting $t = -b_t^{-1}$, this simplifies to

$$\text{(S-9)} \qquad E\big[\exp\big(-\varepsilon^*_{jkt}/b_t\big)\big] = \exp\big(\log p_{jkt}(h)^{1/b_t}\big)\Gamma\big[(b_t+1)/b_t\big] = p_{jkt}(h)^{1/b_t}\Gamma\big[(b_t+1)/b_t\big].$$

2. Rearranging the participation constraint (4.15) in the main text and substituting for $q_{jk}[p_t(h)]$ from (S-1), we obtain

$$\text{(S-10)} \qquad \alpha_{jkt}(h)^{1/b_t} E_t[v_{jk,t+1}]^{(b_t-1)/b_t} A_{t+1}\big[\overline{H}_{jk}(h)\big]^{(b_t-1)/b_t} = \big[p_{0t}(h)/p_{jkt}(h)\big]^{1/b_t}.$$

In the recursion for $A_{t+1}(h, b_t)$ given in (4.14) in the main text, we now substitute for

$$\alpha_{jkt}(h)^{1/b_t} E_t[v_{jk,t+1}]^{(b_t-1)/b_t} A_{t+1}\big[\overline{H}_{jk}(h)\big]^{(b_t-1)/b_t}$$

using (S-10), and also for $E[\exp(\varepsilon^*_{jkt}/b_t)]$ using equation (S-9), to obtain

$$\begin{aligned} A_t(h) &= p_{0t}(h)^{1+1/b_t}\Gamma\left[\frac{b_t+1}{b_t}\right] \\ &\quad + \sum_{j=1}^{J}\sum_{k=1}^{K}\left\{p_{jkt}(h)^{1+1/b_t}\Gamma\left[\frac{b_t+1}{b_t}\right]\left[\frac{p_{0t}(h)}{p_{jkt}(h)}\right]^{1/b_t}\right\} \\ &= p_{0t}(h)^{1/b_t}\Gamma\left[\frac{b_t+1}{b_t}\right], \end{aligned}$$

as required.

3. To prove (S-3), the formula for $B_t(h, h')$, we first note that if ε_{jkt} is independently and identically distributed as a Type I extreme value with location and scale parameters $(0, 1)$, then from (S-1) and (5.6) in the main text,

$$\text{(S-11)} \qquad V'_{jkt}\big(h, h'\big) = \left[\frac{p_{0t}\big(h, h'\big)}{p_{jkt}\big(h, h'\big)}\right]^{1/b_t}.$$

Summing over (j, k) and rearranging, we obtain

$$\text{(S-12)} \qquad p_{0t}\big(h, h'\big) = \left\{1 + \sum_{j=1}^{J}\sum_{k=1}^{K}\big[V'_{jkt}\big(h, h'\big)\big]^{-1}\right\}^{-1}.$$

Following the same logic used to derive (S-9), we can show, when shirking is an option and human capital is private information,

$$\text{(S-13)} \qquad E_t\left[\exp\left(-\frac{\varepsilon^*_{jkt}}{b_t}\right)\right] = p_{jkt}\big(h, h'\big)^{1/b_t}\Gamma\left(\frac{b_t+1}{b_t}\right).$$

Substituting (S-13) along with the conditional-choice probability ratios (S-11) and the retirement probability (S-12) into (5.4) yields

$$\begin{aligned}
B_t(h,h') &= p_{0t}(h,h')^{1+1/b_t}\Gamma\left(\frac{b_t+1}{b_t}\right)\\
&\quad+\sum_{j=1}^{J}\sum_{k=1}^{K}\left[p_{jkt}(h,h')^{1+1/b_t}\Gamma\left(\frac{b_t+1}{b_t}\right)\left[\frac{p_{0t}(h,h')}{p_{jkt}(h,h')}\right]^{1/b_t}\right]\\
&= p_{0t}(h,h')^{1/b_t}\Gamma\left[\frac{b_t+1}{b_t}\right],
\end{aligned}$$

which simplifies to (S-3). *Q.E.D.*

B. DATA SET

The data for our empirical study are compiled from three sources. The main data source is Standard & Poor's ExecuComp database, which contains annual records on 30,614 individual executives, itemizing their compensation and describing their titles. Each executive worked for one of the 2,818 firms comprising Standard & Poor's (composite) 500, MidCap, and SmallCap indices for at least one year spanning the period 1992 to 2006, which covers about 85 percent of the U.S. equities market. In the years for which we have observations, the executive was one of up to the top eight paid in the firm whose compensation was reported to the Securities and Exchange Commission (SEC). Data on the 2,818 firms for the ExecuComp database were supplemented by COMPUSTAT North America database and monthly stock-price data from the Center for Research in Security Prices database. We also gathered background history for a subsample of 16,300 executives, recovered by matching the 30,614 executives from our COMPUSTAT database, using their full name, year of birth, and gender, with the records in Marquis Who's Who, which contains biographies of about 350,000 executives. The matched data provide 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 sociodemographic characteristics, including age, gender, education; and a comprehensive description of their career path sequence described by their annual transitions through the possible positions and firms.

B.1. *Construction of Variables*

Ranks. In the paper, executive management is defined as an occupation of general managers in publicly traded firms whose compensation and financial assets in their employer firm are reported to the SEC. Although each firm is only required to report on its top five executives, the SEC accepts and publishes data from firms which provide the records on a greater number of employees, and most firms do. Using Standard & Poor's ExecuComp database, we coded the position of each executive in any given year with one of 35 abbreviated titles, forming the basis of the hierarchy from which the ranks are constructed. We define a career hierarchy as a rational (complete and transitive) ordering over a set of job titles based on transitions independent of compensation. (See Gayle, Golan, and Miller (2012) for a detailed description of the titles and the construction of the hierarchy.) Applying this procedure, we consolidate the data into five ranks, Table S-I lists the ranks and the corresponding titles. It is clear that Rank 1 consists roughly of chairman of the board of the company or chairman of a subsidiary who does not have any other executive position in the firm. Rank 2 consists of the CEO of the company, while Rank 3 consists mainly of chairman of the board of the company who holds some executive position in the company other than CEO. Rank 4 and Rank 5 consist of other lower-level executives. The first observation is that CEOs are not in Rank 1 but instead in Rank 2. This hierarchy is based on transitions and, therefore, reflects lifecycle considerations more than control.

Total Compensation and Abnormal Return. We followed Antle and Smith (1985), Hall and Liebman (1998), Margiotta and Miller (2000), and Gayle and Miller (2009) 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. Changes in wealth from executive 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.

