Promotion, Turnover and Compensation in the Executive Market

George-Levi Gayle, Limor Golan, Robert A. Miller

Carnegie Mellon University

June 2009-Econometric Society Meetings
Introduction
What are executives paid for?

- CEOs are paid more than executives in lower ranks.
- Average tenure of a CEO is five years.
- They are mainly promoted internally.
- Is promotion to CEO a reward for excellent service at lower ranks?
- The income volatility of CEOs is also much higher.
- Rent from human capital or risk premium?
- Are there non pecuniary benefits?
Introduction
What we do: develop and estimate structural model

- Formulate a dynamic model where there is:
  1. Moral hazard and incentive concerns
  2. Human capital, firm specific and general
  3. Job turnover stimulated by demand from firms for a mix of executive talent and idiosyncratic (private) shocks to executives.

- Identify non pecuniary benefits of jobs, human capital, risk premium, span of control.

- Estimate model and compute importance of factors above.
There is a growing literature on estimating structural models of contracting.

See Ferral and Shearer (99), Margiotta and Miller (00), Dubois and Vukina (05), Bajari and Khwaja (06), D’Haultfoeviller and Fevrier (07), Einav, Finkelstein and Schrimpf (07), Nekipelov (07), Gayle and Miller (08a,b,c).

In related work Gibbons and Murphy (92) test implications of optimal contract with career concerns, and Frydman (05) presents evidence on turnover and general human capital.

There is little empirical work relating career hierarchies to human capital, promotion and job turnover.

See Baker Gibbs and Holmstrom (94) for a case study of one firm.
Introduction

Outline of this talk

- Data
- Develop a structural model.
- Discuss identification and estimation.
- Present preliminary results from structural model.
Data

- S&P ExecuComp database
- Compensation and title on top 8 paid executives (1992-2006)
- 30,614 executives
- 2818 firms S&P 500, midcap, smallcap
- Background data: Who’s Who
- Match: 16,300 executives, 2100 firms
- Compensation data: costs to shareholder
  - Direct compensation: salary, bonus, value of restricted stocks and options granted, retirement and long-term compensation schemes
  - Total compensation: includes wealth changes from holding firm options and stocks
Table 2a- Transitions

<table>
<thead>
<tr>
<th></th>
<th>RANK 1</th>
<th>RANK 2</th>
<th>RANK 3</th>
<th>RANK 4</th>
<th>RANK 5</th>
<th>RANK 6</th>
<th>RANK 7</th>
<th>Size</th>
<th>exit</th>
<th>%exit</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANK 1</td>
<td>88</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3995</td>
<td>487</td>
<td>12</td>
</tr>
<tr>
<td>RANK 2</td>
<td>4</td>
<td>95</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20150</td>
<td>929</td>
<td>5</td>
</tr>
<tr>
<td>RANK 3</td>
<td>3</td>
<td>14</td>
<td>78</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>6272</td>
<td>1370</td>
<td>22</td>
</tr>
<tr>
<td>RANK 4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>86</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>19359</td>
<td>2624</td>
<td>14</td>
</tr>
<tr>
<td>RANK 5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>85</td>
<td>2</td>
<td>1</td>
<td>15781</td>
<td>2356</td>
<td>15</td>
</tr>
<tr>
<td>RANK 6</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>85</td>
<td>2</td>
<td>14646</td>
<td>2248</td>
<td>15</td>
</tr>
<tr>
<td>RANK 7</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>7</td>
<td>81</td>
<td>5581</td>
<td>1035</td>
<td>19</td>
</tr>
</tbody>
</table>

entries: 1303  1872  1447  2634  1981  1086  726  
%entries: 33   9    23   14    13    7     12   

