Are There Glass Ceilings for Female Executives?

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Abstract

Less than 10 percent of executives in large publicly traded firms are women. On average female executives earn less than male executives, and hold less senior positions. They retire earlier. This paper is an empirical study of these differences based on panel of about 2,500 firms and 16,000 executives tracked through 60 job titles over a 14 year period. We construct a simple career hierarchy to analyze promotion rates and compensation for males and females, controlling for firm and industry characteristics, as well as the executive's socioeconomic, demographic and background experience. At any given level in the career hierarchy, women are paid slightly more than men with the same background, have slightly less income uncertainty and are promoted as quickly. We conclude that the gender pay gap and differences in job rank in this most lucrative occupation is explained by females leaving the market at higher rates than males.

I. Introduction

Fewer women than men become executives, on average female executives rank lower than male executives, they are paid less, and are more likely to quit than their male counterparts. A simple explanation for these stylized facts is that female executives have less promotion opportunities than males in a labor market segment infamous for its lucrative compensation to top players, making them more reluctant than males to accept positions in management, and also more likely to quit.

Many other occupations fit the stylized facts that broadly characterize the gender differentials in promotion, wages and quitting in the executive market, and several explanations have been forthcoming. One view is that women are less attached to the labor force because of births and childcare responsibilities, which come at the expense of gaining greater experience on the job. There is abundant evidence that taking time off the job to parent depreciates market human capital, and furthermore that employers anticipate loss in firm specific human capital by using gender as a signalling device.[1] Another explanation is that in unionized industries, women and other minorities have traditionally not as well treated as males, and only relatively recently have they become a more effective force with the unionization of the white collar class. The role of informal networking in making business connections is sometimes mentioned as facilitating or maintaining the gender gap.[2]

The first two explanations do not apply to the executive market. Managing a corporation is not a union job. Executives, male and female alike, are typically in mid-life when most women having put their child bearing years behind them. The third argument, that intangible factors impede the promotion of women to the apex of their profession, is captured well by the phrase "glass ceiling". Thus the executive market lends itself to investigations seeking to confirm their existence, nature and durability.

This paper provides new evidence for answering the question whether female executives are differentially treated from males with respect to wages and promotions. We begin by showing, in Section 2, how aggregate measures of these outcome variables might give a misleading summary of gender differences. Simply put, if women are more likely to quit than males, but the rate of promotion does not depend on gender, then a higher proportion of males at any given rank are promoted. If in addition compensation is positively related to rank, but does not depend on gender, then males in the profession earn more than females on average. James Albrecht, Anders Bjorklund, and Susan Vroman (2003) recently concluded there is a glass ceiling in Sweden because females are under represented in the upper quantiles of the wage distribution. Similarly Francine Blau and Lawrence Kahn concluded from their study of wage data for the U.S. that the gender gap stopped shrinking 15 years ago and has not closed. Our analysis in Section 2 show that questions about glass ceilings cannot be definitively answered without recourse to detailed data on compensation, rank, experience, and promotion rates.

There is surprisingly little empirical work on job hierarchies in business firms. Our approach draw from a case study of internal promotions within a single firm by George Baker, Michael Gibbs and Bengt Holmstrom (1994), which ranks the firm's white collar workers over a broader span of their life cycle. Our framework covers job transitions within and between firms. Following the spirit of Baker et al, we adopt two axioms for defining a job hierarchy, that promotions should reflect life cycle job transitions, and that employee compensation, and payoff relevant variables which change over time within a job spell, should not determine rank. We add a third axiom every hierarchy should satisfy, called transitivity, that no sequence of consecutive promotions should constitute a demotion.[3] Defined this way, a hierarchy is an example of a rational ordering. Our data on promotion and turnover, described in Section 3, are drawn from roughly 2,500 publicly listed firms, 30,000 executives and 60 job descriptions over a 14 year period. From this large longitudinal data set compiled from observations on executives and their firms, we define and construct a career hierarchy, ranking jobs in the executive market, and reporting on its transition matrices.

Only five percent of the executive management is female. This fact begs the question whether females executives are drawn from a more select population than males, and consequently are not directly comparable. Finding compensation and promotion rates do not vary with gender, but that females are better qualified and more experienced than males, could well be treated as evidence supporting gender discrimination. To address these selection issues, we augmented the original data on promotion, turnover and compensation with professional and demographic background information on executives compiled from the Marquis "Who's Who". Our data contain background information on executives, including age, gender, education, executive experience and the types of firms they work for, plus detailed information on their compensation and the financial returns of their firms. Section 4 summarizes the main features of the subsample constructed for those executives for which this background data is available. We find that the educational and background characteristics of women closely resemble men. On average they are younger and have less experience, but this is mainly because they retire earlier.

Section 5 reports logits on promotion, turnover and retirement using the career hierarchy constructed in Section 3. We find that female executives are promoted at the same rate as males with similar background characteristics and occupational experience. Women are promoted more quickly internally, but this is offset by a lower external promotion rate (promotions involving firm turnover), and are also more likely to be demoted and accept lower rankde positions with other firms. The other striking feature distinguishing men from women about job transitions is that the women exit the sample at a much higher rate. To evaluate their usefulness as explanatory variables, many of which are significant, we ran the promotion logits omitting the background regressors on the full sample. The logit coefficient on the female indicator variable switched signs from positive and significant to negative and significant. This result demonstrates that excluding background variables induces bias, falsely suggesting that females are promoted more slowly than males.

Overall our results are somewhat at variance with those found for academics and metal workers, the only two other occupations gender discrimination has been studied in relation to career hierarchies. In a sequence of papers, Donna Ginther and Kathy Hayes (1999, 2003), John McDowell, Larry Singell and James Zilliak (1999), and Ginther and Shulamit Kahn (2004) have compared the trajectories of male and female academic faculty in the social sciences and humanities, finding that women tend be paid less at any given rank and are also less likely to be promoted. An empirical study by Tuomas Pekkarinen and Juhana Vartianinen (2004) of metal workers in Finland finds that women are internally promoted more slowly than males. Our results on the differential exit rate is consistent with previous results found for academics, but our finding about promotion is not. Given the important role background variables play in our empirical analysis, perhaps the inclusion of better measures of job experience and work effort might reconcile the qualitative differences between our study and previous work. Another explanation is that the nonprofit and public sectors might accommodate prejudice more easily than the private corporate sector, with its stronger emphasis on value maximation and less tolerance towards individual tastes that mitigate against this goal.[4]

Wage regressions are reported in Section 6. We find that females are paid slightly more than males at each rank after controlling for observed heterogeneity. Furthermore their compensation varies less than male compensation with the excess returns of firms, and is therefore less volatile. It follows that a risk averse executive of either gender with any given educational and experience variables characteristics would prefer to receive compensation paid to female rather than male executives. The greater sensitivity of compensation to firm excess returns is robust to whether background variables are included or not. However the level effect of gender switches sign in median quantile regressions. It is positive and significant if the background variables are included, but negative and significant if omitted. The change in the least squares regression coefficients is less dramatic, because they are insignificant when the background variables are omitted.

Our results predicting the effects of gender on the volatility of compensation are somewhat comparable to findings in Stefania Albanesi and Claudia Olivetti (2008). However they also found, as did Linda Bell (2005), that females at equivalent ranks are paid less than males, while the earliest work on this subject by Marianne Bertrand and Kevin Hallock (2001) concludes that after controlling for background and position, gender differences in compensation are minor.[5] The composition of the samples varies across the four studies, as does the definition of compensation, and controls for selection in the regressions. Most notably, all previous work on the gender gap in executive compensation contains fewer observations and less detail about executive background.