Bond Prices. We follow Gayle and Miller (2009) when constructing our bond-price series. The data come from the Federal Reserve Economic Database (FRED) and are based on Treasury bills with maturities of 1, 2, 3, 5, 7, 10, 20, and 30 years. For each date, τ, we impute a yield curve using the data on newly issued bonds for various maturities, using a cubic spline for each date–maturity combination in the data. Using these imputed yields, we construct the

TABLE S-I

TITLES AND RANKS

Rank	Title(s)
1	Chairman of the Board & Vice Chairman of the Board; Chairman of the Board of a subsidiary or region & CEO of subsidiary or region; Chairman of a subsidiary or region & Vice Chairman of a subsidiary or region; Chairman of the Board & Executive of a subsidiary or region
2	Chairman & President & CEO of the company, CEO of the company
3	President & Chief Operating Officer of the company; Chairman of the Board & Chief Financial Officer of the company; Chairman of the Board & Executive Vice President of the company; Chairman of the Board and Chief Operating Officer of the company
4	Executive Vice President of the company; Executive Vice President and Chief Operating Officer of the company; Executive Vice President and Chief Financial Officer of the company; Chief Operating Officer of the company; President of a subsidiary or region; Executive Vice President & Other Executive[a] of the company; President of a subsidiary or region & Executive Vice President of the company; Executive Vice President of the company & Chief Operating Officer of a subsidiary or region; President and CEO of a subsidiary or region; President and Chief Operating Officer of a subsidiary or region; President & Executive Vice President of the company; CEO of a subsidiary or region & Executive Vice President of the company; Senior Vice President of the company
5	Vice President of the company; Senior Vice President and other executive[a] of the company; Vice President & other executive[a] of the company; Chief Financial Officer & other executive[a] of the company; Senior Vice President & Chief Financial Officer of the company; Senior Vice President & Chief Operating Officer of the company; Senior Vice President of the company & President of a subsidiary or region; President & other executive[a] of the company; Senior Vice President of the company & CEO of a subsidiary or region; CEO of a subsidiary or region & other executive[a] of the company; Chief Operating Officer of a subsidiary or region; Vice President & Chief Operating Office of the company; Vice President of the company & President of a subsidiary or region; Vice President of the company & CEO of a subsidiary or region; Vice President of the company & Chief Operating Officer of a subsidiary or region; Chief Financial Officer of the company

[a]Other executive includes titles that did not occur often enough to warrant their own category and hence were grouped together. These include, but are not limited to, General Counsel, Chief Technology Officer, Chief Information Officer, Chief Marketing Officer, and Consultant.

bonds for each date. By definition, the price of a bond, b_{jt}, purchased at period τ and maturing at date $\tau + j$, can be expressed as

$$\text{(S-14)} \quad b_{jt} = \sum_{s=0}^{\tau+j} \prod_{i=1}^{s} (1 + r_{i\tau})^{-1},$$

where $r_{i\tau}$ is the marginal yield from lengthening the bond one period by extending the maturity date from $\tau + j$ to $\tau + j + 1$. We do not have data on Treasury Bills with maturities greater than 30 years, so we assume that the marginal annuitized yield rate for any bond maturing in more than 30 years is the same as the 30-year rate:

$$\text{(S-15)} \quad b_{j\tau} = \sum_{s=0}^{\tau+j} \prod_{i=1}^{s} (1 + r_{i\tau})^{-1} = \sum_{s=0}^{\tau+30} \prod_{i=1}^{s} (1 + r_{i\tau})^{-1} + \frac{1}{r_{30,\tau}} \prod_{i=1}^{30} (1 + r_{i\tau})^{-1}.$$

For each date τ, we impute a yield curve using the data on newly issued bonds for various maturities, using a cubic spline for date–maturity combinations in the data, to estimate $\widehat{r}_{i\tau}$ for each date τ and for all $i \in \{1, \dots, 30\}$.

Sector and Firm Size. Most of the executives' and firms' characteristics in the subsample of matched data require no (further) explanation but the construction of several variables merit some remarks. The sample of firms was initially partitioned into three industrial sectors by GICS code. The first is primary and includes firms in energy (GICS:1010), materials (1510), industrials (2010, 2020, and 2030), and utilities (5510). The next, consumer goods, comprises firms from consumer discretionary (2510, 2520, 2530, 2540, and 2550), and consumer staples (3010, 3020, and 3030). Firms in health care (3510, 3520), financial services (4010, 4020, 4030, and 4040), and information technology and telecommunication services (410, 4520, 4030, 4040, and 5010) make up the services sector.

We classified firms into three sizes—large, medium-sized, and small—based on the value of their assets and number of employees over the sample period. A firm is classified as large if both its asset value and its number of employees are above the median for its sector over the sample period and as small if both its asset value and number of employees are below the median for its sector over the sample. All other firms are classified as medium-sized.

Interlock and Large Insider Board. Following the literature on corporate governance, we construct two measures of good governance and executive power. The first measure—interlocked—is at the executive level. A executive is classified as interlocked if at least one of the following is true:

(a) The executive serves on the board committee that makes his compensation decisions.

(b) The executive serves on the board (and possibly compensation committee) of another company that has an executive officer serving on the compensation committee of the indicated executive's company.

(c) The executive serves on the compensation committee of another company that has an executive officer serving on the board (and possibly compensation committee) of the indicated executive's company.

The second measure is at the company level: the number of its own executives that serve on its board of directors. This measure is constructed from the variables reported in Standard & Poor's ExecuComp database indicating whether or not a given executive is a member of the board of directors. From these data, we created a variable for the number of insiders on the board of directors and we classified a company as having a large insider board if the number of insiders on its board is above the median for its sector and firm size over the sample.

Definition of the Outside Option. For the purposes of this study, we define executive management as an occupation of general managers in publicly traded firms whose compensation and financial assets in their employer firm are reported to the Securities and Exchange Commission. Recall that although each firm is required only to report on its top five executives, the SEC accepts and publishes data from firms which provide the records on a greater number of employees, and most firms do. For all such firms, the SEC requirement is not a binding constraint, but a device to help the firms establish and maintain credibility with their shareholders and bondholders. Like any tightly defined occupation, executive management is porous. People become executive managers through promotion within the firm or from another publicly traded company, by transferring from a privately held company or a nonprofit organization, or by coming out of retirement. They exit from executive management by retiring, by accepting less prestigious and less well-paid positions within management (having been overtaken by other executives within the company and sidelined without a title change or summarily demoted), by transferring to an organization not listed on an exchange (such as starting a sole proprietorship), or entering another occupation (such as one that makes more use of previously acquired professional qualifications).

We construct a sample measure of this population-exit variable that captures the above types of exit from executive management. As such, we define our outside option called exit as an absorbing state so executives who leave all our data sets and do not return for four years are classified as exited. Note that the following are not classified as exited by our measure: Executives disappearing because the firm becomes a nonpublicly traded company, the firm is dropped from the COMPUSTAT data sets, the company merges with another company and does not exist any more, or the firm goes completely out of business, as well as executives who exit the sample in the last four years of the sample. Less than 1 percent of those who leave for more than three years ever show up again in our data sets. As such, we are confident we do not have a right-censuring problem.