Gayle, Golan, Miller (Carnegie Mellon University)  Promotion, Turnover and Compensation
<table>
<thead>
<tr>
<th>RANK 1</th>
<th>RANK 2</th>
<th>RANK 3</th>
<th>RANK 4</th>
<th>RANK 5</th>
<th>RANK 6</th>
<th>RANK 7</th>
<th>Size</th>
<th>Size</th>
<th>Trans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Moves</td>
</tr>
<tr>
<td>RANK 1</td>
<td>52</td>
<td>36</td>
<td>8</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>165</td>
<td>3995</td>
</tr>
<tr>
<td>RANK 2</td>
<td>19</td>
<td>58</td>
<td>9</td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>389</td>
<td>20150</td>
</tr>
<tr>
<td>RANK 3</td>
<td>10</td>
<td>40</td>
<td>26</td>
<td>14</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>140</td>
<td>6272</td>
</tr>
<tr>
<td>RANK 4</td>
<td>3</td>
<td>21</td>
<td>7</td>
<td>40</td>
<td>12</td>
<td>11</td>
<td>5</td>
<td>281</td>
<td>19359</td>
</tr>
<tr>
<td>RANK 5</td>
<td>2</td>
<td>36</td>
<td>10</td>
<td>14</td>
<td>34</td>
<td>3</td>
<td>1</td>
<td>211</td>
<td>15781</td>
</tr>
<tr>
<td>RANK 6</td>
<td>0</td>
<td>9</td>
<td>8</td>
<td>30</td>
<td>8</td>
<td>34</td>
<td>10</td>
<td>130</td>
<td>14646</td>
</tr>
<tr>
<td>RANK 7</td>
<td>2</td>
<td>13</td>
<td>4</td>
<td>30</td>
<td>6</td>
<td>19</td>
<td>26</td>
<td>53</td>
<td>5581</td>
</tr>
<tr>
<td>Total</td>
<td>188</td>
<td>496</td>
<td>141</td>
<td>244</td>
<td>160</td>
<td>96</td>
<td>44</td>
<td>1369</td>
<td>85748</td>
</tr>
</tbody>
</table>
Seven Ranks, Hierarchy construction - Gayle, Golan and Miller (2008)

- Rank 1, life-cycle (president, chairman, etc.)
- Rank 2, CEO, and CEO with multiple positions

Most executives remain in the same position

Promotions to an adjacent positions are more common

99% of Rank 2 executives are promoted or remain in the same rank

Demotions are not rare: 5% in Rank 3, 7% in rank 4

More exit than entry in lower ranks, the opposite is true for high rank

Small percent of transitions involves turnover-different patterns

Substantial part of firm turnover involve promotions

Below rank 2 a promotion is more likely than not
Table 4: Executives Characteristics  
Compensation and Salary are measured in Thousand of 2006 US$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rank1</th>
<th>Rank2</th>
<th>Rank3</th>
<th>Rank4</th>
<th>Rank5</th>
<th>Rank6</th>
<th>Rank7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>59.6</td>
<td>55.7</td>
<td>52.4</td>
<td>52.0</td>
<td>52.8</td>
<td>52.4</td>
<td>52.2</td>
</tr>
<tr>
<td></td>
<td>(9.8)</td>
<td>(7.6)</td>
<td>(8.0)</td>
<td>(8.8)</td>
<td>(10)</td>
<td>(10.3)</td>
<td>(11.2)</td>
</tr>
<tr>
<td>Female</td>
<td>0.02</td>
<td>0.02</td>
<td>0.03</td>
<td>0.05</td>
<td>0.06</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>No Degree</td>
<td>0.25</td>
<td>0.21</td>
<td>0.25</td>
<td>0.21</td>
<td>0.21</td>
<td>0.17</td>
<td>0.21</td>
</tr>
<tr>
<td>MBA</td>
<td>0.24</td>
<td>0.26</td>
<td>0.23</td>
<td>0.27</td>
<td>0.19</td>
<td>0.18</td>
<td>0.22</td>
</tr>
<tr>
<td>MS/MA</td>
<td>0.16</td>
<td>0.17</td>
<td>0.17</td>
<td>0.19</td>
<td>0.21</td>
<td>0.21</td>
<td>0.21</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>0.15</td>
<td>0.15</td>
<td>0.14</td>
<td>0.13</td>
<td>0.21</td>
<td>0.27</td>
<td>0.17</td>
</tr>
<tr>
<td>Prof. Certification</td>
<td>0.15</td>
<td>0.14</td>
<td>0.15</td>
<td>0.22</td>
<td>0.24</td>
<td>0.37</td>
<td>0.30</td>
</tr>
<tr>
<td>Executive Experience</td>
<td>22.3</td>
<td>19.8</td>
<td>16.1</td>
<td>15.9</td>
<td>16.6</td>
<td>16.5</td>
<td>16.9</td>
</tr>
<tr>
<td></td>
<td>(13.0)</td>
<td>(10.5)</td>
<td>(10.7)</td>
<td>(11.0)</td>
<td>(12)</td>
<td>(11.7)</td>
<td>(11.7)</td>
</tr>
<tr>
<td>Tenure</td>
<td>17.1</td>
<td>15.1</td>
<td>13.7</td>
<td>13.8</td>
<td>14.1</td>
<td>13.7</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td>(13.5)</td>
<td>(11.7)</td>
<td>(11.4)</td>
<td>(11.2)</td>
<td>(12)</td>
<td>(11.0)</td>
<td>(10.8)</td>
</tr>
</tbody>
</table>
# Table 4: Executives Characteristics