To quantify the importance of the greater exit hazard rate for women executives we conducted a counterfactual exercise using an extension of the statistical framework of Section 2 to predict what would happen to their average career wage if they quite as infrequently as males. We estimate how much of the difference between average compensation can be explained by substituting the quit rates of females with those for males in their respective conditional transitional functions, while simultaneously accounting for heterogeneity, the effects of job experience on compensation and promotion, and gender differences in the rates of internal versus external promotion. The analysis and results are reported in Section 7. Finally Section 8 offers some concluding comments on where there might be gender differences in the market for executives.

II. Career Hierarchy and Job Transitions

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

In this paper a career hierarchy is defined as a rational (complete and transitive) ordering over a set of jobs or positions based on transitions. Thus a career hierarchy is any partition of jobs that does not contain the possibility of promotion cycles, that is any job sequence of promotions starting and ending at the same position. Although these are appealing criteria to impose on a job hierarchy we remark that the definition has content. Under this criterion switching positions as CEO from a small firm to a large firm does not constitute a promotion, since the larger firm may shrink, a second switch to a mid sized firm creating an intransitivity. A similar argument can be made about compensation. More generally position within the hierarchy does not depend on time varying characteristics.

Let J denote a finite collection of jobs, denoted $j \in \{1, \ldots, J\}$. We denote the probability of switching the j^{th} job to the k^{th} by p_{jk}. Suppose $p_{jk} \geq p_{kj}$, then $j \succeq k$. We also impose the property of transitivity. Thus if $p_{jk} \geq p_{j'j} \geq p_{j''j}$ then $j \succeq j''$. Finally if $j \succeq k$ and $k \succeq j$ then $j \sim k$. If $j \succeq k$ but $j \nsim k$ then $j \succ k$, in which case we say that the j^{th} job ranks higher than the k^{th}. Thus indifference occurs if $p_{jk} = p_{kj}$, of if say $p_{jk} > p_{kj}$ but $p_{kj} \geq p_{j'j} \geq p_{jk}$. We ascribe a rank to each of the distinct indifference sets, where $R \leq J$. Thus rank $r \in \{1, \ldots, R\}$ is higher than rank $s \in \{1, \ldots, R\}$ if every job $j \in r$. Since there are only a finite number of jobs, the algorithm described above ensures the ranking is complete.

This ranking has a second desirable property. Suppose we strengthened the requirement to say that $p_{jk} - p_{kj} \geq p$ for some $p > 0$ as a necessary condition for $j \succ k$, then it is straightforward to show that we would end up with a coarser partition defining the hierarchy. In this respect the definition we adopt maximizes the number of ranks. Furthermore if we relaxed our definition would imply that more workers are demoted from their position than are promoted, or that a sequence of consecutive promotions amounted to a demotion. In our empirical work we allow the hierarchy to depend on fixed characteristics to see whether the career track differs across socioeconomic demographics. Thus we let$p_{jk}(z)$ where $z_0 \in Z$

is a fixed set of characteristics. In this way our definition of hierarchy depends on initial characteristics, such as gender and education, but does not depend on outcomes such as experience or wages.

We follow Baker et al (1994), by defining the hierarchy solely on the basis of job transitions between jobs that have different titles. They applied their definition to internal transitions, and in extending their approach to an occupational hierarchy one must take a stand on several issues. Our definition implies that changes in compensation, or the size of the employee's firm, do not constitute a promotion or demotion within the hierarchy unless there is a title change, and that workers might seek demotions from say highly ranked positions in small firms to lower ranked positions in larger firms. the character rather than factoring in other characteristics of jobs and their respective compensations as well.

Their approach is particularly amenable to addressing life cycle issues and analyzing human capital. Baker et al devised the rule that if greater than one percent of all transitions from job x were from x to job y, and more than one percent transitions from y were from y to x, then the jobs x and y are assigned to the same rank. The predominant transition flow, which defines the direction of promotion, determined the order in which jobs and ranks are listed in their job transition matrix, where jobs for which there are mainly outflows to other jobs in the sample being listed in the top left. Applying this rule to their data set, a case study involving a single firm with 17 positions and 69,840 employee years, yielded 8 ranks. Their job transition matrix is (almost) upper block triangular and therefore satisfies the transitivity property, implying their ordering is rational for the sample population. If we apply the same rule to our full data set described in the next section, however, then only one rank emerges from our 37 defined positions for the 85,748 employee years in our data if transitivity is imposed as well. Our data set, containing both internal and external transitions across many firms in a more narrowly defined labor market, does not support a (nontrivial) hierarchy if such a stringent rule is used to characterize a rational ordering. For this reason we used a weaker criterion to characterize the ordering.

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

The last two rows in the top panel of Table 4 represent the number/percent of entries into the rank from other ranks, while the two right columns give the number/percent who exit the rank for another one, that is conditional on remaining in the sample. The two right columns are the number/percent of executives exiting the rank. For example, the highest rank, Rank 1 has 33 percent of entry but only a 12 annual exit rate yearly, Rank 2 also has more entries than exits, the differences decline in the rank, but in the lower ranks, there is more exit than entry as would be expected of entry level jobs. Our choice of the order relation is confirmed by the fact that every cell has nonzero entries, and most of the off diagonal cell numbers exceed one percent of the total number of changes, whether measured as an exit from the rank, or an entry into it.

Executive turnover rates from one firm to another are displayed in the lower panel of Table 4. Overall, transitions that involve changing firms are small relative to internal transitions, accounting for 1.6 percent of the observations. The bottom row shows that a substantial fraction of all firm-to-firm transitions are into higher ranks. Taking proportions of the bottom row elements to their corresponding rank sizes, the panel also shows that the rate declines with rank, very few executives changing firms into the lower ranks. The row entries describe the percent of transitions from a rank as a fraction of all transitions involving firm turnover from the rank. For example, 52% of executives who moved from Rank 1 move into the same rank in a different firm. The rest of the movers move into lower levels in other firms. External transition patterns are different from the internal transitions. Below Rank 2, conditional on turnover, a promotion is more likely than not, in contrast to the top panel, where the diagonal elements are dominant. A large percent of executives who change firms in Ranks 2 and 3 move to Rank 1. Comparing external moves into a rank with total moves into the same rank, more than one quarter of Rank 2 officers are brought in from outside (496 out of 1872), a much higher proportion than for any other rank. Note too, from the top panel, that conditional on remaining in the sample, Rank 2 executives have a lower hazard rate out of their job than the other ranks.

III. Executive Background

Data on the 2,818 firms for the ExecuComp database were supplemented by the S&P COMPUSTAT North America database and monthly stock price data from the Center for Securities Research (CSP) database. We also gathered background history for a sub-sample of 16,300 executives, recovered by matching the 30,614 executives from our COMPUSTAT data base using their full name, year of birth and gender with the records in Who's Who, which contains biographies of about 350,000 executives. The matched data gives us unprecedented access to detailed firm characteristics, including accounting and financial data, along with their managers' characteristics, namely the main components of their compensation, including pension, salary, bonus, option and stock grants plus holdings, their socio-demographic characteristics, including age, gender, education, and a comprehensive description of their career path sequence described by their annual transitions through the 37 possible positions.

Most of the characteristics of the executives and firms in the subsample of matched data require no (further) explanation, but the construction of several variables merit a remark. The sample of firms was initially partitioned into three industrial sectors by GICS code.