B.2. *Characteristics of Data*

Table S-II presents the main characteristics of our sample by firm type. Although we report on between five and eight executives per firm, many have more than one manager in some ranks and none in others. For example, a typical small firm has one person in Rank 2 (who is both CEO and President), and four others at one other of Ranks 4 or 5, which explains why only a tiny proportion, 0.03, are in Rank 1. Rank 4 is the mode followed by Rank 2. The exit rate is between 12 percent and 15 percent per year, but the turnover rate is much lower, about 2 percent to 3 percent per year. Executives average between 51 and 54 years old and on average have about 13 to 14 years' firm tenure. They average about 17 years of executive experience. Female executives comprise about 4 percent of the sample and are more concentrated in the consumer-goods sector. Just under half of all executives are on the board of directors, but only 3 percent are interlocked. About 80 percent of executives graduated from college and about 20 percent have an MBA. The firm-size differences are noteworthy. On average, large firms in our sample have 50 times more assets than small firms, 19 times the equity value, 13 times as many employees, and the variation in the size of large firms relative to that of small firms is even greater. Total compensation averages between \$1.5 and \$4.5 million, with executives in the service sector at the upper end of that range, and salary comprising only about 20 percent of the total. Compensation increases substantially with firm size, as does its variability. The difference in average compensation of executives across the number of insiders on the firm's board is not significant, although executives working for firms with a small number of board members receive a lower proportion of their total compensation in salary.

C. FIRST-STAGE ESTIMATION

Our economic model is embedded in a dynamic system that tracks the manager's employer, rank within the firm, and compensation, given personal background. The state space for the dynamic system is the Cartesian product of the manager's age, t, and personal background, $h_t \in \{1, \dots, H\}$, at the beginning of each period; a vector that includes last period's employer firm, $j_{t-1} \in \{1, \dots, 36\}$, management rank last period, $k_{t-1} \in \{0, 1, \dots, 5\}$, and fixed components (such as cohort, gender, and education); and other variable components (such as measures of executive experience). To capture aggregate conditions, we also include bond prices in our framework. However, where possible, we suppress them in the notation. We assume throughout that—given the manager's job-match selection, (j, k), at age t—human capital is updated deterministically, denoted by $h_{t+1} \equiv H_{jk}(h_t)$. Job matches follow a stochastic law of motion: We denote by $p_{jkt}(h_t)$ the probability of choosing job match (j, k) at age t, conditional on human capital at the beginning of the period, h_t. The conditional exit probability, $p_{0t}(h_t)$, is defined similarly.

TABLE S-II

SAMPLE CHARACTERISTICS BY FIRM TYPE[a]

		Industrial Sectors			Firm Size			Insiders on Board	
	Full Sample	Service	Primary	Consumer	Large	Medium	Small	Large	Small
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rank 1	0.06	0.05	0.05	0.07	0.08	0.05	0.03	0.08	0.03
Rank 2	0.28	0.28	0.30	0.29	0.25	0.30	0.30	0.27	0.29
Rank 3	0.07	0.08	0.07	0.09	0.09	0.07	0.06	0.09	0.06
Rank 4	0.37	0.38	0.35	0.38	0.40	0.39	0.32	0.37	0.37
Rank 5	0.21	0.21	0.23	0.17	0.17	0.19	0.29	0.18	0.25
Exit	0.13	0.14	0.12	0.13	0.12	0.12	0.15	0.12	0.13
Turnover	0.02	0.03	0.02	0.03	0.03	0.02	0.02	0.02	0.03
No College	0.19	0.18	0.16	0.24	0.16	0.21	0.21	0.20	0.17
Bachelors	0.81	0.82	0.84	0.76	0.84	0.79	0.79	0.80	0.83
MBA	0.23	0.24	0.23	0.22	0.27	0.21	0.19	0.22	0.24
MS/MA	0.20	0.23	0.20	0.16	0.18	0.18	0.23	0.19	0.21
PhD	0.19	0.19	0.21	0.15	0.19	0.19	0.18	0.18	0.19
Female	0.04	0.04	0.03	0.06	0.04	0.05	0.04	0.04	0.05
Execdir	0.41	0.45	0.47	0.51	0.40	0.43	0.40	0.50	0.31
Interlocked	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.04	0.02
Age	52.31	51.97	53.97	52.95	52.82	52.26	51.66	52.70	51.90
	(8.45)	(8.36)	(7.92)	(8.32)	(7.82)	(8.67)	(9.02)	(8.48)	(8.39)
Tenure	13.62	13.49	14.53	14.02	13.13	13.89	14.01	14.20	13.01
	(10.11)	(9.67)	(10.61)	(10.16)	(10.09)	(9.91)	(10.20)	(10.35)	(9.81)
Exec. Exp.	16.60	16.70	17.26	17.37	15.81	17.12	17.21	16.93	16.25
	(10.09)	(10.09)	(9.87)	(10.00)	(9.64)	(10.30)	(10.38)	(10.19)	(9.97)
NBE	0.90	0.93	0.89	0.82	0.77	0.91	1.08	0.85	0.95
	(1.30)	(1.31)	(1.30)	(1.23)	(1.18)	(1.30)	(1.43)	(1.28)	(1.33)
NAE	0.84	0.84	0.85	0.87	0.82	0.83	0.86	0.79	0.88
	(1.34)	(1.32)	(1.34)	(1.40)	(1.31)	(1.35)	(1.38)	(1.32)	(1.37)

(*Continues*)

TABLE S-II—*Continued*

Variable	Full Sample	Industrial Sectors			Firm Size			Insiders on Board	
		Service	Primary	Consumer	Large	Medium	Small	Large	Small
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ab. Return	−0.02	0.02	−0.04	−0.05	−0.03	−0.02	−0.02	−0.02	−0.03
	(0.53)	(0.66)	(0.44)	(0.49)	(0.42)	(0.53)	(0.66)	(0.53)	(0.53)
Assets	17,827	23,826	9,472	7,945	37,427	4,531	700	23,034	12,255
	(76,423)	(102,268)	(33,105)	(29,092)	(112,077)	(7,640)	(593)	(94,455)	(49,841)
Employees	22.93	15.21	19.40	38.21	43.82	11.12	2.62	24.87	20.84
	(52.80)	(33.50)	(44.40)	(77.40)	(69.00)	(36.20)	(2.30)	(58.80)	(45.30)
Equity	3,018	3,440	2,667	2,298	6,022	1,071	321.6	3,611	2,384
	(8,020)	(8,902)	(7,082)	(6,250)	(11,354)	(1,347)	(288)	(9,688)	(5,654)
Salary	477	487	501	576	614	429	332	506	448
	(329)	(311)	(313)	(388)	(381)	(260)	(203)	(360)	(289)
Compensation	2,551	4,487	2,367	2,537	3,612	2,077	1,499	2,536	2,566
	(18,323)	(23,380)	(12,857)	(19,124)	(22,197)	(15,401)	(14,212)	(19,718)	(16,737)
N	60,300	20,302	21,089	18,190	26,581	15,209	18,510	31,268	29,100

