The Role of Luck in the Career Path of CEOs and Directors

Amir Barnea[1]

This version: August 15, 2016

Abstract

This paper argues that in a market where asymmetric information is present, it is possible to mask one's set of skills for a relatively long period, and in some cases even an entire career. Specifically, we investigate the executive market and analyse the career paths of individual directors as well as CEOs who constantly seek additional appointments. Using simulations calibrated with parameters based on real data, we show that it is possible for (lucky) directors whose set of skills is at the lowest septile of the population, to stick to their positions as directors for a career that can be as long as 40 years. Similarly, CEOs with poor credentials can continue to run their firms for as long as 20 consecutive years, without being identified by the market as low-ability CEOs. The paper emphasizes the role of luck in one's career as well as the limitations of an efficient allocation in the presence of asymmetric information.

1. Introduction

[1] Finance Department, HEC Montréal, Canada. 3000 Chemin de la Côte-Sainte-Catherine, Montreal, QC H3T 2A7. Email: amir.barnea@hec.ca

Why do people make it to the top? What are the factors that influence a career path? In the corporate world, one would imagine that individuals are promoted based on their skills and the relevance of these skills-sets to the organization in which they work for. Additional considerations such as personal characteristics (age, gender, education, etc.) and internal politics are also important to the evolution of one's career but at the same time, luck can also play a role. This paper argues that in a market where asymmetric information is present, being in the right place at the right time (or alternatively in the wrong place at the wrong time…) can have crucial consequences on the evolution of careers. Put differently, we show that it is possible to mask one's qualities for a relatively long period, and in some cases even an entire career simply due to luck.

The research literature has explored mostly the role of luck in executive compensation. For example, Bebchuk, Grinstein and Peyer (2010) find that CEOs and directors receive so called "lucky grants" - defined as options grants given at the lowest price of the month. They estimate that about 1,150 lucky grants resulted from opportunistic timing, and that 12% of firms provided one or more lucky grant due to opportunistic timing during the period 1996-2005. Yermack (2004) studies incentives received by outside directors in Fortune 500 firms from compensation, replacement, and the opportunity to obtain other directorships. He shows that these incentive mechanisms provide directors with wealth increases of approximately 11 cents per $1,000 rise in firm value. Hoffmann and Pfeil (2010) study a continuous time principal-agent problem of a firm whose cash flows are determined by the manager's unobserved effort. In their model, the firm's cash flows are further subject to persistent and publicly observable shocks that are beyond the manager's control. While standard contracting models predict that compensation should optimally filter out these shocks, empirical evidence suggests otherwise. In line with this evidence, their model predicts that the manager is "rewarded for luck". Lastly, Cremers and Grinstein (2013) examine the extent to which variation in the market for CEO talent explain pay practices such as benchmarking, pay for luck, and large compensation packages. They find that CEO compensation is benchmarked against other firms only in industries where CEO talent is not firm specific, and that pay for luck is more prevalent there also. These findings are consistent with theories based on the market for CEO talent. However, CEO compensation levels do not depend on whether CEO talent is firm specific, which seems inconsistent with the talent competition argument.

Complementing the above papers, this paper focuses on the role of luck in keeping one's position and gaining additional positions. We investigate the executive market and analyse the career paths of individual directors as well as CEOs. The paper theoretically explores using simulations the evolution of board director networks, focusing on the role of luck in one's career. The paper aims to answer whether simply due to luck, a relatively unskilful director could become a major player in the network of directors, holding multiple board seats. Or alternatively, can a highly qualified director, who sat at the wrong board at the wrong time, effectively be eliminated from the pool of potential candidates to hold additional positions as a board member.

We consider an asymmetric information setting, in which directors and CEOs know their true "type" or skill, but the market doesn't. The market receives noisy signals with respect to the quality of each director, by observing the realized stock returns for different firms. Assuming that all firms operate competitively, this stock return is a weighted average function of the true "values" of individuals who sit on the firm's board (including the CEO) as well as **luck**. Each time a signal is received, the "market value" of individual directors and the CEO is updated. This market value will later be used by firms to assess the perceived quality of directors, and help them choose individuals when they need to make changes to their boards.

When the annual stock return for a given firm is especially low, the firm may want to make changes to its board, for example by replacing a few directors or firing the CEO. Firms would offer positions to the most suitable directors available as ranked by their market value. Directors are always eager to accept new positions, until they have reached their maximum capacity. Directors are aware of the fact that they are approached by firms to fill a vacant board seat purely based on their perceived market value (since their "true" value isn't observable). When a director is offered a board seat, she will accept the offer irrespective of her private knowledge about her true qualifications. That is, in some cases individuals know that they are not qualified for the job, but will accept the position nevertheless, hoping that other directors as well as the CEO will mask their poor natural skill, or simply hoping that luck will generate positive returns that would make investors happy.

The paper focuses on the role of luck in the career path of directors, and the properties of the network in the long run in the presence of asymmetric information. It'll try to answer interesting questions such as the following: are the most successful directors in the network the most skilful ones? What is the impact of a few positive (negative) shocks on the firms return, on the career path of directors? Can a highly qualified director effectively leave the network (loose all appointments) due to a few negative shocks? Can a director with poor qualifications end up as a highly connected director simply due to luck? For how long can this last?