Compensation and Salary are measured in Thousand of 2006 US$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rank1</th>
<th>Rank2</th>
<th>Rank3</th>
<th>Rank4</th>
<th>Rank5</th>
<th>Rank6</th>
<th>Rank7</th>
</tr>
</thead>
<tbody>
<tr>
<td># of past moves</td>
<td>1.9</td>
<td>1.9</td>
<td>1.7</td>
<td>1.9</td>
<td>2.2</td>
<td>2.3</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>(2.0)</td>
<td>(1.9)</td>
<td>(1.9)</td>
<td>(1.9)</td>
<td>(2.0)</td>
<td>(2.1)</td>
<td>(2.1)</td>
</tr>
<tr>
<td># of Executive</td>
<td>0.9</td>
<td>0.93</td>
<td>0.73</td>
<td>0.76</td>
<td>0.77</td>
<td>0.80</td>
<td>0.84</td>
</tr>
<tr>
<td>Moves</td>
<td>(1.4)</td>
<td>(1.38)</td>
<td>(1.3)</td>
<td>(0.13)</td>
<td>(1.32)</td>
<td>(1.3)</td>
<td>(1.4)</td>
</tr>
<tr>
<td>Salary</td>
<td>640</td>
<td>767</td>
<td>591</td>
<td>438</td>
<td>408</td>
<td>323</td>
<td>340</td>
</tr>
<tr>
<td></td>
<td>(375)</td>
<td>(398)</td>
<td>(320)</td>
<td>(197)</td>
<td>(190)</td>
<td>(141)</td>
<td>(217)</td>
</tr>
<tr>
<td>Total</td>
<td>2682</td>
<td>4199</td>
<td>4055</td>
<td>2587</td>
<td>2311</td>
<td>1598</td>
<td>1867</td>
</tr>
<tr>
<td>Compensation</td>
<td>(18229)</td>
<td>(20198)</td>
<td>(14892)</td>
<td>(8536)</td>
<td>(7319)</td>
<td>(5539)</td>
<td>(663)</td>
</tr>
</tbody>
</table>
Labor Supply:
- Risk averse managers choose: Job, Firm, Effort
  - Managers are heterogenous: taste, productivity
- Heterogeneity of Jobs-firms: human capital, non-pecuniary benefits
  - Different career paths (compensation)

Labor Demand:
- Demand for effort, skills in a job, and fixed hierarchy
  - Exogenous: don’t model optimal skill compositions in a firm (work in progress)