[a]Standard deviation in parentheses; Asset and Equity are measured in millions of 2006 US$; Compensation and Salary are measured in thousands of 2006 US$; Employees is measured in thousands; Tenure and Executive Experience (Exec. Exp.) measured in years; NBE (NAE) is the number of times the executive changed firms before (after) becoming a top executive. Execdir is an indicator of whether the executive is a member of the board of directors. *Sources*: Standard & Poor's ExecuComp database for 1991 through 2006 matched with data from the Marquis *Who's Who* database.

Taken together, the conditional-choice probabilities for job matches, $p_{jkt}(h)$, the law of motion for human capital, $H_{jk}(h)$, and the compensation regressions described below constitute the reduced form of our structural econometric model because they are the inputs for estimating the economic model. We estimate a multinomial logit model of firm-type and position transitions with some (but not all) interactions to show exit, promotions, and turnover before conducting linear regressions to summarize the compensation schedule. In estimation, we exploit Bayes's rule: Given background h, the (joint) probability, $p_{jkt}(h_t)$, is the product of the probability of choosing the jth firm conditional on choosing the kth rank, and the (marginal) probability of choosing Rank k.

C.1. *Exit*

Table S-III presents the estimated coefficients and elasticity from the logit regression of the probability of exit. The regression included 10 variables in the managers' state space—age, age squared, tenure, tenure squared, executive experience, executive experience squared, number of employers before becoming an executive, number of employers after becoming an executive, and current and next-period bond price—and 11 indicators—Rank 1 lagged, Rank 2 lagged, Rank 3 lagged, Rank 4 lagged, board membership, interlocked, no college degree, MBA, MS/MA, PhD, and gender. The table reports the coefficients of all variables significant at the five-percent level, and one that is marginally significant.

Table S-III shows that Rank 1 has the highest probability of exit and Rank 2 has the lowest, preserving the ordering reported in Table I in the main text for the (unconditional) relative frequencies. The estimated exit probability is increasing in age, tenure with the firm, years of executive experience, and the executive's number of firms employers. These patterns are consistent with lifecycle behavior that predicts the investment value of human capital, and the scope for finding better job matches declines with the accumulation of work experience with one's current employer and in other jobs and eventually declines with age as death approaches. The table shows that female executives are 17 percent more likely to exit than men, while those who do not have college degrees and MBA graduates are less likely to exit. Exit probabilities do not significantly differ across firm size and sector, confirming results from Table S-II that show only minor differences in the relative frequencies. Finally, exit is inversely related to the bond price. Since stock and bond prices typically move in opposite directions, we infer that executives are more likely to exit when stock prices increase.

C.2. *Promotion and Demotion*

Table S-IV presents the estimated coefficients and elasticities from the multinomial logit regression of the probability of promotion and demotion. As with

TABLE S-III

LOGIT COEFFICIENT ESTIMATES OF THE LIKELIHOOD OF EXIT[a]

Variable	Parameter	Elasticity (%)
Rank 1 lagged	0.778 (0.054)	55.26 (3.23)
Rank 2 lagged	−0.106 (0.051)	−8.90 (4.28)
Exec. Exp.	0.018 (4.1E−3)	24.44 (5.69)
Exec. Exp. Sq.	−3.6E−4 (8.4E−5)	−11.38 (2.65)
Tenure	0.022 (3.5E−3)	24.66 (3.97)
Tenure Sq.	−3.0E−4 (8.1E−5)	−7.26 (1.97)
Female	0.218 (0.061)	17.42 (4.16)
No College	−0.410 (0.209)	−35.68 (18.90)
MBA	−0.935 (0.210)	−84.46 (20.10)
NBE	0.067 (0.012)	5.54 (0.62)
NAE	0.079 (0.009)	4.49 (0.78)
Age	−0.121 (0.013)	−527.74 (58.58)
Age Sq.	0.001 (1.2E−4)	312.89 (28.81)
Interlocked	−0.615 (0.086)	−55.14 (8.29)
Execdir	−0.736 (0.038)	−64.72 (3.50)
Bond Price	−0.232 (0.020)	−335.05 (28.89)
Constant	4.830 (0.503)	
Observations	51,808	

[a]The elasticities are calculated at the mean of variables. For dummy variables, the change is from 0 to 1. Standard error in parentheses; Tenure and Executive Experience (Exec. Exp.) are measured in years; NBE (NAE) is the number of times the executive changed firms before (after) becoming one of the ranks in our sample. Execdir is an indicator of whether the executive is a member of the board of directors. Other ranks, education types, and interactions are included but are not significant and hence are not reported here. *Sources*: The data are for top managers from Standard & Poor's ExecuComp database for 1991 through 2006 matched with background data from the Marquis *Who's Who* database.

Table S-III, all variables in the state space are included and we report all variables significant at the five-percent level. Promotion is much more likely than demotion, but most executives remain in their current position. Also, after controlling for previous-period rank, executive experience and tenure are associated with the lower current-period ranks. However, controlling for previous-period rank, older executives are more likely to be the CEO (Rank 2). The number of moves after being an executive does not have any effect on the probability of choosing ranks. However, the pattern for the number of moves before becoming an executive is similar to that of tenure. Being a board member increases the probability of being or becoming CEO.