Sector 1, called primary, includes firms in energy (GICS:1010), materials (1510), industrials (2010,2020,2030), and utilities (5510). Sector 2, consumer goods, comprises firms from consumer discretionary (2510,2520,2530,2540,2550) and consumer staples (3010,3020,3030). Firms in health care (3510,3520), financial services (4010,4020,4030,4040), information technology and telecommunication services (410, 4520, 4030, 4040, 5010) comprise Sector 3, which we call services. In our sample 37 percent of the firms belong to the primary sector, 28 percent to the consumer goods sector, and the remaining 35 percent to the services sector. Firm size was categorized by total employees and total assets, the median firm in each size category determining whether the other firms are called large or small. The sample mean value of total assets is $18.2 billion (2000 US) with standard deviation $76.2 billion, while the sample mean number of employees is 23,659 with standard deviation 65,702.

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

We followed Rick Antle and Abbie Smith (1985, 1986), Brian Hall and Jeffrey Liebman (1998), Mary Margiotta and Miller (2000) and Gayle and Miller (2008a, 2008b) by using total compensation to measure executive compensation. Total compensation is the sum of salary and bonus, the value of restricted stocks and options granted, the value of retirement and long term compensation schemes, plus changes in wealth from holding firm options, and changes in wealth from holding firm stock relative to a well diversified market portfolio instead.[6] Hence the change in wealth from holding their firms' stock is the value of the stock at the beginning of the period multiplied by the abnormal return, defined as the residual component of returns that cannot be priced by aggregate factors the manager does not control. (In our sample the mean abnormal return is -0.005 with standard deviation 0.6, and we do not reject the null hypothesis that it is uncorrelated with the stock market.)

Table 3 displays summary measures of the background variables by gender. On average, women have two years less tenure in the firm and two and a half years less executive experience than males. Female executives are a little less likely to have an undergraduate degree than males, but a little more likely to have professional certification or a doctorate. Women earn lower salaries and compensation, and reflecting the higher quite rates shown in Table 2, are younger than males by three years on average. Promotion rates by gender are identical.

Differences in executive background by firm type are summarized in Table 4. The sectors are ranked the same way with respect to age and tenure. There are two rank and/or firm previous turnover moves per observation, one of which occurred since acquiring executive status. The incidence of an MBA, some other Master's degree, and a Ph.D. is about the same, and all them are more or less evenly dispersed over different firm and sector sizes. Firms with small assets have both the oldest executives and the longest tenured. The rate of promotion is lower in small firms than large. Perhaps the most important differences between the executives across firm size and sector relate to compensation. Regardless of which measure is used, the mean salary and bonus in small firms is about two thirds the mean in large firms, about half the total compensation, with standard deviations about one third smaller.

Table 5 describes the characteristics of executives by rank. The average age between Rank 1 and 3 declines from 60 to 52, but is more or less constant as rank falls off further. Similarly average tenure is roughly constant in the lower and middle ranks at 14 but rises to 15 and 17 for Ranks 2 and 1 respectively. The average gap between Ranks 1 and 3 in executive experience is 6 years. Relative to the lower ranks, Ranks 1 and 2 are 8 years older, with only 6 years more executive experience and just 2 years more tenure. Executives with MBA degrees are more concentrated in the top 4 ranks, those with another Masters degree or a Ph.D. are more concentrated in the lower ranks. Average total compensation, their salary components and the their respective standard deviations rise from the lower ranks, are maximized at Rank 2, at levels that are more than twice as high as the corresponding figures for Rank 7, and decline.

Females form a very small fraction of the executive sample, and they are not uniformly distributed by rank. By a factor of two to three, females congregate in the lower executive ranks relative to males. Only 2 percent of the top two ranks are females, while 6 percent of Ranks 5 and 6 are female.

Only 1800 of the 2,818 firms in the full sample contain at least one executive listed in Who's Who. With this fact in mind, we checked for differences between the composition of the full and matched samples for those characteristics observed in both data sets, namely gender, promotion, salary and compensation. Comparing the means and standard deviations of the bottom panels in Tables 3 through 5, there are no statistically significant differences between the sample means on the these dimensions, and many of the values for corresponding means and standard deviations are numerically equal up to three significant digits. The most notable differences, in mean salary and compensation, arise because executives in the matched sample come from larger firms than those for which there is no background information.

IV. Promotion, Turnover and Retirement

The logistic regressions, reported in Table 6, show how the probability of promotion, external promotion, turnover and retirement vary with firm and individual characteristics.

The coefficients on ranks (relative to Rank 7) show the lower the rank, the higher the probability of being promoted, implying that promotions become more infrequent, and that the hierarchy looks like a pyramid. The same point applies to external promotions. Retirement (from the sample) is highest from Rank 1, not surprising given our definition of a career hierarchy. Similarly there is more turnover in Rank 1. For the most part the effects of firm size and sector are less pronounced than the effects of rank. The most important feature is that managers are promoted more quickly in, and are more likely to quit from, firms with more employees. It is also noteworthy that the rate of retirement is higher in the primary sector than the other two. Past turnover has a positive effect on promotion, suggesting the managers are sometimes hired from outside at a lower position than is planned for them, to first serve an apprenticeship or receive orientation. Lower excess returns increase the probability of promotion, turnover, and retirement, as the career ladder opens up new opportunities for those executives left with the firm when it becomes unprofitable. Finally, lower compensation increases the rate of retirement.[7] We do, however, find evidence of gender differences in promotions. The external rate of promotion for females is lower than males, implying their internal promotion rate is higher, results that are revealed only when the background controls are included. Finally the logits for both samples show that the hazard rate into retirement is higher for females than males.

Tenure with the firm increases the probability of internal promotion, as does experience with other firms. Age is negatively correlated with internal promotion and turnover, but older executives behave the same way as their younger counterparts when it comes to outside promotions. Greater numbers of previous moves increase the probabilities of internal promotion and turnover, but reduces the probability of external promotion. Managers who moved more in the past are more likely to turn over but less likely to receive an external promotion. For the most part, educational background plays only a minor role in transitions through the job hierarchy. The most noticeable effects are that executives with MBA degrees are more likely to move to jobs of the same or lower rank, while those with doctorates are less likely to receive an external promotion but just as likely to leave. Both these highly educated groups exhibit a greater willingness to take lower ranked jobs in other firms.

Our empirical results in Column 3 of Table 6 shows the equality between male and female executives in the overall promotion rate masks a more subtle finding, that women are promoted more quickly internally, but promoted to external positions significantly more slowly than men, evident from Column 5. These results are not informative about the differential incidence of small (one rank) promotions versus larger (multi-rank) promotions, turnover beween firms at the same level (that result in the loss of firm specific capital but broaden general managerial experience), and demotions.

To address these outstanding questions we estimated a multinomial logit model of the rank and employment transitions as a function of covariates on executive and firm characteristics. Table 7 reports the coefficients (plus standard errors) on rank, gender and experience of the estimated multinomial logit.[8] The excluded outcome category are internal transitions to Rank 2. We see from summing the column rank constant next year plus the row/column cell coefficient for the current/next year transition, that in Ranks 4 through 7, the most likely outcome is hold the current position, and one step promotions are more likely than multistep promotion or demotions. Similarly managers in Ranks 2 and 3 are more likely to remain in the their current position than switch to any one of the other 13 combinations. Remarkably Rank 1 executives are, however, more likely to to be internally demoted to a lower level below Rank 2 than remain in their current position. This last result corroborates our earlier finding that Rank 1 are most likely to retire, leading us to conclude that managers in this position are the most prone.