Equilibrium
- Moral Hazard-incentives contracts
- Clear market
- Job and Firm turnover
  - Human capital (firm and general skills)
  - Demand for skills and hierarchy - only one CEO position
Manager chooses job $k$ in firm $j$ be setting indicator variable $d_{jkt} = 1$, and chooses an effort level $l_t \in \{0, 1\}$. Retirement is also possible, by setting $d_{0kt} = 1$.

$$\sum_{j=0}^{J} \sum_{k=1}^{K} d_{jkt} = 1$$

**Human Capital, private information:**

- **firm specific human capital:**
  
  $$h_{jt} = \sum_{k=1}^{K} \sum_{s=1}^{t} d_{j,k,t-s} l_{t-s}$$

- **General human capital:**
  
  $$h_{0t} = \sum_{j=1}^{J} h_{jt}$$
Managers get utility from current consumption $c_t$.
Managers have absolute risk aversion parameter $\rho$.
Jobs, firms, and effort level give nonpecuniary utility though the functions $\alpha_{0jmkt}$ (shirking) and $\alpha_{1jmkt}$ (working):

$$\alpha_{0jmkt} < \alpha_{1jmkt}$$

An i.i.d. firm-job privately observed taste shock $\varepsilon_{jkt}$ also affects utility.
Managers face life-time budget constraint for goods and services, consumption smoothing for publicly disclosed events.
Individual characteristics on age, education, gender, stock of human capital, all captured in $z_t$. 

Excess return $x_{jt}$ of $j^{th}$ firm attributed to all its executive management:

- This residual is not priced by (purged of) its aggregate factors
- It is the relevant measure for compensation and incentives

p.d.f. of excess return depends on each executive’s effort and human capital:

- $f_j(x|z_{jt})$ high effort by all managers
- $f_{jk}(x|z_{jt})$ only executive in rank $k$ shirks
- $g_{jk}(x,z) \equiv f_{jk}(x|z_{jt}) / f_j(x|z_{jt})$ likelihood ratio

Firms maximize expected value, by minimizing expected cost of achieving HR goals.
Executives know their $z$ and privately observe realizations of $\epsilon_{jkt}$.
Demand for positions $P_{jkt}(z)$ and effort level $L_{jkt}$ revealed to firms.
Firms offer contracts, $w_{jkt+1}$.
Executives choose contracts, $d_{jkt}$.
Executives choose effort, $l_t$.
Hence the positions are filled with probability $p_{jkt}(z)$.
Expectations by firms and managers are rational, meaning $(p_{jkt}(z), l_t) = (P_{jkt}(z), L_{jkt})$. 
Optimization by executives
Job, firm and effort choice

- Let $e_t$ denote the value of assets in $t$, $b_t$ denote the bond price in $t$, $a_t$ denote security

$$v_{jk,t+1}(z, x) \equiv \exp \left[ -\rho w_{jk,t+1}(z, x) / b_{t+1} \right]$$

- The conditional value function is:

$$V_{jklt}(z_t, \varepsilon_{jkt}^*) = - \left\{ \alpha_{jkl}^{1/b_t} \left[ A_{s-1} \left( z_{t+1}^{(j,k,l)} \right) E[v_{jk,t+1}|z_t, l_t] \right]^{1-1/b_t} \right\} \times \exp \left( -\frac{\varepsilon_{jkt}^*}{b_t} \right) b_t \exp \left( -\frac{a_t + \rho e_t}{b_t} \right)$$

- Set $A_0(z_t) \equiv 1$ and recursively define $A_s(z_t)$

$$\sum_{(j,k,l)} p_{jkl}(z_t) \alpha_{jkl}^{1/b_t} E \left[ e^{-\varepsilon_{jkt}^*/b_t} | z_t \right] \left[ A_{s-1} \left( z_{t+1}^{(j,k,l)} \right) E[v_{jk,t+1}|z_t, l_t] \right]^{1-1/b_t}$$