C.3. *Turnover*

Table S-V presents the estimated coefficients and elasticity from the logit regression of the conditional probability of choosing a new employer. In addition to state-space variables in Tables S-III and S-IV, the probability of choosing a new employer is conditional on the other choice variables: rank, industrial

TABLE S-IV

LOGIT ESTIMATES OF THE LIKELIHOOD OF PROMOTION AND RANK CHOICE[a]

	Rank				Rank				
	1	2	3	4	1	2	3	4	5
Variable	Parameter				Elasticities (%)				
Rank 1 lagged	10.505	6.488	5.935	3.542	111	−290	−345	−585	−939
	(0.322)	(0.283)	(0.282)	(0.274)	(10)	(34)	(34)	(34)	(39)
Rank 2 lagged	7.824	9.687	5.080	3.501	−118	68	−393	−551	−901
	(0.276)	(0.207)	(0.219)	(0.194)	(25)	(4)	(20)	(18)	(22)
Rank 3 lagged	6.659	6.815	8.678	3.498	−88	−72	114	−404	−754
	(0.285)	(0.210)	(0.194)	(0.192)	(24)	(13)	(4)	(15)	(20)
Rank 4 lagged	5.158	4.598	4.682	5.994	−20	−76	−68	63	−536
	(0.225)	(0.134)	(0.112)	(0.056)	(21)	(10)	(10)	(4)	(7)
Exec. Exp.	−0.027	−0.041	−0.021	−0.013	−10	−33	1	14	35
	(0.012)	(0.011)	(0.011)	(0.009)	(15)	(9)	(12)	(7)	(11)
Exec. Exp. Sq.	4.0E−4	5.0E−4	2.0E−4	2.0E−4	6	8	−3	−4	−10
	(3.0E−4)	(2.0E−4)	(2.0E−4)	(2.0E−4)	(6)	(4)	(6)	(4)	(6)
Tenure	−0.026	−0.036	−0.027	−0.011	−10	−23	−11	11	26
	(0.010)	(0.009)	(0.009)	(0.007)	(10)	(6)	(8)	(5)	(8)
Tenure Sq.	0.001	0.001	0.001	3.0E−4	5	7	4	−3	−12
	(2.0E−4)	(2.0E−4)	(2.0E−4)	(2.0E−4)	(5)	(3)	(4)	(2)	(4)
Female	−0.845	−0.737	−0.729	−0.268	−43	−32	−31	15	42
	(0.247)	(0.200)	(0.186)	(0.114)	(20)	(12)	(14)	(7)	(10)
NBE	−0.197	−0.219	−0.172	−0.0577	−9	−1	−7	3	8
	(0.033)	(0.029)	(0.028)	(0.0189)	(2)	(2)	(2)	(1)	(1)
NAE	−0.012	0.019	−0.027	−0.0011	−1	1	−2	−1	−1
	(0.041)	(0.036)	(0.036)	(0.0259)	(2)	(2)	(2)	(1)	(2)

(*Continues*)

TABLE S-IV—*Continued*

	Rank				Rank				
	1	2	3	4	1	2	3	4	5
Variable	Parameter				Elasticities (%)				
Age	0.160	0.358	0.195	0.0743	−9	1,024	174	−459	−847
	(0.049)	(0.043)	(0.042)	(0.0271)	(188)	(124)	(158)	(86)	(128)
Age Sq.	−0.001	−0.003	−0.002	−7.0E−4	136	−5	−111	236	434
	(0.001)	(0.001)	(4.0E−4)	(3.0E−4)	(89)	(60)	(80)	(44)	(66)
Execdir	1.438	2.279	1.208	0.348	−23	123	17	−70	−105
	(0.105)	(0.092)	(0.091)	(0.076)	(13)	(4)	(5)	(3)	(7)
Bond Price	−0.139	−0.294	−0.144	−0.087	−2	−265	−10	87	235
	(0.047)	(0.042)	(0.041)	(0.030)	(55)	(36)	(46)	(26)	(43)
Constant	−8.682	−8.630	−6.304	−2.437					
	(1.599)	(1.369)	(1.321)	(0.878)					
Observations	58,328	58,328	58,328	58,328					

[a]The elasticities are calculated at the mean of variables. For dummy variables, the change is from 0 to 1. Rank 5 is the base outcome. Standard error in parentheses; Tenure and Executive Experience (Exec. Exp.) are measured in years; NBE (NAE) is the number of times the executive changed firms before (after) becoming one of the ranks in our sample. Execdir is an indicator of whether the executive is a member of the board of directors. Other ranks, education types, and interactions are included but are not significant and hence are not reported here. *Sources*: The data are for top managers from Standard & Poor's ExecuComp database for 1991 through 2006 matched with background data from the Marquis *Who's Who* database.

TABLE S-V

LOGIT ESTIMATES OF THE LIKELIHOOD OF NEW EMPLOYER[a]

Variable	Parameter	Elasticities (%)
Primary Sector	−0.192 (0.073)	−18.7 (7.1)
Large Board	−0.262 (0.058)	−25.7 (5.7)
Rank 1	0.912 (0.257)	86.1 (23.2)
Rank 2	2.420 (0.182)	213.0 (12.6)
Rank 3	1.002 (0.197)	94.7 (17.6)
Rank 2 × Female	−1.174 (0.548)	−0.5 (0.2)
Rank 2 Lagged	−1.321 (0.187)	−132.0 (18.6)
Rank 3 Lagged	−0.432 (0.194)	−42.8 (19.1)
Exec. Exp.	0.052 (0.008)	82.8 (13.4)
Exec. Exp. Sq.	−0.001 (1.9E−4)	−20.6 (6.6)
Tenure	−0.227 (0.007	−302.0 (9.0)
Tenure Sq.	0.003 (1.6E−4)	88.1 (4.3)
NBE	−0.130 (0.025)	−11.1 (2.1)
NAE	−0.168 (0.024)	−13.7 (1.9)
Age	0.385 (0.047)	1,948 (239.0)
Age Sq.	−0.004 (0.001)	−992 (122.0)
Interlocked	−0.939 (0.286)	−93 (28.6)
Execdir	−1.036 (0.093)	−102 (9.2)
Bond Price	−0.241 (0.036)	−397 (59.4)
Constant	−8.227 (1.382)	
Observations	54,705	

[a]The elasticities are calculated at the mean of variables. For dummy variables, the change is from 0 to 1. Standard error in parentheses; Tenure and Executive Experience (Exec. Exp.) are measured in years; NBE (NAE) is the number of times the executive changed firms before (after) becoming one of the ranks in our sample. Execdir is an indicator of whether the executive is a member of the board of directors. *Sources*: The data are for top managers from Standard & Poor's ExecuComp database for 1991 through 2006 matched with background data from the Marquis *Who's Who* database.

sector, and insider of board firm type. We also allowed for full interactions between the choice variables and the state-space variables. We report all variables significant at the five-percent level.

The ordering of the top three ranks taken individually and the bottom two taken together exactly match the corresponding ordering of relative frequencies reported in Table I in the main text. A CEO is more likely to be a new hire than executives in other ranks, and an executive in Rank 4 or 5 is less likely to be a new hire than anyone else. The probability that a Rank-2 executive just joined the firm is lower if the person is female or (not surprisingly) was in the same rank last period. The table shows that previous turnover reduces the probability of turnover in the future. Age, tenure, and executive experience reduce turnover, with the quadratic term dominating the linear term. When the bond prices rise (and stock prices fall), turnover falls. Finally, we note that after controlling for current rank, the probability of joining a new firm is not significantly affected by the previous period's rank; we later appeal to this finding when constructing instruments for the structural estimation.