Differences in transition patterns between the genders emerge from modeling the data at this finer level of detail. The highly significant positive coefficients on the female indicator variables for Ranks 4 through 7 reveal that conditional on staying with the firm, compared to males, females gravitate towards the lower ranks. Having been promoted, females are less likely than males to remain in the top two ranks. They are also more likely than males to be attracted to a new firm at Rank 2, and more likely to switch firms but restart at the bottom of the career ladder, Rank 7. In an extended model not reported here, formed from interacting the female indicator variable with each rank, we found that the probability of promoting a woman was not significantly different from promoting a man, that the probability of a Rank 2 female switching to Rank 2 in another firm is significantly higher than for a male, and that several of the demotion probabilities were significantly higher for women. The evidence from Table 7 broadly consistent with the notion of a glass ceiling restricting the upward mobility of female executives. One intepretation of these findings is that ambitious women executives are more likely than their male counterparts to see limited opportunities for internal advancement, and consequently move laterally, or even accept a lower ranked position at another firm.

In the Appendix we display the results from the matched sample, and also from the full sample, to assess how much bias is induced by ignoring age, education and experience variables correlated with the gender of executives. Since we cannot directly compare the regression results from the full sample with the results in the matched sample, we also compare between the regressions results from the matched sample in which we omit the background variables in order to address the possible differences between the two samples. Our findings on rank, excess returns, firm size and sector do not depend on whether the full data set or the matched data set is used. In contrast, whether or not to include background variables critically affects estimates pertaining to the promotion of females. When background variables on education and experience are included in the analysis, the estimated coefficient on the female indicator variable is positive but insignificant. Our results show that females are promoted as quickly as males. Excluding background variables yields a positive and significant estimate in the full sample. We ran the regression excluding the bacground variables on the matched sample, and find that the coefficient on female is positive, larger and statistically signifiact (at 5%). This difference can be caused because women are 4 years younger on average than men, and younger workers are more likely to be promoted. The contrast between the results in the full sample and matched sample suggests that in the matched sample females are more likely to be promoted, this can be due to the fact that women representation in smaller firms is larger but larger firms are overrepresented in the matched sample, and that omitting background variables on age and experience, both highly significant, leads to false inferences about the role of gender in promotion.

The regressions results from the conditional and unconditional regressions in the matched sample indicate that the coefficient on female is almost twice as large once we control for background characteristics. We conjecture that this results from females being on average 4 years younger than males, and younger workers are more likely to get promoted. Comparing the unconditional regression from the match sample to the full sample indicate that females in the sample tend to retire slightly more, but the difference is not as nearly as large as in the promotion regressions. We do not find any significant differences between the coeffiicents in the regressions of turnover and external promotions in the full and matched sample.

V. Compensation

We ran least squares (LS) and median quantile (LAD) regressions of compensation on firms' and executives' characteristics,corrected for heteroskedasticity, on the full and matched samples. Table 8 reports the results from the four regressions in eight columns. The conditional level effects are presented in the first four columns of estimates, their interactions with abnormal returns in the second four.

Most of the coefficients on rank, firm size and sector do not vary much in magnitude with the regression technique or the sample used, and only one changes sign. Controlling for background demographics and tenure more or less leaves intact the qualitative rank ordering on total compensation displayed in Table 4. Total compensation to Ranks 6 and 7 differ by a statistically insignificant amount, and then rises with promotion, spiking at Rank 2, compensation to Rank 1 falling between Ranks 3 and 4. In contrast the unconditional means and standard deviations reported in Table 3, the results from the regression analysis separate the effects of excess return, which induces uncertainty to manager's total compensation, from the background variables that determine observed heterogeneity.

Rank 1 is more affected by excess returns than every rank except Rank 2. Rank 1 has a lower (LS) or the same (LAD) estimated mean and more dependence on abnormal returns than Rank 3, while Rank 2 has a higher mean but more dependence than Rank 3. Therefore Rank 3 offers a superior total compensation package to Rank 1, and for sufficiently risk averse executives, a more attractive compensation package than the Rank 2. Continuing in this vein, dependence on excess returns is virtually eliminated by remaining in the middle or lower ranks; our results show that Ranks 4 though 7 are hardly affected by excess returns. Both measures of firm size and sector variables significantly affect compensation; working for bigger firms raises average compensation level and also its dependence on the firm's excess returns.

Several background variables are significant. Compensation is quadratic in age, reflecting a pattern evident in many occupations. Executives who have college degrees only earn less than those who also hold an MBA, but compensation of the latter is also more exposed to the vicissitudes of their firm's profitability. In this occupation other professional qualifications and post college degrees do not increase compensation. There is a large sign-on bonus from joining the firm, but reductions associated with increased tenure and the number of past moves; past executive moves are less penalized than earlier moves. Compensation to newcomers is not as sensitive to excess returns, and similarly greater tenure and fewer moves in the past tie compensation more closely to the fortunes of the firm.

Whether we use the matched or the full data, we find women executives receive compensation packages that are less sensitive to their firm's excess return. Conditional on the same background characteristics females receive significantly more compensation than males. Assuming executives are risk averse, the compensation packages awarded to women executives is therefore superior to what equivalently qualified males would receive. When the background variables are omitted (in the matched sample) the coeffieints are positive but statistically insignificant. In the full sample, however, the coeffieicnt in the least squares regression is small, negative and statistiacally insignificant, but the in the quantile regression in the full sample is negative and significant, suggesting that in the full sample it is possible that women may earn less, possibly because women are over represented in smaller firms and in the matched sample larger firms are overrepresented.

VI. A Framework

Our empirical results show three factors might explain why female executives earn less than their male counterparts, even though they are paid significantly more compensation at any given level for the same experience, and their overall rate of promotion is as fast as men. First, women come from slightly different backgrounds and differ in their mix of experience to men, which might affect their career trajectories through the executive ranks; for example a greater proportion have doctorates, but a slightly higher percentage have no degree. Second, in a profession that rewards experience, given the same background and experience, women are more likely to leave the sample population. Third, their equality with males in the overall promotion rate masks some more subtle findings. Within the firm they are promoted more quickly, but are promoted to external positions significantly more slowly than men. They are also demoted more frequently internally, and exhibit a greater proclivity to accept positions at new firms at the same or even lower ranked levels.[9]

To untangle these factors we construct a dynamic system from the estimated equations obtained in the previous sections to explain how they affect the length of careers, how high executives of different types climb the career ladder, and how executive compensation evolves with rank and over time. More generally, our approach provides a template for analyzing how important heterogeneity, in educational background, executive experience of different types, in age and gender, is for determining outcomes across the different industrial sectors of the executive labor market.