2. The Model

There are n firms in the economy. Each company has a CEO and x directors who sit jointly on the board. Overall, there is a pool of $\bar{J}$ individuals who compete for positions on firms' boards as well as CEO positions. Directors wish to maximize the number of board seats they have up to a limit of $\hat{J}$ positions. Individuals have a preference to sit on boards of larger firms, that is, if at given period they will have multiple offers to join boards, they will accept first the offer that comes from the largest firm in the network. Directors can accept only one board seat every period. Directors are also eager to become CEO of firms. If an individual receives an offer to serve as a CEO of some firm, she will accept it unless she already serves as the CEO of some other company in the network.

Individuals' qualities are heterogeneous; that is, their "type" or skill set is a random variable, normally distributed with a mean of μ_d and standard deviation of σ_d. CEOs are chosen from the same pool of directors. They have similar characteristics; again, having a true value drawn from a normal distribution with a mean of μ_d and standard deviation of σ_d. CEOs can serve as directors in up to $\hat{J}$ additional firms. CEOs may be fired when the realized stock return for a given firm in a given year is lower than some threshold (for example, -35%.) Firms wish to appoint highly skilled directors and CEOs based on their perceived market value. Firm value changes from one period to another as a function of the quality of the CEO, the quality of its directors, and luck (noise).

More formally, the mechanism of the model goes as follows. All n firms in the economy start with a market value of $V_0^i = \$\mu_f$ $(i = 1 \dots n)$ at period $t = 0$. At the same period, x directors and one CEO are assigned randomly to each firm. By nature, their quality varies. While directors know their true type (quality), the market doesn't. Ex-ante, the market assigns a value of $V_0^j = \mu_d$ $(j = 1 \dots \bar{J})$ to each one of the $\bar{J}$ potential directors and CEOs in the network. The market knows the distribution from which individuals are drawn, but not the specific value of each director.

Since there are n CEO positions and $n \times x$ director positions available, it is possible that some individuals would be appointed to more than one board by the end of the first period.

This is a dynamic model and as we move one period forward, firm value changes as a function of the true quality of the CEO, the true qualities of its directors, and luck. Specifically, we compute r_t^i, the rate of return for company i, in period t, in the following way:

$$r_t^i = \frac{\alpha\left[\text{average}_{j \in s^i}\left(q_j\right) - 100\right] + (1-\alpha)\{[q(c_i)] - 100\}}{100} + \varepsilon_i$$

where q_j is the (**true**) quality of director j, s^i is the set of directors who sit on the board of firm i, and c_i is the CEO of firm i. The random shock (luck) is ε and it is drawn from the following $i.i.d.$ distribution: $\varepsilon_i \sim N\left(0, \sigma_f^2\right)$. In addition, we set $0 \leq \alpha \leq 1$ to account for the relative importance of the inputs of the CEO vs. the directors in firm's realized return.

Once firms' returns are obtained, firms' values are updated in the following way:

$$V_t^i = V_{t-1}^i \times \left(1 + r_t^i\right)$$

where V_t^i is the value of firm i at time t.

When a signal (firm's realized stock return) is received, the market perception with respect to each director's quality as well as the CEO is updated. Each director's new market value is updated based on the following formula:

$$V_t^j = \begin{cases} V_{t-1}^j + ln\left[1 + \frac{\sigma_d}{2} \times average\left(r_t^i\right)\right], & \text{If average}_{i \in k}\left(r_t^i\right) \geq 0 \\ V_{t-1}^j - ln\left[1 + \frac{\sigma_d}{2} \times \left|average\left(r_t^i\right)\right|\right], & \text{If average}_{i \in k}\left(r_t^i\right) < 0 \end{cases}$$

where V_t^j is the market value of director $j, (j = 1 \ldots \bar{J})$ at time t, r_t^i is defined above, and average$\left(r_t^i\right)$ is the average return of the k firms in which director j was serving as a board member.

In cases in which a director also serves as a CEO, the update is done in the following way:

$$V_t^{c_i} = \begin{cases} V_{t-1}^{c_i} + ln\left[1 + \frac{\sigma_d}{2} \times \left(\frac{\sum_{k=1}^{n}\left(r_t^k\right) + \beta \times r_t^i}{n + \beta}\right)\right], & \text{If } \sum_{k=1}^{n}\left(r_t^k\right) + \beta \times r_t^i \geq 0 \\ V_{t-1}^{c_i} - ln\left[1 + \frac{\sigma_d}{2} \times \left|\left(\frac{\sum_{k=1}^{n}\left(r_t^k\right) + \beta \times r_t^i}{n + \beta}\right)\right|\right], & \text{If } \sum_{k=1}^{n}\left(r_t^k\right) + \beta \times r_t^i < 0 \end{cases}$$

where n is the number of additional firms that the CEO sits on their board, and $\beta > 1$. Hence, after the realized returns for each company have been obtained, the market will update the perceived market values for the entire pool of individuals in the network.