C.4. *Compensation*

Table S-VI presents ordinary least squares estimates of the compensation schedule. In addition to the choice and state-space variables, the compensation schedule is also a function of abnormal return. We include both linear and quadratic terms to capture the effect of abnormal returns. We also allow for full interactions between three classes of variables: state-space, choice, and abnormal return. Table S-VI reports those variables that are significant at the five-percent level.

The table shows that the ordering in total compensation by rank, size, and sector displayed in Table S-II and Table I in the main text is robust to controlling for background variables. That is, average executive compensation increases up to Rank 2 and then declines, Rank 1 executives receiving a little less than Rank 3. It is increasing in firm size, and executives in the service sector receive more compensation, while those in the primary sector average the least. Rank 1 is most affected by excess returns, which is a little surprising given the titles of executives holding this rank (Table S-I).

Only in Ranks 2 and 3 is an executive in his first year at the firm paid significantly higher compensation, but expected compensation of new hires in all ranks is not as closely tied to firm performance. Compensation is more closely tied to firm's performance in larger firms, firms with more insider board members, and for interlocked executives. Similarly, being highly ranked last period, and having a lot of executive experience, ties compensation more closely to firm's performance. Increasing tenure reduces compensation, age has a concave profile; both trends are commonly found in other labor markets. Turning to the aggregate economy, Table S-VI shows that lower bond prices increase dependence of pay on excess return, possibly reflecting a greater divergence between shareholders' interest and executives' goals when stock prices are higher.

D. ADDITIONAL RESULTS

D.1. *Compensating Differential for Observed Factors*

Table S-VII presents our estimates of $\Delta^{\alpha}_{jkt}(h)$, the compensating differential for working versus retiring.[1] It shows that a 50-year-old Rank-5 male executive in a small consumer-goods company receives an extra \$1.6 million compensation for nonpecuniary costs, \$263,000 more in Rank 2, \$241,000 less in the

[1]The standard errors were obtained using the multistep procedure given by Newey and McFadden (1994).

TABLE S-VI

OLS COEFFICIENT ESTIMATES OF THE COMPENSATION REGRESSION[a]

Rank	π	π^2	Level
1	9,839	−454	1,055
	(1,690)	(987)	(797)
2	6,007	−789	3,456
	(1,394)	(699)	(683)
3	2,627	−164	1,267
	(1,407)	(605)	(662)
4	1,529	−242	103
	(926)	(444)	(463)
2 × Female	–	–	2,668
			(1,295)
Firm			
New Employer	−12,396	2,155	−1,026
	(996)	(478)	(1,255)
Service Sector	3,149	88	777
	(419)	(222)	(198)
Primary Sector	−3,609	1,537	−633
	(473)	(267)	(198)
Medium Firm	4,079	−253	937
	(437)	(201)	(214)
Large Firm	12,703	−2,224	3,697
	(405)	(212)	(190)
Large board	2,683	−1,203	280
	(358)	(176)	(163)
Firm × Rank			
2 × New Employer	–	–	3,840
			(1,459)
3 × New Employer	–	–	5,289
			(1,975)

Variable	π	π^2	Level
Interlocked	6,403	−1,496	−299
	(995)	(471)	(464)
Execdir	7,695	−848	845
	(570)	(304)	(251)
Bond Price	−1,521	531	−97
	(217)	(110)	(92)
Rank 1 Lagged	12,085	−3,054	544
	(1,769)	(987)	(822)
Rank 2 Lagged	14,640	−2,875	660
	(1,342)	(625)	(658)
Rank 3 Lagged	4,849	−1,100	597
	(1,389)	(586)	(653)
Exec. Exp.	191	−42	2
	(26)	(14)	(25)
Tenure	−23	22	−40
	(25)	(14)	(20)
NAE	−484	−58	215
	(174)	(93)	(80)
PhD	−871	83	11
	(464)	(223)	(212)
Age	17	15	281
	(23)	(10)	(85)
Age sq.	–	–	−3
			(1)
Constant	21,601	−9,114	−4,359
	(3,859)	(1,914)	(2,716)
Observations	50,405	50,405	50,405

[a]*Note*: Compensation is measured in thousands of 2006 US$; Standard error in parentheses; Tenure and Executive Experience (Exec. Exp.) are measured in years; NAE is the number of times the executive changed firms after becoming one of the ranks in our sample. Execdir is an indicator of whether the executive is a member of the board of directors. Other ranks, education types, and interactions are included but are not significant and hence are not reported here. *Sources*: The data are for top managers from Standard & Poor's ExecuComp database for 1991 through 2006 matched with background data from the Marquis *Who's Who* database.

primary sector, $400,000 more in the service sector, and $553,000 less in large firms. Overall, higher-ranked executives receive a larger compensating differential from nonpecuniary cost of working than do lower-ranked executives.

The most striking result of Table S-VII is that executives prefer large firms to small ones. An executive is willing to accept $373,000 less to work in a medium-sized firm compared to a small firm, and $553,000 less to work in a large firm. Thus, the compensating differential declines from $1.63 million for a small firm to $1.07 million for a large firm. The fact that larger firms pay more than small firms is well documented and clearly illustrated by our sample in Figure 1 and

TABLE S-VII

COMPENSATING DIFFERENTIAL FOR NONPECUNIARY COST OF DILIGENCE VERSUS EXIT[a]

Variable	Constant	Age-50	Tenure	Exec. Exp.	NBE	NAE	Female	No College	MBA	MS	PhD
Constant	1.628	0.007	0.016	−0.004	−0.006	0.025	−0.043	−0.085	0.025	−0.047	0.005
	(0.071)	(0.001)	(0.002)	(0.000)	(0.004)	(0.001)	(0.024)	(0.007)	(0.006)	(0.007)	(0.005)
Rank 1	0.205						0.219				0.060
	(0.063)						(0.020)				(0.003)
Rank 2	0.263						0.347				0.060
	(0.063)						(0.020)				(0.003)
Rank 3	0.111						−0.072				0.060
	(0.063)						(0.020)				(0.003)
Rank 4	−0.181										0.060
	(0.063)										(0.003)
Industrial Sector											
Primary	−0.241	−0.006	−0.008	0.003	0.000	−0.009	0.106	0.051	−0.008	−0.004	−0.034
	(0.048)	(0.001)	(0.001)	(0.000)	(0.003)	(0.001)	(0.018)	(0.005)	(0.005)	(0.006)	(0.003)
Service	0.400	0.009	0.008	0.002	−0.012	0.003	0.091	−0.028	0.010	−0.095	−0.021
	(0.050)	(0.001)	(0.001)	(0.000)	(0.003)	(0.001)	(0.019)	(0.006)	(0.005)	(0.006)	(0.003)
Firm Size											
Medium	−0.373	−0.009	−0.010	0.001	0.021	−0.002	−0.080	0.060	−0.024	0.082	−0.007
	(0.050)	(0.001)	(0.001)	(0.000)	(0.003)	(0.001)	(0.019)	(0.006)	(0.005)	(0.006)	(0.003)
Large	−0.553	−0.016	−0.012	0.004	0.033	−0.006	−0.063	0.105	−0.052	0.094	−0.010
	(0.049)	(0.001)	(0.001)	(0.000)	(0.003)	(0.001)	(0.019)	(0.006)	(0.005)	(0.006)	(0.003)
Turnover											
New Employer	−0.380	0.001	0.008	−0.002	−0.004	0.004	−0.020	0.003	0.000	−0.001	0.002
	(0.040)	(0.001)	(0.001)	(0.000)	(0.003)	(0.001)	(0.015)	(0.005)	(0.004)	(0.005)	(0.003)