Let h denote a set of state variables characterizing firm specific and general human capital that help determine compensation and job transitions between and within firms. The exact definition of this vector, discussed below, is determined by the results of our empirical analysis. Let $p_t(r', h' | r, h)$ denote the joint probability that an executive aged $t \in \{t_0, t_0 + 1, \ldots\}$ holding rank $r \in \{1, 2, \ldots, R\}$ and experience $h \in H$, moves to rank $r' \in \{1, 2, \ldots, R\}$ and acquires experience $h' \in H$ next period, conditional on remaining in executive management for another period (empirically determined by our estimates from Table 7). Let $p_{tr0}(h)$ denote the corresponding probability of retiring at age t from rank r (estimated with the discrete hazard reported in Table 6). Then the job rank transition matrix at period t for a worker denoted by P_t, is formed from generic elements that define the probability that the worker moves from rank r to rank s:

$$p_{trs} \equiv \sum_{h'}^{H} \sum_{h}^{H} p_t(s, h' | r, h)$$

and the discrete exit hazard at t, the probability of quitting the occupation at t conditional on surviving to that point, is:

$$1 - \sum_{r=1}^{R} p_{trs} = \sum_{h}^{H} p_{tr0}(h)$$

Let $q_{tr}(h)$ denote the probability of a person who was an executive at age t_0, is still in the executive population at age t, and at that age holds rank r and has experience h. We define $q_{tr}(h)$ recursively by the formula:

$$q_{t+1,s}(h') = \sum_{h}^{H} \sum_{r=1}^{R} p_t(s, h' | r, h)[1 - p_{tr0}(h)] q_{tr}(h) \tag{1}$$

for some initial assignment probabilities $q_{t_0,r}(h)$ (estimated from our data). Hence the survivor function, denoted by Q_t, can be expressed as:

$$Q_t = \sum_{r=1}^{R} \sum_{h=1}^{H} q_{tr}(h) \equiv \sum_{r=1}^{R} q_{tr} = q_{t-1} P_t = q_{t_0} \prod_{\tau=t_0}^{t} P_\tau \tag{2}$$

Writing $q_{tr} = \sum_{h=1}^{H} q_{tr}(h)$ we also define the R dimensional vector $q_t \equiv (q_{t1}, \ldots, q_{tR})$ as the defective probability distribution over the ranks formed by excluding the proportion of workers who have already quit by time t. It follows that $q_t \left[\sum_{r=1}^{R} q_{tr}\right]^{-1}$ defines the truncated probability distribution of those remaining after t periods over the ranks. Summing over Q_t we obtain the expected future duration remaining in management for an executive age t_0, defined by:

$$T \equiv \sum_{t=t_0}^{\infty} Q_t = \sum_{t=t_0}^{\infty} \sum_{r=1}^{R} q_{tr} \equiv \left(q_{t_0} \sum_{s=t_0}^{\infty} \prod_{t=t_0}^{s} P_t I \right) \tag{3}$$

where by I denotes the R dimensional column vector $(1, \ldots, 1)'$ and $\prod_{\tau=t_0}^{t} P_t$ denotes the t period transition matrix for a worker over the time frame $\{t_0, \ldots, t\}$.

Finally, let $w_{tr}(h)$ denote compensation as a function of human capital, rank and age (as estimated in Table 8), and let $w_t \equiv (w_{t1}, \ldots, w_{tR})$ where w_{tr} is the expected compensation of executives aged t in rank r. Expected undiscounted cumulative earnings is then:

$$(4) \qquad W \equiv \left(q_0 \sum\nolimits_{s=1}^{\infty} \prod\nolimits_{t=t_0}^{s} P_t w_s \right) = \sum\nolimits_{t=t_0}^{\infty} q_t w_t = \sum\nolimits_{t=t_0}^{\infty} \sum\nolimits_{r=1}^{R} \sum\nolimits_{h=1}^{H} w_{tr}(h)\, q_{tr}(h)$$

Hence expected compensation per period, averaged over time spent in the occupation, is $T^{-1}W$.

VII. Aggregation Bias

The main purpose of this framework is to conduct dynamic decompositions illustrating the quantitative impact of different features of the background variables, wage regressions, probability transitions for promotions, demotions and firm mobility, and retirement hazards on the gender gap in executive careers. But it is also a useful tool for proving that questions about glass ceilings cannot be definitively answered without recourse to detailed data on compensation, rank, experience, and promotion rates. Aggregate measures of these outcome variables might give a misleading summary of gender differences. Simply put, if women are more likely to quit than males, but the rate of promotion does not depend on gender, then a higher proportion of males at any given rank are promoted. If in addition compensation is positively related to rank, but does not depend on gender, then males in the profession earn more than females on average.

For suppose that at some point γ the probability of quitting is increased by δ. The expected time spent in the occupation declines to:

$$\left(q_0 \sum\nolimits_{s=t_0}^{\infty} \prod\nolimits_{t=t_0}^{s} P_t I - \delta q_0 \sum\nolimits_{s=\gamma}^{\infty} \prod\nolimits_{t=t_0}^{s} P_t I \right) \equiv T - \delta A$$

and undiscounted expected cumulative earnings falls to:

$$\left(q_0 \sum\nolimits_{s=t_0}^{\infty} \prod\nolimits_{t=t_0}^{s} P_t w_s - \delta q_0 \sum\nolimits_{s=\gamma}^{\infty} \prod\nolimits_{t=t_0}^{s} P_t w_s \right) \equiv W - \delta B$$

Consequently the expected average wage for a group of homogeneous workers changes from

$T^{-1}W$ to $(T-\delta A)^{-1}(W-\delta B)$. We now prove that if average wages increase with tenure then:

$$T^{-1}W > (T-\delta A)^{-1}(W-\delta B)$$

Note expected wages from period ρ onwards are:

$$\left(q_0 \sum_{s=\gamma}^{\infty} \prod_{t=t_0}^{s} P_t I\right)^{-1} \left(q_0 \sum_{s=\gamma}^{\infty} \prod_{t=t_0}^{s} P_t w_s\right) = A^{-1}B$$

Because expected wages per period after ρ exceed those received before γ if and only if the former exceeds average wages received over the whole career, it now follows that if average wages increase with tenure then $A^{-1}B > T^{-1}W$. But:

$$\begin{aligned} T^{-1}W &< A^{-1}B \\ &\Longleftrightarrow -\delta A T^{-1}W > -\delta B \\ &\Longleftrightarrow (T-\delta A)\,T^{-1}W > W-\delta B \\ &\Longleftrightarrow T^{-1}W > (T-\delta A)^{-1}(W-\delta B) \end{aligned}$$

Therefore the expected wage from γ onwards is higher than the expected wage beforehand if and only if an increase in the probability of quitting at γ reduces the average expected wage overall.

The upshot is that if some groups of workers are more likely to quit than otherwise identical workers, and we do not control for differential wages paid to workers by rank, then we might confuse a premium paid to higher ranked workers with wage discrimination. This result is robust to any definition of career hierarchy satisfying two conditions, that average compensation for the career rises with rank, and one type of worker has the same or higher propensity to quit in each rank than another type. Our result implies that aggregation bias can be signed even when the hierarchy is missclassified, providing these two conditions are met. Thus we do not require average compensation in each rank to exceed average compensation in the preceding rank. These two remarks are noteworthy, because defining a hierarchy has subjective elements, and although the hierarchy that we have defined for our empirical work does not exhibit monotonicity in compensation, our results from Table 8 do satisfy the weaker sufficient condition about average compensation and tenure.

VIII. Attrition

In principle, differential retirement rates, rank probability transition or initial conditions can explain the longer duration of males in executive management. To quantify comparisons between female and male executive careers, it is convenient to let an f superscript stand for females and an m superscript stand for males, writing $q_{t_0 r}^{(g)}(h)$ for $q_{t_0 r}(h)$ and $p_t^{(g)}(s, h' | r, h)$ for $p_t(s, h' | r, h)$ when referring to an executive of gender $g \in \{f, m\}$. Thus the defective distribution of ranks conditional on human capital, age and gender is recursively defined as:

$$q_{t+1,s}^{(f)}(h') = \sum_{h}^{H} \sum_{r=1}^{R} p_t^{(f)}(s, h' | r, h) \left[1 - p_{tr0}^{(f)}(h)\right] q_{tr}^{(f)}(h) \tag{5}$$

for initial probabilities $q_{t_0,r}^{(f)}(h)$, and for males in an analogous manner. As we just shown, differential attrition between the genders creates a spurious gap in average lifetime compensation if average compensation rises with ranks that are defined using a lifecycle criterion. Table 6 shows that women are more likely to retire than men. To illustrate the quantitative importance of this point, we computed the survivor rates for the population, and showed how they are affected by different features of gender specific behavior.