Occasionally, CEOs and directors will leave the network (retire, die, etc.). This will happen with a pre-specified probability of $d\%$ (for example, 1%) every period. Whenever an individual director leaves the network, a new director will be introduced to the network pool such that the number of candidates in the pool, $\bar{J}$, remains constant. The quality of the new director will be drawn again from the same distribution of qualities, and her market value will be set to μ_d initially. Then, a list of directors who are available to obtain an additional seat will be composed, sorted by their market values. In most cases, the departure of a director will be followed by an appointment of one of the current (old) directors to the vacant post. Newly introduced directors, will typically have to wait a few periods before starting to accumulate seats as there will probably be some candidates who haven't reached their seat capacity, $\hat{J}$, and have perceived market values greater than μ_d. But at some point, it is possible that μ_d will be at the top of the list, and individuals who are new to the network will start accumulating positions.

Changes to the firms' boards will occur also in periods in which firm value goes down significantly. Then, the firm would like to take action and replace a few of its directors. In some more extreme cases, when firm value goes down even further, the firm would like to replace more directors and in addition to fire the CEO. We define $\bar{r}_1$ as the first threshold that will trigger changes on the firm's board (for example, a negative return of 20%) and $\bar{r}_2$ as the second threshold (for example, a negative return of 35%) that will trigger more changes on the board as well as the replacement of the CEO. In sum, firms will use the following guidelines to make changes to their boards each period based on realized returns:

$$\begin{cases} \text{Make no changes on the board,} & \text{If } r_t^i \geq \bar{r}_1 \\ \text{Replace } \bar{x}_1 \text{ directors, keep CEO ,} & \text{If } \bar{r}_2 \leq r_t^i < \bar{r}_1 \\ \text{Replace } \bar{x}_2 \text{ directors, fire CEO ,} & \text{If } r_t^i < \bar{r}_2 \end{cases}$$

In order to decide which directors will be replaced, the firm will use the perceived market values, and will replace those directors on its board who have the lowest market value. In cases in which two directors will have the exact same market value, one will be chosen randomly. Once directors were chosen by the firm to be dismissed, the firm will need to offer the vacant positions to new directors. The firm will use a similar process when a director retires – it would search for the best director available based on the perceived market values. Firms will offer directors to join their boards, and directors will accept or reject offers based on their availability and the following set of rules:

- CEO positions are more attractive and therefore offered first before directorship positions.
- The first right of choice will be given to the largest firm in the network who needs to replace its CEO.
- This position will be offered to the director with the highest perceived market value in the network.
- This director will accept the position if she isn't serving as the CEO of some other company.
- Then, the right of choice will be given to the second largest company who needs to replace its CEO.
- Once all CEO positions were filled, firms will start hiring directors.
- Again, the first right of choice will be given to the largest firm in the network who needs to replace some of its directors.
- This position will be offered to the director with the highest perceived market value in the network.
- The director will accept the position if she didn't reach her capacity of the maximum number of seats an individual director can have of $\hat{\jmath}$ (for example, 5 board seats).
- Directors can accept only one additional seat every period.
- The process repeats itself until all requests for new directorships are fulfilled in a given year.

3. Calibration of the model and results

We calibrate our model using reasonable market-driven parameters for each one of the variables. n, the total number of firms in the economy is set to 500 to represent the S&P 500 index. x, the number of directors on each board is set to 10, similarly to the median of S&P 500 firms.[2] $\bar{J}$, the size of the director pool network – the total number of individuals seeking positions as directors and as CEOs is set to 2,500 which is comparable with the number of unique directors serving on S&P 500 firms. The maximum number of board seats that a director can hold, $\hat{J}$, is set to five. This is reasonable as with the tightening of corporate governance rules, there are very few examples these days for directors who have more than five positions. Moreover, with an estimated workload of 300 hours a year, 60% of the firms in the S&P 500 have established a numerical limit for other board service for all directors; of those, 5% cap additional directorships at two, 73% cap additional directorships at three or four, 21% at five and 1% at six. None limits other directorships to one. This is an improvement in corporate governance policies over previous years. For example in 2008, 56% of boards had limits on other directorships, and only 27% had them in 2006.[3] d, the probability of an individual to leave the network each period is set to 1%. This probability applies to all directors in the network independent of their position and tenure. It can be interpreted as retirement or death. Based on the most recent Board Index 2013 report by Spencer Stuart, the average director age for S&P 500 firms is 62.9 years. The average CEO age is 56.7 years. Hence a positive departure rate seems reasonable. $\bar{r}_1$ and $\bar{r}_2$ are the first and second return thresholds that trigger firms to make changes to their boards. They are set to minus 20% and minus 35%, respectively. $\bar{x}_1$, the number of directors that will be replaced

[2] See Steven Hall & Partners publication: "2013 S&P 500 Total Board Cost Study"