[a]Compensation is measured in millions of 2006 US$; Standard error in parentheses; Tenure and Executive Experience (Exec. Exp.) are measured in years; NBE (NAE) is the number of times the executive changed firms before (after) becoming one of the ranks in our sample. Execdir is equal to 1 if the executive is on the board and zero otherwise.

Table I in the main text; this result refutes one contending explanation for the differential, taste.

The results on sector explain most of differences in average compensation reported in Table S-VI, and the sector ordering of compensation is also the same as in Table S-II. The model mostly attributes compensating differentials in sectors to working conditions, although the large differences in average compensation between the service sector and the other two depicted in Table S-II are not fully accounted for in either Table S-VI or Table S-VII.

Female executives receive a higher differential than men to accept Rank-1 and -2 jobs in the consumer sector, \$176,000 and \$304,000 respectively, plus an additional \$100,000 for primary- and service-sector jobs. At the average age, tenure, and executive experience, female executives receive \$1.6 million overall, as compared to \$1.5 million for men, to offset nonpecuniary utility losses from continuing to work one more year. Of all the education groups, executives with a PhD receive the highest compensating differential for nonpecuniary losses from working versus retiring, \$1.52 million averaged overall, while those with MBA degrees receive the lowest, \$1.41 million. The pattern we observe for education and gender may reflect superior outside options, in other labor markets and retirement, for female executives and executives with a PhD.

The differential increases with age, tenure, number of moves after becoming an executive, and board membership. Executives moving to a new employer receive \$380,000 less compensation for nonpecuniary losses, but one third of this is wiped out if they are placed on the board in their first year. On average, an executive in the first year with a firm receives \$1.16 million as compared to \$1.54 million in the second year to offset nonpecuniary losses. This suggests that part of the reason managers turn over is to take job matches with more attractive nonpecuniary benefits.

D.2. *Compensating Differential for Unobserved Factors*

Table S-VIII reports our estimates of $\Delta^{q}_{jkt}(h)$, which measures how much extra managers matching with a given personal background (t, h) must be paid to attract the proportion we observed in the data selecting job match (j, k). It shows a marginal Rank-5 executive in a small consumer-goods company gives up \$569,000 for the unobserved idiosyncratic component relative to exit. Rank 4 has the highest net demand, whereas Rank 1 has the lowest net demand, with employers offering a negative differential of \$151,000 to Rank-1 executives and a positive differential of \$181,000 to Rank-4 executives. Firms in the primary sector pay an additional \$48,000, while large firms pay an extra \$170,000 to meet demand. Comparing the ordering by rank in the top entries of the first column, with the ordering of the estimated unconditional exit probabilities by rank implied by the first column of Table S-II, we see that the effect of conditioning on the observed variables affects the ordering of the conditional-choice variables by rank. For example, compensation in Rank 4 is most boosted by the unobservable factors; in our model, it attracts managers who receive relatively low values of $\varepsilon_{14t} - \varepsilon_{0t}$ (as reflected in the low cutoff value $q_{j3t}(h)$); yet Rank 2 is more likely to be selected than any other rank, including exiting. This demonstrates that the observed variables in our model explain why managers are deterred from taking the CEO post.

Table S-VIII shows that larger firms have higher demand for executives, which partially explains the positive relationship between pay and firm size. Only at low ranks in the consumer and service sectors is there greater net demand for women relative to men. Finally, our finding that the marginal executive takes a discount of \$85,000 in compensation to switch firms, shows that executives only switch firms when they receive a relatively favorable idiosyncratic shock from their new employer job match.

D.3. *Human-Capital Compensating Differential*

Leaving aside career concerns, the value of human capital to managers offsets their equilibrium compensation by $\Delta^{A}_{jkt}(h)$. With reference to Table S-IX, we find that human-capital investment is important for executives at all ranks. They would demand an extra \$200,000 to \$300,000 in compensation per annum, but for the benefits of on-the-job experience. As a fraction of their certainty-equivalent wage, $w^{*}_{jk,t+1}(h)$, the value of human capital is bracketed between approximately one quarter and one half of total compensation, remarkably high given the distribution of ages, positions, and the lengths of future careers. The value of human-capital investment is concave in rank, peaking in Rank 2 and then dropping off sharply, its value in Rank 1 falling below that in Rank 5. Within our model, the formula for $A_t(h)$ in equation (S-2) shows that the investment value of human capital is inversely related to the probability of exit. So it is not surprising to see that the relationship between human capital and rank shown in Table S-IX is exactly the opposite to the plot of relative frequencies of exit by rank implied by Table I in the main text. Predictably, the value of human-capital investment declines with age and all types of experience; similarly, moving to a new firm increases the value of human-capital investment. Reflecting their higher exit rate, female executives place a lower value on human-capital investment. A female executive is willing to give up \$200,000 for the human-capital investment, whereas men are willing to forgo \$300,000.

D.3.1. *Education*

Figure S-1(a) shows the certainty-equivalent wage and its components by education. Figure S-1(b) shows the expected pay, risk premium, and agency cost components by education. As Arcidiacono, Cooley, and Hussey (2008) noted, the return to an MBA degree is usually contaminated by the benefits of

TABLE S-VIII

COMPENSATION FOR MARKET DEMAND VERSUS EXIT[a]