In our empirical model, there are seven ranks so $R = 7$. Executive experience $EEXP_t$, tenure with the firm TEN_t, the number of previous moves NPM_t and the number of previous moves as an executive $NPEM_t$ are affected by past outcomes and also help determine future outcomes. So for this application we define experience by $h_t \equiv (EEXP_t, TEN_t, NPM_t, NPEM_t)$. By definition h_t follows the law of motion:

$$h_{t+1} = k_t \Gamma_1(h_t) + (1 - k_t) \Gamma_0(h_t)$$

where $k_t \in \{0,1\}$ is an indicator variable for staying in the firm versus moving to another firm and:

$$\begin{aligned}\Gamma_1(h_t) &\equiv (EEXP_t+1, 0, NPM_t+1, NPEM_t+1)\\ \Gamma_0(h_t) &\equiv (EEXP_t+1, TEN_t+1, NPM_t, NPEM_t)\end{aligned}$$

Estimates of experience and rank, $p_{tr0}(h)$, attrition as a function of the same variables, and and $p_t(s,h'|r,h)$ the rank and experience transition probability, were found by respectively integrating the exit hazard, and transition probability with respect to the remaining variables, namely educational background, firm size and sector characteristics, and excess returns. Since age is a significant determinant of compensation and rank, we computed all our measures for executives who were present in the sample at the median age, 49, and also at the twentieth percentile, 39.

Figure 2 depicts the survival function by genders $g \in \{f,m\}$, now denoted by $Q_t^{(g)}$ found by substituting $q_{tr}^{(g)}(h)$ for $q_{tr}(h)$ in Equation (2), for $t_0=39$ and $t_0=49$. At both ages just over one third of female executives leave after one year, and only about 10 percent survive six years or more. The survivor rate for males is much higher. Over 80 percent last more than a year, and more than 20 percent longer than six years, the older group of males experiencing less attrition than younger ones. From our estimates of the survivor function, we computed $T_{t_0}^{(g)} \equiv \sum_{t=t_0}^{75} Q_t^{(g)}$, the gender specific analogue to Equation (3), total expected future career length for an executive of gender $g \in \{m,f\}$ and age t_0. The two top left entries in the two panels of Table 9 show that regardless of the two methods of selection, being an executive manager at age 49, being an executive manager at age 39, the expected remaining duration in executive management is just over 3 years for women and about 5 for men, almost two years longer for males versus females.

Suppose females changed in just one respect, by following the retirement behavior of males. That is instead of the discrete hazard $p_{tr0}^{(f)}(h)$, we now suppose $p_{tr0}^{(m)}(h)$ applied. Denoting the defective probability distribution for describing the survivors in this counterfactual by $q_{tr}^{(retire)}(h)$, we computed estimates of $q_{tr}^{(retire)}(h)$ from the recursion:

$$q_{t+1,s}^{(retire)}(h') = \sum_{h}^{H}\sum_{r=1}^{R} p_t^{(f)}(s, h'|r, h)\left[1 - p_{tr0}^{(m)}(h)\right] q_{tr}^{(retire)}(h) \tag{6}$$

by replacing $p_{tr0}^{(f)}(h)$ with $p_{tr0}^{(m)}(h)$ and $q_{tr}^{(f)}(h)$ with $q_{tr}^{(retire)}(h)$ in Equation (5). Summing $q_{tr}^{(retire)}(h)$ over h and r we obtained the survivor function for females when they leave from the sample population at the same rate as males given the same experience and rank. From Figure 2 we see that this counterfactual exercise practically closes the gender gap between the survivor functions. Reflecting the importance of this factor, Table 9 shows that the expected career duration increases one and a half years to about four and a half years, not quite equalizing the expected career lengths for the genders.

Another counterfactual, which speaks to the question of why females tend to have shorter careers, is to replace $p_t^{(f)}(s, h'|r, h)$ with $p_t^{(m)}(s, h'|r, h)$ in Equation (6) to obtain:

$$q_{t+1,s}^{(rank)}(h') = \sum_{h}^{H}\sum_{r=1}^{R} p_t^{(m)}(s, h'|r, h)\left[1 - p_{tr0}^{(f)}(h)\right] q_{tr}^{(rank)}(h)$$

This would generate the survivor function for females if they experienced the same rank transitions as males throughout their career in executive management, and tell us whether women executives tend to gravitate to "dead end" positions that are associated with higher rates of retirement. We can also calculate the differential effect of initial conditions on females by replacing $q_{t0,r}^{(f)}(h)$ with $q_{t0,r}^{(m)}(h)$ and $q_{tr}^{(f)}(h)$ with $q_{tr}^{(initial)}(h)$ in Equation (6), defined in an analogous way. Since there are fewer women executives than men, there may be greater selectivity into the sample by those women who are less likely to leave the sample population, suggesting that the aggregate rate of female retirement in some sense understates the underlying process.

As an empirical matter, gender differences in the rank probability transitions and initial conditions affect the differences in the survivor functions only minimally. Replacing $p_t^{(f)}(s, h'|r, h)$ with $p_t^{(m)}(s, h'|r, h)$ and $q_{tr}^{(f)}(h)$ with $q_{tr}^{(rank)}(h)$ in Equation (5) yields the survivor function for females if they experienced the same rank transitions as males throughout their career in executive management. Similarly we calculated the differential effect of initial conditions on females by replacing $q_{t_0,r}^{(f)}(h)$ with $q_{t_0,r}^{(m)}(h)$ and $q_{tr}^{(f)}(h)$ with $q_{tr}^{(initial)}(h)$ in Equation (5). In both cases the shift in the survivor function is barely visible at this level of resolution. From Table 9, swapping the initial conditions, or changing the transition probability, increases the expected career length for female executives in the panel at 39 and 49 by less than a month. Summarizing, the direct effect of retirement essentially explains almost the difference in the career length of female and male executive managers.

IX. Is there a Glass Ceiling?

With estimates of $q_{tr}^{(g)}(h)$, we can now answer the question, whether women executives less likely than men to achieve the pinnacle of executive management, and if so, why. The probability that an executive in the population at t_0 with gender $g \in \{f, m\}$ is a CEO at age $t \geq t_0$ is:

$$q_{t2}^{(g)} = \sum_{h=1}^{H} q_{t2}^{(g)}(h) \tag{7}$$

The top two panels of Figure 3 show that executives in the sample at 49 are more than twice as likely to be a CEO than an executive in the sample ten years younger, reflecting our lifecycle approach to the definition of a career hierarchy. Most notably, from the standpoint of our topic, a female executive in the population at the either age is less than half likely to be a CEO than a male.

What explains these gender differences? Are women are promoted within the firm more slowly and less likely to accept attractive offers from other firms? We set $g = rank$ in Equation (7) and checked how much the probability of being a CEO increased when females transited through the ranks following the same transition matrix as males. Figure 3 shows the effect of this counterfactual is small. In other words the gender differential in probability of being a CEO is primarily due to differences in the other two factors, retirement and initial conditions.