[3] See Spencer Stuart publication: "Spencer Stuart Board Index 2013"

if $\bar{r}_2 \le r_t^i < \bar{r}_1$ is set to 2, and $\bar{x}_2$, the number of directors that will be replaced if $r_t^i < \bar{r}_2$ is set to 3. Note that these days 91% of S&P 500 firms have a term limit of one year, hence replacing a director from one year to another is feasible. μ_f, firms' initial market value is set to \$100 at $t = 0$ for convenience. Similarly, μ_d, directors' initial perceived market value is set to 100 for convenience. μ_d and σ_d the mean and standard deviation of directors' true value are set to 100 and 18, respectively. σ_f, the standard deviation of the luck (error) term in the firm's return (ε_i) is set to 25%, where $\varepsilon_i \sim N(0, \sigma_f^2)$. α is set to $\frac{1}{2}$; $(1 - \alpha)$ is the weight assigned to the quality of the CEO in calculating the overall return in a given year, where α is the weight assigned to the average qualities of all other directors who sit on the firm's board. β, the weight assigned to the return of the company in which an individual serves as a CEO in calculating the overall change in perceived market value for an individual is set to 1.5. That is, in calculating the perceived market value of an individual who serves as a CEO as well as a director, since $\beta > 1$, a larger weight is given to the return of the firm in which she serves as CEO than to other firms in which she serves as a director. Lastly, T, the total number of periods in our model is set to 40. Table 1 summarizes the different variables and market-driven parameters that we use to calibrate the model.

[Insert Table 1 about here]

After explaining how we calibrate the model, we can proceed with presenting the results. We start by presenting how the initial cohort evolves in our dynamic model. Table 2 shows the total number of director positions held by seven different septiles sorted by the true values of directors. Recall that there are 500 firms in the economy, and 10 director positions for each firm. Hence, there are 5,000 director positions to be filled in the first period. Since the pool of candidates consists of 2,500 unique individuals, and these candidates are assigned randomly to each firm's board, on average, individuals from each septile will hold two positions each. Looking at the allocation as of period 0, this is indeed the case. In absolute numbers, the vast majority of the positions are held by the fourth septile due to the normal distribution. About 230 positions are held each by the seventh septile (the most talented) and the first septile (the least talented). Note that in Table 2 we follow only the initial cohort of directors. As time progress, these individuals will be subject to occasional firing by the firms they work for, as well as a natural departure rate of 1% a year. Observing the numbers in the table, there is clear positive correlation between the quality of the septile, and the likelihood to keep your position. Out of 233 director seats initially held by the seventh septile (the most talented directors), 96 (41%) were still held after twenty periods, and 68 after 40 periods (29%). On the other hand out of 228 director seats held by the first septile (the least talented directors), only 38 (16%) were still held after twenty periods, and only 9 after 40 periods (4%). Clearly, the market learns and updates its perception with respect to each director, and those of lower quality are less likely to stick to their positions.

While the lowest septile held on average only 9 positions after 40 periods, one can also view this as a remarkable achievement. Even though these directors are of lowest ability group, more than 2 standard deviations below the average, 9 of them managed to mask their true low quality for 40 full periods! The fact that they managed to stick to their positions is simply due to luck. It is either that by chance, the other nine directors and

CEO on the board had an above average ability that compensated for the not-so-talented director and / or, ε_i, was never too negative to trigger the replacements of many directors on the board.

[Insert Table 2 about here]

Table 3 complements by showing the total number of CEO positions held by seven different septiles sorted by the true values of directors of the original cohort. Again, this is simply the track record of the original 500 CEOs that were appointed at the end of the first period. Similarly to the results presented in Table 2, we find a high positive correlation between the CEO ability type, and the likelihood to keep the position for a longer period. Out of 23 CEO positions initially held by the seventh septile (the most talented directors), 13.2 (57%) were still held after twenty periods, and 8 after 40 periods (35%). On the other hand out of 24 CEO positions held by the first septile (the least talented directors), none were still held after twenty periods. As the model would have predicted, it is harder to mask your type when you are the CEO compared to when you hold a director position. Nevertheless, the fact that at least one CEO from the worst septile was able to keep her position for 19 periods as the table suggests, is impressive – luck has an important role.

[Insert Table 3 about here]

We now move to describe the richer dynamic model that tracks not only the original cohort of CEOs and directors that were assigned in the first period, but also the evolution of one's career in the network as well as the introduction of new members. Figure 1 plots the average number of director seats held by each septile classified by true value of directors over 40 periods across 100 simulations. Again, the starting point at the first period is that directors in each septile hold on average 2 seats, since there are 5,000 director positions available (500 firms times 10 directors in each firm) and 2,500 available candidates. As time progresses, signals are received by the market, and in return, the market updates its perception with respect to directors' true qualities. Slowly, directors with higher ability start accumulating additional positions, and directors of lower ability start losing them. There is a clear positive correlation between the septile skill level, and the accumulation of board seats. For example, after 10 periods, the average number of seats held by the seventh septile (the most talented) increases to about 2.75 seats, whereas, the average number of seats held by the first septile (the least talented) falls to about 1.6 seats. After 35 periods, the gap between septiles widens further. The average number of seats held by the seventh septile is around three and a half seats, whereas, the average number of seats held by the first septile falls to close to one and a half seats.