- $A_s(z_t)$ is a normalized value function for the consumption smoothing problem reflecting wealth from future lotteries
If $\varepsilon_{jkt}$ is standard Type 1 extreme value, the choice probability is:

$$p_{jkl} (z_t) =$$

$$\frac{\alpha_{jkl} \left[ A_{s-1} \left( z_{t+1}^{(j,k,l)} \right) \right]^{(b_t-1)} \left\{ E\left[ v_{jk,t+1} | z_t, l_t \right] \right\}^{(b_t-1)}}{1 + \sum_{j', k'} \alpha_{j'k'l'} \left[ A_{s-1} \left( z_{t+1}^{(j',k',l')} \right) \right]^{(b_t-1)} \left\{ E\left[ v_{j'k',t+1} | z_t, l' \right] \right\}^{(b_t-1)}}$$
Cost Minimizing Contract
Incentive compatible contracts to correct moral hazard

- If human capital is private information then the incentive compatibility constraint is:

\[
E[v_{jk,t+1}(x) g_{jk}(x, z_t) | z_t] \leq \frac{\alpha_{1jkt}}{\alpha_{0jk0t}} b_{t-1}^{1} \frac{A_{s-1,t+1}^{(j,k,1)}}{A_{s-1,t+1}^{(j,k,0)}} E[v_{jk,t+1}(x) | z_t]
\]

- In the private information case, career concerns (may) help to offset current benefits from shirking because human capital accumulation depends on effort, not just on participation.
Outside Market

- In equilibrium $P_{jk}(z_t) = p_{jkl_t}(z_t)$
- Participation constraint: pick $v_{jk,t+1}^*$ to satisfy

$$
\alpha_{jkl_t} \left[ A_{s-1} \left( z_{t+1}^{(j,k,l_t)} \right) \right]^{(b_t-1)} \left\{ E[v_{jk,t+1}^* | z_t, l_t] \right\}^{(b_t-1)} \left( \frac{1 - P_{jk}(z)}{P_{jk}(z)} \right) =

\left( 1 + \sum_{j' \neq j, k' \neq k} \alpha_{j'k'l'} \left[ A_{s-1} \left( z_{t+1}^{(j',k',l')} \right) \right]^{(b_t-1)} \left\{ E[v_{j'k',t+1}^* | z_t, l'] \right\}^{(b_t-1)} \right)
$$

- Compensation is smaller the greater the value in the firm relative to the market
- Tenure may have negative effect, general skills, positive effect
Equilibrium

- **Supply:**
  - Executives: given the IC constraint and off-equilibrium contracts
    - Choice probabilities are optimal (check for single deviation)
    - If deviate, same contracts, lower productivity and higher costs

- **Demand:**
  - Optimal probability of hiring by type is exogenous
  - Firms’ contracts, given executives strategies and "market" contracts are optimal
  - Beliefs are correct (on the equilibrium path)
    - All executives work diligently

\[ P_{jkt}(z) = p_{jkt}(z) \]
- Assume $\varepsilon_{mk}$ iid extreme value Type 1 (analytical tractability)
- Regularity condition: For $x \geq \bar{x}$, $g_{m2k}(x|.) = 0$
- Parameters:
  1. Taste: $\alpha_{1mk}, \alpha_{2mk}, \rho, \alpha_0 = 1 \ (2JK + 1)$,
  2. Abnormal returns distributions: $g_{jk}(x|z), f_j(x|z), f_{jk}(x|z)$
- Multi-step estimation
Identification and Estimation

Overview

Estimation proceeds sequentially in six steps. Estimate:

1. $f_j(x|z)$ nonparametrically from data on abnormal returns
2. $w_{jk}^0(x, z)$ nonparametrically from data on compensation and abnormal returns
3. $P_{jk}(z)$ from data on executive choices
4. $\rho$ and $\alpha_{1jk}(z)$ from market participation equation
5. $\alpha_{0jk}(z)$ from incentive compatibility condition
6. $g_{jk}(x|z)$ from compensation equation
Identification and Estimation:

1. Taste for diligent work $\alpha_{1jk}$, risk aversion $\rho$

2. Exploit market participation equation

$$E_t \left[ \frac{1}{A_{s-1}(z_{t+1})} \left( \frac{U_{jk}(z)}{\alpha_{1jk}} \right)^{1/(b_t-1)} - v_{j,k,t+1}(x,z) \right] = 0$$

$$U_{jk}(z)^{(b_t-1)} \equiv \left( \frac{P_{jkt}(z)}{1 - P_{jkt}(z)} \right) \times \left( 1 + \sum_{j'k'} \alpha_{1,j'k'} A_{s-1}(z_{t+1})^{(b_t-1)} \right) \left( b_t-1 \right)$$
Equilibrium choice probabilities $P_{jk}(z)$

We estimated annual excess returns

Nonparametrically identify $w_{1jk}(x, z)$

Instruments: age, tenure, experience affect transitions and compensation, but not taste

$\rho$: choice of lotteries (jobs)
Identification and Estimation

- $f_j(x|z)$ can be estimated from the data
- Using $\rho$ and wage function $w_{1jk}^o(x, z)$ we identify

$$g_{jk}(x|z) = \frac{v_{k,j,t+1}^{-1}(\bar{x}, z) - v_{k,j,t+1}^{-1}(x, z)}{v_{k,j,t+1}^{-1}(\bar{x}, z) - E_t[v_{k,j,t+1}^{-1}(x, z)|z]}$$

- $g_{jk}(x|z)$ is identified of relative slope of wage compensation schedule
- Taste for shirking $\alpha_{0jk}$, IC constraint for each job

$$\frac{\alpha_{0jk}}{\alpha_{1jk}} = \left[ \frac{A_{s-1}\left(z^{(1,j,k)}\right)}{A_{s-1}\left(z^{(0,j,k)}\right)} \right]^{1-b_t}$$

$$\left[ \frac{v_{k,j,t+1}^{-1}(\bar{x}, z) \cdot E[v_{j,k,t+1}(x, z) | l = 1]^{-1} - 1}{v_{j,k,t+1}^{-1}(\bar{x}, z) - E_t[v_{k,j,t+1}^{-1}(x, z)|z]} \right]^{1-b_t}$$
The most important explanatory factor is the firm’s excess return
Incentives and moral hazard are important
Higher ranks, more sensitive to excess returns
  - Career concerns
    - age and tenure
  - Span of control
    - Larger firms (assets and employees)

Jobs–high ranks pay more:
  - human capital, non pecuniary benefit, income volatility
One measure of how important a position is to the firm is how much the firm’s value would fall if its occupant shirked.

The expected gross loss from executive $k$ with characteristics $z$ in firm $j$ shirking is:

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

$$= E \left[ x \left| diligent \right. \right] - E \left[ x \left| shirk \right. \right]$$

$$= -E \left[ x g_{jk}(x, z) \right]$$
Human Capital versus Moral Hazard
Estimated span of control and dispersion across firms

<table>
<thead>
<tr>
<th>Measure</th>
<th>Rank</th>
<th>Estimates</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho$</td>
<td>0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\tau_1$</td>
<td>1</td>
<td>5.2</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10.9</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>8.3</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>4.2</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1.6</td>
<td>1.2</td>
</tr>
</tbody>
</table>

- The estimate of the risk aversion parameter implies a manager would pay up to $217,780 to insure himself against a fair bet of losing versus winning one million dollars.
- Span of control is highest at rank 2, 11 percent per year.
Human Capital versus Moral Hazard
Compensating differential for diligent work versus shirking

- From the optimal contract, manager’s reservation wage to shirk:

\[ w_{0jk}(z) = \frac{b_{t+1}}{\rho} \log(A_{s-1}(z_{t+1}^{j,k,0})) + \frac{b_{t+1}}{\rho(b_t - 1)} \log(\alpha_{0jk} / U_{jk}(z)) \]

- Manager’s reservation certainty equivalent wage for diligent work:

\[ w_{1jk}(z) = \frac{b_{t+1}}{\rho} \log(A_{s-1}(z_{t+1}^{j,k,1})) + \frac{b_{t+1}}{\rho(b_t - 1)} \log(\alpha_{1jk} / U_{jk}(z)) \]