Setting $g = initial$ in Equation (7) yields the probability of a woman executive at age being a CEO at age t if they had been assigned the initial endowment of males. By construction the probability at t_0 is equal, but quickly falls off, partly because of the differential retirement rates. Breaking things down further, we investigated to what extent their initial assignment conditional on their past experience is a determining factor, versus the different background they have at the time. We found only the initial rank counts, not initial differences in executive experience, industry background or education. For setting $g = rinitial$ in produces a line in Figure 3 that practically overlays the $g = initial$ line.

The higher rate of female attrition diminishes the size of the pool of female candidates eligible for CEO, thus contributing to the gender differences. If female retirement patterns mimicked those of their male colleagues, would the sequence of probabilities close the gap? Upon setting $g = retire$ in Equation (7) , Figure 3 shows that the sequence of probabilities would increase, but not close the gap. Thus both initial conditions and retirement are important explanatory factors in explaining why women are less likely to make CEO than men.

We can eliminate the effects of attrition, and mitigate through the passage of time, the effects of the initial conditions, by analyzing the pool of survivors. The probability of being a CEO with gender g at age t conditional on belonging to the population at age t_0 and remaining in it until at least age t is:

$$q_{t2}^{(g)} = \frac{\sum_{h=1}^{H} q_{t2}^{(g)}(h)}{\sum_{r=1}^{R} \sum_{h=1}^{H} q_{tr}^{(g)}(h)} \tag{8}$$

The panels of Figure 3 in the second row have two notable features, which characterize both age groups. Conditional on survival, the probability of being a CEO increases for more than a decade, rising to and then remaining above one half for a further 10 years (and longer for the younger group). More remarkably, amongst those who survive longer than 15 years, a woman invariably has a higher probability of being a CEO than a man! This finding contradicts common belief that women face glass ceilings.

Of course there are alternative definitions of top management, and we did investigate whether our conclusions are sensitive to them. In our career hierarchy chairmen who are not also officers directly under the CEO (such as the CFO and the COO) are classified in Rank 1. Rather than focus on Expression (7) only we also experimented with a more inclusive definition of top executive position by combining the two top ranks, and recomputing the comparable panels of the second row. The probability of being in the two top ranks with gender g at age t conditional on belonging to the population at age t_0 and surviving until age t at least is:

$$q_{t2}^{(g)} + q_{t1}^{(g)} = \frac{\sum_{r=1}^{2} \sum_{h=1}^{H} q_{tr}^{(g)}(h)}{\sum_{r=1}^{R} \sum_{h=1}^{H} q_{tr}^{(g)}(h)}$$

There is little to distinguish between the second row panels and fourth row panels, which depict our estimates of $q_{t2}^{(g)} + q_{t1}^{(g)}$. Using either definition of top management, our results provide scant support for the view that female executives in publicly listed companies face glass ceilings.

An alternative approach to measuring female representation at the highest levels of management is to compute, by gender, the fraction of executives who pass through the rank of CEO before retiring. Denote by $q_{t2}^{(CEO,g)}$ the number of executives who were in the sample at age $t_0 \in \{39, 49\}$ and had at least one year of CEO experience by age t, as a fraction of the sum of this number plus executives who are still waiting for the job of CEO, having neither quit the sample by age t nor made CEO. Within our framework this is equivalent to treating the CEO rank as an absorbing state, thus eliminating CEO retirement, leaving the other retirement probabilities unchanged, and assuming that an executive attaining the rank of CEO never changes rank again, Mathematically, it corresponds to defining $p_{t20}^{(CEO,g)}(h) = 0$, but leaving $p_{tr0}^{(CEO,g)}(h) = p_{tr0}^{(g)}(h)$ for all $r \neq 2$, and setting $p_t^{(CEO,g)}(2, h' | 2, h) = 1$ which implies $p_t^{(CEO,g)}(s, h' | 2, h) = 0$ for all $s \neq 2$. Thus:

$$q_{t+1,s}^{(CEO,g)}(h') = \sum_{h}^{H} \sum_{r=1}^{R} p_t^{(CEO,g)}(s, h' | r, h) \left[1 - p_{tr0}^{(CEO,g)}(h)\right] q_{tr}^{(CEO,g)}(h)$$

and

$$q_{t2}^{(CEO,g)} = \frac{\sum_{h=1}^{H} q_{t2}^{(CEO,g)}(h)}{\sum_{r=1}^{R}\sum_{h=1}^{H} q_{tr}^{(CEO,g)}(h)}$$

From the third panel we see that the cross over occurs earlier than in the second panel, thus validating our finding, that amongst survivors, females have a higher probability of reaching the position of CEO than males. The fact that their crossover age is about two years younger indicates that their tenure as a CEO is also a little lower, partly attributable to their higher rate of attrition.

X. Lifetime Compensation

Although female executives are paid more than males for a specific experience vector at any given rank, and have a higher probability of attaining the position of CEO than males conditional on remaining in top management, they quit sooner than males from these very lucrative senior positions. This not only reduces the net present value of their lifetime earnings in this occupation. From the results in Section 2, it also reduces their average annual earnings in the profession. One important reason why glass ceilings is a topical issue in discussions of gender discrimination is that the high ranking executive jobs are more financially lucrative than lower ranked positions. Rather than concentrate on whether female executives reach top executive positions, we can investigate the gender compensation gap directly, using estimates of $w_{tr}^{(g)}(h)$, expected compensation of executives conditional on age, gender,rank and human capital. In this part of the study we focus on two measures of lifetime earnings. The first measure is the sum of discounted expected earnings from executive management, defined by:

$$V_{t_0}^{(g)} \equiv \sum_{t=t_0}^{\infty}\sum_{r=1}^{R}\sum_{h=1}^{H} \beta^{t-t_0} w_{tr}^{(g)}(h)\, q_{tr}^{(g)}(h) \quad (9)$$

where β is the subjective discount factor. The second measure we use is average annual career wages, which corresponds to the steady state cross sectional average earnings. Average annual career earnings can be expressed as the ratio $W_{t_0}^{(g)}/T_{t_0}^{(g)}$, where $W_{t_0}^{(f)}$ is just Equation (4) defined for women executives, undiscounted expected future earnings for t_0 year old female executives, averaged over their experience and ranks:

$$W_{t_0}^{(f)} \equiv \sum\nolimits_{t=t_0}^{\infty} \sum\nolimits_{r=1}^{R} \sum\nolimits_{h=1}^{H} w_{tr}^{(f)}(h)\, q_{tr}^{(f)}(h) \tag{10}$$

Integrating the estimates obtained from the compensation regressions reported in Table 8 to obtain $w_{tr}(h)$, we calculated estimates of average career wage over that time $W_{t_0}^{(f)}/T_{t_0}^{(f)}$, and expected discounted sum of compensation $V_{t_0}^{(f)}$ from age t_0 onwards, and analogous quantities for males, setting the discount factor to $\beta = 0.9$. Then we computed counterfactuals for these numbers by endowing female executives with some of the factors that determine the executive careers of males.