Note that by period 35, as reflected by the average number of positions held by each septile, many of the directors of the seventh septile who managed to stay active in the network, are approaching their full capacity of five directors seats. In addition, the majority of them are also serving as CEOs. The reason for that is that these directors' outstanding qualities contributed significantly to firms' return and in turn this signal was attributed to the directors when the market updated their perceived market value. Once some of them became CEOs, as long as they could avoid a very negative shock, the narrowing of the asymmetric information gap was accelerated further, and these individuals were marked as "star directors".

[Insert Figure 1 about here]

Figure 2 plots the average number of CEOs held by each septile classified by the true value of directors over 40 periods across 100 simulations. We find a similar pattern in Figure 2. The starting point at the first period is that directors in each septile hold on average 0.2 CEO positions, since there are 500 CEO positions available (for 500 firms) and 2,500 available candidates. The process of revealing the asymmetric information is accelerated when it comes to CEOs, especially bad ones. Recall that the annual stock return formula for a given firm in a given year, r_t^i, is a function of the true quality of the CEO, the average quality of the set of 10 directors and a random luck component. We calibrate the weight assigned to the importance of the CEO ability, α, to equal one half. That is, CEO ability is as important as the average ability of the 10 directors sitting on the board jointly with the CEO. Therefore, when a low-ability CEO is appointed, on average, the market is going to learn that fact relatively fast. This is clearly reflected in Figure 2. The average number of CEO positions held by the first septile (the least talented) falls to 0.05 positions from 0.2 positions after 10 periods. At the same time the opposite process occurs on the right side of the distribution. High-ability directors that were not assigned as CEOs during the first period are slowly gaining more attention as the market increases their perceived market value. Then, they are called to replace CEOs who were fired because their firms produced negative returns, or because their firms had an open CEO position due to the retirement or death of the CEO. The average number of CEO positions held by the seventh septile (the most talented) jumps to 0.35 positions from 0.2 positions within 10 periods, to 0.45 within 20 periods, and to 0.5 within 35 periods. This means that half of directors in the top septiles are working as CEOs, an optimistic result.

[Insert Figure 2 about here]

4. Conclusions

Based on Spencer Stuart Board Index 2013 report, firms in the S&P 500 pay an average $249,000 in annual compensation to their directors. With an average board size of 10 directors, this is a significant monetary expenditure. Moreover, the important role that boards have steering the firm and monitoring top management is extremely valuable to corporations, and having the right people on board can make the difference. Based on the same Spencer Stuart report, 38% of new directors that were appointed in 2013 are "first time directors". While firms are investing a lot of resources and seek the help of consulting companies to screen for the best directors, asymmetric information is significant between directors and firms. This paper shows that a few lucky years for a newly appointed director can transform her to a "director superstar", guaranteeing additional appointments in future years. The paper also shows that the opposite can happen. An extremely talented director, who had no luck, either because he sat on the same board with unskilful directors and CEO, or because a few negative random shocks to the company resulted in very negative stock returns, can effectively be eliminated from the pool of directors permanently.

Our model is calibrated with parameters that resemble real life data. There are 500 firms in the economy each has a board of 10 directors and a CEO. The average tenure of directors in our model is 9.8, similar to the average tenure of S&P 500 boards members which stands at 8.6 years in 2013. The average tenure of CEOs in our model is 9.6, a bit higher but close enough to the average tenure of S&P 500 sitting CEOs which stands at 7.2 years in 2013.

The paper shows that on average, as time passes, the market updates effectively information about the true type of individuals and the asymmetric information gap narrows. The network of directors also becomes quite centralized with the majority of the high-ability directors sitting on multiple boards and serving as CEOs. But at the same time, due to the presence of luck, and the fact that on an average board there 10 directors and a CEO, it is possible even for extremely unskilful directors to mask their low abilities for an entire career that can be as long as forty years. The model also predicts that it is possible that a low-ability CEO will continue to run successful company for as many as nineteen years.

In future work we intend to introduce to the model additional factors that are on firms' wish list when they seek new directors. Among these are the director background, age, industry experience and previous experience as a CEO of some other company. We also plan to add to the model positive externalities to being highly connected. That is, once a director holds multiple positions, she may become a better director and her true quality may increase. We will explore how these additional factors interact with the role of luck.

5. References

Bebchuk, Lucian A., Yaniv Grinstein and Urs Peyer, 2010 ,“Lucky CEOs and Lucky Directors,” Journal of Finance, Vol. 65, No. 6, pp. 2363-2401.

Cremers, Martijn, Yaniv Grinstein, 2013, “Does the Market for CEO Talent Explain Controversial CEO Pay Practices?”, Review of Finance *forthcoming.*

Hoffmann, Florian, Sebastian Pfeil, 2010, “Reward for Luck in a Dynamic Agency Model”, Review of Financial Studies, Vol. 23 Issue 9, pp. 3329-3345.

Yermack, David, 2004, “Retention, and Reputation Incentives for Outside Directors”, Journal of Finance, Vol. 59, No. 5, pp. 2281-2308.