Variable	Constant	Age-50	Tenure	Exec. Exp.	NBE	NAE	Female	No College	MBA	MS	PhD
Constant	−0.569	−0.003	−0.007	0.002	−0.003	−0.010	0.069	0.036	0.010	−0.009	0.014
	(0.013)	(0.001)	(0.001)	(0.000)	(0.003)	(0.001)	(0.014)	(0.003)	(0.003)	(0.002)	(0.003)
Rank 1	−0.151						−0.219				−0.058
	(0.013)						(0.013)				(0.002)
Rank 2	0.022						−0.181				−0.058
	(0.013)						(0.013)				(0.002)
Rank 3	0.019						−0.050				−0.058
	(0.013)						(0.013)				(0.002)
Rank 4	0.182										−0.058
	(0.013)										(0.002)
Industrial Sector											
Primary	0.048	0.002	0.004	−0.003	0.001	0.006	−0.124	−0.029	−0.006	0.019	0.032
	(0.010)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)	(0.012)	(0.003)	(0.003)	(0.002)	(0.002)
Service	−0.006	−0.002	0.001	−0.001	0.004	−0.001	−0.045	−0.011	0.003	0.042	0.021
	(0.010)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)	(0.012)	(0.003)	(0.003)	(0.002)	(0.002)
Firm Size											
Medium	0.032	0.001	0.002	−0.002	−0.010	0.000	0.029	−0.010	0.003	−0.022	0.011
	(0.010)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)	(0.012)	(0.003)	(0.003)	(0.002)	(0.002)
Large	0.170	0.005	0.000	−0.004	−0.020	0.003	−0.003	−0.046	0.022	−0.033	0.011
	(0.010)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)	(0.012)	(0.003)	(0.003)	(0.002)	(0.002)
Turnover											
New Employer	−0.085	0.000	−0.013	0.003	−0.007	−0.010	−0.006	−0.012	0.007	−0.006	−0.019
	(0.008)	(0.000)	(0.001)	(0.000)	(0.002)	(0.001)	(0.010)	(0.002)	(0.002)	(0.002)	(0.002)

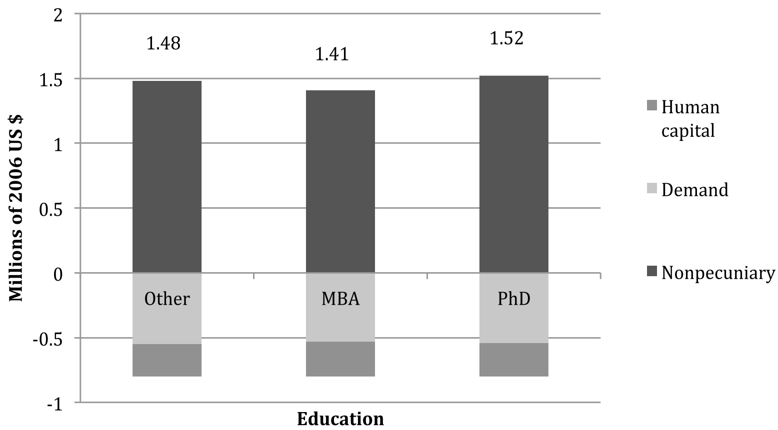
[a]Compensation is measured in millions of 2006 US$; Standard error in parentheses; Tenure and Executive Experience (Exec. Exp.) are measured in years; NBE (NAE) is the number of times the executive changed firms before (after) becoming one of the ranks in our sample. Execdir is equal to 1 if the executive is on the board and zero otherwise.

TABLE S-IX

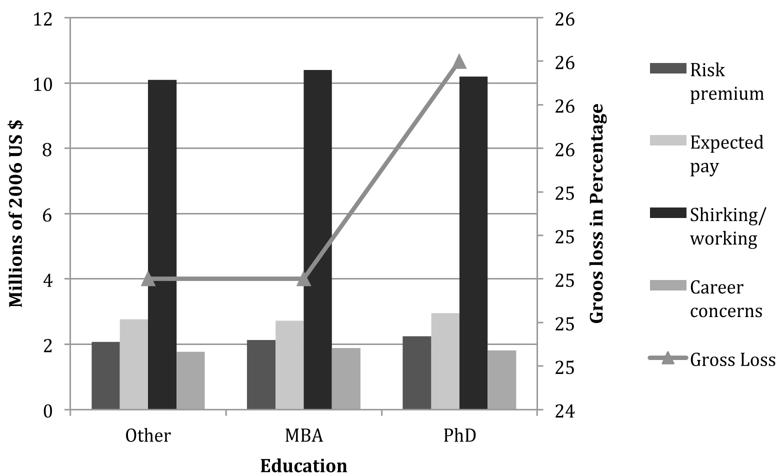
VALUE OF HUMAN-CAPITAL INVESTMENT[a]

Variable	Constant	Age-50	Exec. Exp.	NBE	NAE	Female	No College	MBA	MS	PhD
Constant	−0.2278	0.0013	0.0014	0.0058	0.0050	0.0182	−0.0090	−0.0100	0.0055	−0.0043
	(0.0002)	(0.0005)	(0.0006)	(0.0001)	(0.0001)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Rank 1	0.0237			0.0001	0.0003	0.0033	−0.0015	0.0003	−0.0006	0.0002
	(0.0005)			(0.0001)	(0.0001)	(0.0006)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
Rank 2	−0.0632			0.0006	0.0007	0.0017	−0.0003	−0.0005	0.0007	−0.0012
	(0.0005)			(0.0001)	(0.0001)	(0.0006)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Rank 3	−0.0372			0.0012	0.0012	0.0070	−0.0027	−0.0010	0.0002	−0.0002
	(0.0005)			(0.0001)	(0.0001)	(0.0006)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Rank 4	−0.0062			0.0005	0.0005	0.0026	−0.0016	−0.0006	−0.0001	0.0001
	(0.0005)			(0.0001)	(0.0001)	(0.0006)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Turnover										
New Employer	−0.0132			0.0006	0.0006	0.0036	−0.0014	−0.0005	0.0002	−0.0003
	(0.0005)			(0.0001)	(0.0001)	(0.0006)	(0.0003)	(0.0003)	(0.0003)	(0.0003)

[a]Compensation is measured in millions of 2006 US$; Standard error in parentheses; Tenure and Executive Experience (Exec. Exp.) are measured in years; NBE (NAE) is the number of times the executive changed firms before (after) becoming one of the ranks in our sample. Execdir is equal to 1 if the executive is on the board and zero otherwise.



(a)



(b)

FIGURE S-1.—Education pay decomposition. (a) Decomposition of Certainty equivalent pay, (b) agency cost.

previous work experience, a requirement of many MBA programs. Our study does, however, shed light on the long-term benefits of a general business education versus a more specialized degree. We find MBA degree holders have a lower marginal productivity than graduates with a PhD or another specialized degree. An executive with a PhD has a higher non–executive-market outside option relative to the nonpecuniary benefits of executive work, and higher certainty-equivalent compensation than an executive with an MBA. This implies that the MBA graduate has more implicit incentives and hence requires less explicit incentives and current compensation, which translates to a higher value of human-capital investment and greater career concerns. There is a higher net demand for executives with an MBA, while PhD graduates have a higher gross loss to the shareholders if they shirk, which may be attributed to their specialized knowledge and intellectual prowess.

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