- Differential between shirking and working diligently:

\[ \tau_{2jk}(z) \equiv w_{1jk}(z) - w_{0jk}(z) = \frac{b_{t+1}}{\rho} \log \left( \frac{A_{s-1}(z_{t+1}^{j,k,1})}{A_{s-1}(z_{t+1}^{j,k,0})} \right) + \frac{b_{t+1}}{\rho(b_t - 1)} \log \left( \frac{\alpha_{1jk}}{\alpha_{0jk}} \right) \]
In a static moral hazard model the compensating differential is

$$\tau_{2jk}^{PM} \equiv \frac{b_{t+1}}{\rho (b_t - 1)} \log \left( \frac{\alpha_{1jk}}{\alpha_{0jk}} \right)$$

Defining $\tau_{2jk}^H(z)$ as the amount which career concerns abate the moral hazard problem

$$\tau_{2jk}^H(z) \equiv \tau_{2jk}(z) - \tau_{2jk}^{PM}$$

$$= \frac{b_{t+1}}{\rho} \log \left[ \frac{A_{s-1} \left( z_{t+1}^{j,k,1} \right)}{A_{s-1} \left( z_{t+1}^{j,k,0} \right)} \right]$$
Human Capital versus Moral Hazard

Estimates of the compensating differential

<table>
<thead>
<tr>
<th>Measure</th>
<th>Rank</th>
<th>Estimates</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau^H_2$ and $\tau^{PM}_2$ is measured in $$US100,000$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measure Rank Estimates Standard Deviation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\tau^H_2$</td>
<td>1</td>
<td>4.0</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>9.0</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>11.8</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>16.4</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>18.8</td>
<td>2.2</td>
</tr>
<tr>
<td>$\tau^{PM}_2$</td>
<td>1</td>
<td>18.6</td>
<td>34.7</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>24.8</td>
<td>56.6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>8.3</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>2.5</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.9</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Firms pay the difference between expected compensation and its certainty equivalent to resolve moral hazard:

\[
\tau_{3jk} = E \left[ w_{jk} (x) \mid z \right] - w_{1jk}^0 (z) \\
= E \left[ w_{jk} (x) \mid z \right] - \frac{b_{t+1}}{\rho} \log (A_{s-1} (z_{t+1}^{j,k,1})) \\
- \frac{b_{t+1}}{\rho (b_t - 1)} \log \left[ \frac{\alpha_{1jk}}{U_{jk} (z)} \right]
\]

If there were no career concerns, the additional cost of moral hazard to the firm would be

\[
\tau_{4jk} (z) \equiv \frac{b_{t+1}}{\rho} \log (A_{s-1} (z_{t+1}^{j,k,1}))
\]
## Human Capital versus Moral Hazard

### Estimating the welfare cost

$\tau_3$ and $\tau_4$ are measured in US100,000 of dollars

<table>
<thead>
<tr>
<th>Measure</th>
<th>Rank</th>
<th>Estimates</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_3$</td>
<td>1</td>
<td>17.3</td>
<td>34.0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>32.5</td>
<td>45.6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>16.03</td>
<td>24.8</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1.2</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.8</td>
<td>1.3</td>
</tr>
<tr>
<td>$\tau_4$</td>
<td>1</td>
<td>0.5</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2.6</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>12.0</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>14.0</td>
<td>18.9</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>18.2</td>
<td>22.7</td>
</tr>
</tbody>
</table>
What are executives paid for? productivity, human capital, risk

- Productivity-Span of control is substantially larger in higher ranks (11% for CEOs)
  - CEO can drive the value of firm equity down to less than half its current value in 8 years
  - 1.6% in lower ranks

- Cost of moral hazard (income volatility) is 1/4 in low ranks compared to CEOs

- Human capital and career concerns: twice as large in lower levels than for CEOs