Table 1: Definitions of the different variables used in the model, and their market-driven parameters that we use to calibrate the model.

Variable	Definition	Value
n	The total number of firms in the economy	500
x	The number of directors on each board	10
$\bar{J}$	The total number of individuals seeking positions as directors and CEOs	2,500
$\hat{J}$	The maximum number of board seats that a director can hold	5
d	The probability of an individual to leave the network each period	1%
$\bar{r}_1$	The first return threshold that will trigger firms to make changes to their boards	-20%
$\bar{r}_2$	The second return threshold that will trigger firms to make changes to their boards and their CEOs	-35%
$\bar{x}_1$	The number of directors that will be replaced if $\bar{r}_2 \leq r_t^i < \bar{r}_1$	2
$\bar{x}_2$	The number of directors that will be replaced if $r_t^i < \bar{r}_2$	3
μ_f	Firms initial market value at $t = 0$	\$100
μ_d	The mean value of directors' true value and each directors' initial perceived market value	100
σ_d	The standard deviation of directors' true value	18
σ_f	The standard deviation of the luck (error) term in the firm's return	25%
ε_i	The random "luck" component in the company return	$\varepsilon_i \sim N(0, \sigma_f^2)$
α	The weight assigned to the return of the company in which an individual serves as a CEO in calculating the overall return in a given year, where $(1 - \alpha)$ is the weight assigned to the average return of all other firms in which the individual serves as a director	0.5
β	The weight assigned to the return of the company in which an individual serves as a CEO in calculating the overall change in perceived market value for an individual	1.5
T	The total number of periods (years) in our model	40

Table 2: The evolution over 40 periods of the first cohort of directors. The total number of board positions held by each septile sorted by the true values of directors. The numbers represent averages across 100 simulations. Percentages represent the fraction of directors in each septile that mange to keep their job after *n* periods.

Period	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Septile #1	228	210	192	174	158	148	134	125	115	103	93	85	77	71	64	60	54	49	45	42	38
		92%	84%	76%	69%	65%	59%	55%	51%	45%	41%	37%	34%	31%	28%	26%	23%	22%	20%	18%	17%
Septile #2	554	515	479	447	414	381	352	326	298	275	255	233	214	197	180	165	150	140	130	118	112
		93%	86%	81%	75%	69%	64%	59%	54%	50%	46%	42%	39%	36%	33%	30%	27%	25%	23%	21%	20%
Septile #3	1 059	985	917	856	797	741	690	643	593	553	513	478	446	412	380	357	334	312	291	270	251
		93%	87%	81%	75%	70%	65%	61%	56%	52%	48%	45%	42%	39%	36%	34%	32%	29%	28%	25%	24%
Septile #4	1 322	1 239	1 166	1 094	1 024	963	899	841	781	733	690	648	606	573	533	499	472	444	418	391	368
		94%	88%	83%	77%	73%	68%	64%	59%	55%	52%	49%	46%	43%	40%	38%	36%	34%	32%	30%	28%
Septile #5	1 074	1 014	956	901	850	800	747	693	649	604	569	537	508	477	453	428	406	385	366	349	332
		94%	89%	84%	79%	74%	70%	65%	60%	56%	53%	50%	47%	44%	42%	40%	38%	36%	34%	33%	31%
Septile #6	530	498	466	443	419	399	379	360	335	318	300	282	266	254	243	230	221	211	203	193	186
		94%	88%	84%	79%	75%	71%	68%	63%	60%	57%	53%	50%	48%	46%	43%	42%	40%	38%	36%	35%
Septile #7	233	223	212	202	192	180	171	163	151	145	137	131	125	120	116	112	107	104	102	99	96
		96%	91%	87%	82%	77%	73%	70%	65%	62%	59%	56%	53%	51%	50%	48%	46%	45%	44%	42%	41%
Total	5 000	4 684	4 389	4 118	3 855	3 612	3 371	3 150	2 923	2 732	2 557	2 394	2 242	2 104	1 970	1 851	1 744	1 645	1 555	1 462	1 383

Period	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Septile #1	35	33	30	27	26	24	23	21	20	19	18	16	15	14	14	13	12	11	10	9
	15%	14%	13%	12%	11%	10%	10%	9%	9%	8%	8%	7%	7%	6%	6%	6%	5%	5%	4%	4%
Septile #2	105	96	91	85	79	75	71	70	67	63	60	56	53	48	47	45	43	41	39	37
	19%	17%	16%	15%	14%	14%	13%	13%	12%	11%	11%	10%	10%	9%	8%	8%	8%	7%	7%	7%
Septile #3	236	223	209	198	188	179	169	161	153	149	144	138	133	127	122	117	111	109	106	102
	22%	21%	20%	19%	18%	17%	16%	15%	14%	14%	14%	13%	13%	12%	12%	11%	11%	10%	10%	10%
Septile #4	348	332	313	299	286	274	260	251	246	239	230	222	214	203	199	194	190	187	182	175
	26%	25%	24%	23%	22%	21%	20%	19%	19%	18%	17%	17%	16%	15%	15%	15%	14%	14%	14%	13%
Septile #5	319	309	298	288	279	269	259	253	245	239	234	228	223	218	212	207	205	200	196	193
	30%	29%	28%	27%	26%	25%	24%	24%	23%	22%	22%	21%	21%	20%	20%	19%	19%	19%	18%	18%
Septile #6	179	174	168	161	157	151	146	142	140	137	133	131	129	126	125	123	121	121	119	118
	34%	33%	32%	30%	30%	29%	28%	27%	26%	26%	25%	25%	24%	24%	24%	23%	23%	23%	22%	22%
Septile #7	95	94	91	87	85	83	82	81	80	79	78	78	78	77	75	74	73	72	69	68
	41%	40%	39%	37%	36%	36%	35%	35%	34%	34%	33%	33%	33%	33%	32%	32%	31%	31%	30%	29%
Total	1 319	1 261	1 199	1 146	1 099	1 055	1 010	980	951	923	896	870	844	814	795	773	755	740	720	703

Table 3: The evolution over 40 periods of the first cohort of CEOs. The total number of CEO positions held by each septile sorted by the true values of directors. The numbers represent averages across 100 simulations. Percentages represent the fraction of CEOs in each septile that mange to keep their job after *n* periods.

Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Septile #1	24,2	17,6	13,4	9,6	7,4	5,6	4,4	3,2	2,2	1,8	1,6	1,2	1	0,6	0,4	0,2	0,2	0,2	0,2	0,2	0
		73%	55%	40%	31%	23%	18%	13%	9%	7%	7%	5%	4%	2%	2%	1%	1%	1%	1%	1%	0%
Septile #2	55,6	43,8	34	27,8	22,4	18	14,4	10,6	8,8	7,6	5,8	4,6	3,8	3	2,2	2	1,6	1,4	1,4	1,2	1,2
		79%	61%	50%	40%	32%	26%	19%	16%	14%	10%	8%	7%	5%	4%	4%	3%	3%	3%	2%	2%
Septile #3	105,8	88,6	77,8	67	59,6	51	45,4	37,6	33,2	28	25,2	22,4	20,8	19	16,8	14	12,8	10,8	8,6	7,4	6
		84%	74%	63%	56%	48%	43%	36%	31%	26%	24%	21%	20%	18%	16%	13%	12%	10%	8%	7%	6%
Septile #4	127,8	113,4	102	92,8	86,2	79,8	75,2	68,8	62,2	55,8	51,4	47,8	44,2	40,2	36,4	33,4	30,4	28,6	26,4	22,6	19,8
		89%	80%	73%	67%	62%	59%	54%	49%	44%	40%	37%	35%	31%	28%	26%	24%	22%	21%	18%	15%
Septile #5	103,4	98,4	91,6	86	81,2	77,4	71,8	68,6	64	59,2	55,2	53,8	50,6	47,8	46	43	40	38,2	34,8	32,4	30
		95%	89%	83%	79%	75%	69%	66%	62%	57%	53%	52%	49%	46%	44%	42%	39%	37%	34%	31%	29%
Septile #6	60,2	58,6	56,4	54,2	52,2	50,4	48,8	47,6	45,6	43,8	42,2	40	37,8	36,6	35,2	33,8	32,4	31,8	31,8	31,2	30,2
		97%	94%	90%	87%	84%	81%	79%	76%	73%	70%	66%	63%	61%	58%	56%	54%	53%	53%	52%	50%
Septile #7	23	21,4	21	20,2	19,8	19	18,4	18	17,8	16,8	16,4	15,6	14,8	14,6	14,2	14,2	13,8	13,8	13,8	13,2	13,2
		93%	91%	88%	86%	83%	80%	78%	77%	73%	71%	68%	64%	63%	62%	62%	60%	60%	60%	57%	57%
Total	500	441,8	396,2	357,6	328,8	301,2	278,4	254,4	233,8	213	197,8	185,4	173	161,8	151,2	140,6	131,2	124,8	117	108,2	100,4

Period	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Septile #1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Septile #2	1	0,8	0,8	0,6	0,6	0,6	0,6	0,4	0,4	0,4	0,4	0,4	0,4	0,2	0,2	0,2	0,2	0,2	0,2	0,2
	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%
Septile #3	5,6	4,8	4,2	4	3,4	3,2	3	3	2,8	2,8	2,6	2,2	2	2	1,8	1,8	1,8	1,6	1,2	1
	5%	5%	4%	4%	3%	3%	3%	3%	3%	3%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%
Septile #4	17,8	17,2	16	14,4	13,2	12,6	11	10,6	9,8	9,6	8,8	8	7,8	6,2	6	5,8	5,6	5,4	5	4
	14%	13%	13%	11%	10%	10%	9%	8%	8%	8%	7%	6%	6%	5%	5%	5%	4%	4%	4%	3%
Septile #5	29,8	28,8	27,2	26,4	25,8	25,2	23,8	23,6	22	21,2	20,4	18,4	17,6	16,4	15,4	14,6	13	12,2	12	10,8
	29%	28%	26%	26%	25%	24%	23%	23%	21%	21%	20%	18%	17%	16%	15%	14%	13%	12%	12%	10%
Septile #6	29,8	29,4	28	27	25,6	24,2	24	23,4	23	22,4	22,2	22	21,6	21,4	20,8	20,4	20	19,6	18,6	18,2
	50%	49%	47%	45%	43%	40%	40%	39%	38%	37%	37%	37%	36%	36%	35%	34%	33%	33%	31%	30%
Septile #7	13,2	12,6	12,2	12,2	11,8	11,4	11,2	10,6	10,4	10	9,6	9,4	9,2	8,8	8,6	8,4	8,4	8,2	8	8
	57%	55%	53%	53%	51%	50%	49%	46%	45%	43%	42%	41%	40%	38%	37%	37%	37%	36%	35%	35%
Total	97,2	93,6	88,4	84,6	80,4	77,2	73,6	71,6	68,4	66,4	64	60,4	58,6	55	52,8	51,2	49	47,2	45	42,2

Figure 1: The average number of director seats held by each septile classified by true value of directors

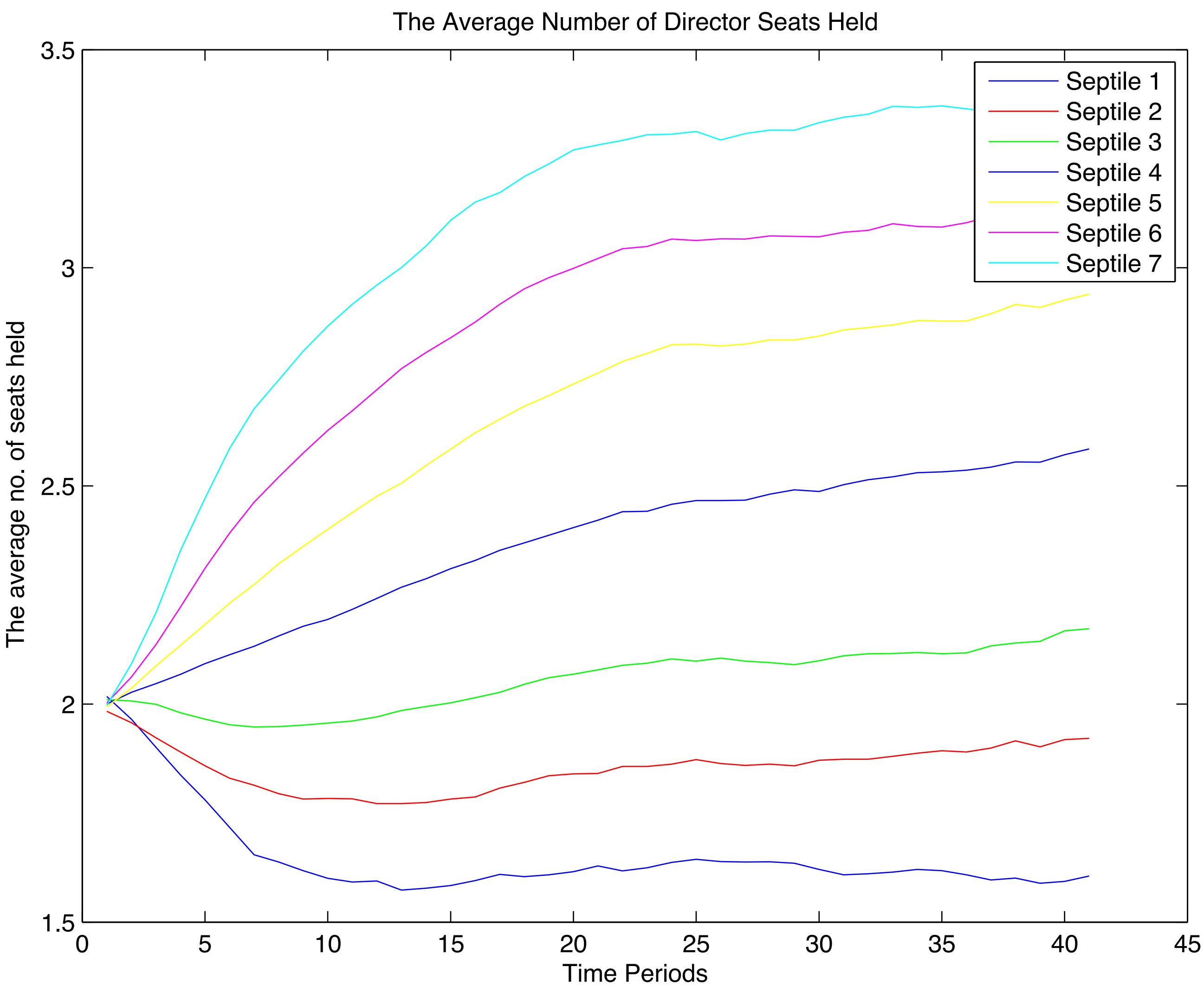

Figure 2: The average number of CEO positions held by each septile classified by true value of directors