The top entries in the middle column of the two panels imply that the estimated gender gap in (undiscounted) annual compensation for executives at age 39 and 49 averaged over the remainder of their management career is about $\$100,000$. Given the longer career horizon of males, at a 10 percent discount factor this translates to a present value of about \$2 million, which can be deduced from the third column. The gender gap in these career measures of executive compensation is not attributable to unequal pay for equal work. Our wage regressions, reported in Table 8, showed that at any given rank females are paid more for the same experience credentials. Substituting $q_{tr}^{(m)}(h)$ for $q_{tr}^{(f)}(h)$ in Equations (10) and (9) for $t_0 \in \{39, 49\}$ we find that the males would benefit about $\$100,000$ per year on average from receiving the compensation package of females, all else the same, which translates to about $\$400,000$ in present value terms over their career as executives, numbers that follow differencing the top from the bottom numbers in the middle and right columns of Table 9.

We investigated the effect of assigning the initial male distribution of ranks to female executives, substituting $q_{tr}^{(initial)}(h)$ for $q_{tr}^{(f)}(h)$ in Equations (10) and (9), and computing $W_{t_0}^{(initial)}/T_{t_0}^{(initial)}$ and $V_{t_0}^{(initial)}$. Table 9 shows that the initial assignment has greater impact (rising by $\$134,600$ for the older group, $\$76,400$ for the younger) than the probability transition computed in a similar fashion (where the numbers are $65,500 and $55,900 respectively). Most of the effect from switching the initial endowments comes from switching the initial rank alone, obtained by computing $W_{t_0}^{(rinitial)}/T_{t_0}^{(rinitial)}$ and $V_{t_0}^{(rinitial)}$. Indeed giving 49 year old executives the distribution of male initial experience actually reduces their average annual earnings throughout their career. Note that because these changes hardly affect the survivor function, the effect on discounted career earnings is attenuated.

Giving female executives the same retirement rates as males significantly lengthens their expected durations and for that reason alone generates higher expected discounted sums. To determine the effect of imposing male attrition rates on females we substituted $q_{tr}^{(retire)}(h)$ for $q_{tr}^{(f)}(h)$ in Equations (10) and (9) and computed $W_{t_0}^{(retire)}/T_{t_0}^{(retire)}$. The gender gap for discounted earnings over the remaining career declines substantially from $2.3 million to $699,000 for 49 year old executives and even more for 39 year old executives, from $1.85 million to $249,000. However the evidence from annual average career compensation is inconclusive. If 39 year old female executives substituted male retirement behavior for their own, then their annual compensation would rise by $69,100 per year, but for 49 year old executives, compensation would actually fall by $44,800.

In identifying the most important factors driving the average annual gender compensation gap, we should distinguish between the two age groups. Focusing first on the top panel we see that if 49 female executives had been assigned the initial rank distribution for males, their average career wage, $2,296,800 would have surpassed $2,195,200 the corresponding figure for males by about $100,000. The remaining factors, gender differences in retirement, job transitions, and the initial distribution of experience, collectively accounted for less than $2,000 per year of the differential between women and what men would earn if they received female compensation awards. Thus for the older group, the initial distribution of ranks fully accounts for the pay gap between men and women. This result contrasts with our findings for the younger group of executives, where switching retirement plays a much greater role in closing the gap between female average earnings and the hypothetical earnings males would make from receiving female wages. The younger group earns less than the older one over their career, partly because they are initially in lower ranked positions. Consequently as Table 6 shows, they are promoted more quickly, and earn relatively more late in their career. The effect on total earnings from spending an average of an extra 18 months in executive management is therefore more pronounced at 39 than at 49. This explains why both retirement and initial conditions contribute to the differences in average annual compensation in executive careers for this age group.

XI. Conclusion

To gauge the economic importance of the different characteristics, this empirical study of the executive market is based on a large panel data set, compiled by combining socioeconomic characteristics of executives with their job histories, detailed data on their compensation and the financial performance of their firms. We defined a career hierarchy of jobs as a complete and transitive ordering that reflects lifecycle choices, and constructed one for the executive market, and then the probability transitions for different groups and compensation. We find that the main reason why female executives rank lower than males and are paid less is that females are more likely to quit than their male counterparts. This result is robust to our definition of the career hierarchy, our aggregation result showing that if we have missclassifed then the bias appears favors those least likley to quit, males.

Conditional on age, education, working experience with the firm, turnover history, executive experience, rank, firm size and sector, women are paid slightly more than males, enjoy less wage volatility due to abnormal returns, and are equally likely to be promoted within the firm (although a little less likely to receive and accept an outside offer). Simply put, women don't climb as many rungs on the executive ladder because they are more likely than males to exit, through retirement or less plausibly move to another occupation. In this highly paid professional segment of the labor market there seems to be equal pay and equal opportunity for equal work.

We are not suggesting the glass ceiling is simply a manifestation of aggregation bias. Unobserved factors that lead managers to retire earlier could include more unpleasantries, indignities, and tougher unrewarding assignments at work, which are examples factors that reduce the nonpecuniary benefits from working without necessarily affecting productivity or human capital acquisition. Perhaps women are subject to this form of gender discrimination. Another hypothesis is that women acquire more nonmarket human capital than men throughout their lives, and hence find retirement a relatively attractive option. Whatever the mix of these unobservable factors, we conclude that the aggregate differences observed in the executive market between genders are almost entirely driven by factors that are unrelated to wages and promotion.

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Notes

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[1]Jacob Mincer and Solomon Polachek (1974) pioneered the neoclassical approach to human capital as a methodology for comparing wage and job choices by females with males. The quantitative importance of human capital in the labor market and within the household is estimated in a structural model of dynamic female labor supply by Sumru Altug and Robert Miller (1998). George-Levi Gayle and Limor Golan (2008) develop and estimate an equilibrium model of statistical discrimination to explain differences in wages between males and females that cannot be directly accounted for age or experience variables alone.

[2]For example, in their seminal work on negotiation, Linda Babcock and Sara Laschever (2003) extensively document and analyze gender differences in wage and salary negotiations.

[3]The data in Baker et al (1994) automatically satisfy the third axiom without further restrictions.

[4]Justin Wolfers (2006) remarks that if gender discrimination has no adverse consequences on the firm operations, but simply reduces the probability of promoting women, then only an especially talented woman would be promoted to CEO, and her achievement would be reflected in greater financial returns to the firm. Yet he finds no significant statistical relationship between the financial returns of a firm and the gender of its CEO, thus corroborating our findings.

[5]More generally Dan Black, Amelia Haviland, Seth Sanders and Lowell Taylor (2008), report although highly educated women earn approximately 30 percent less than men, more than half, but typically less than all the difference, is accounted for by background variables such as age, education and work experience.

[6]Changes in wealth from holding firm stock and options reflect the costs a manager incurs from not being able to fully diversify his wealth portfolio because of restrictions on stock and option sales. When forming their portfolio of real and financial assets, managers recognize that part of the return from their firm denominated securities should be attributed to aggregate factors, so they reduce their holdings of other stocks to neutralize those factors.

[7]Our results on retirement are comparable to those found in Table 5 of Margiotta and Miller (2000, page 696), whose study focuses on the three highest paid corporate executives. They also find that higher ranked executives are more likely to retire, and that higher compenstion has a significant, negative effect. The sign of the coefficient on excess returns is negative in both studies, but only in ours is it significant.

[8]The coefficients on the other variables, including indicators of education and firm sector, plus measures of firm size, excess returns, and lagged excess returns are not reported because they are less noteworthy.

[9]From Table 2 females are more concentrated in small firms than males, and, as documented in Gayle and Miller (2009) the premium on the CEO rank is much higher in large firms than small ones. From Table 4 females are least concentrated in the Primary sector, which offers the lowest compensation. These offsetting effects give the three factors we focus on greater prominence.

Figure 1: Hierarchy

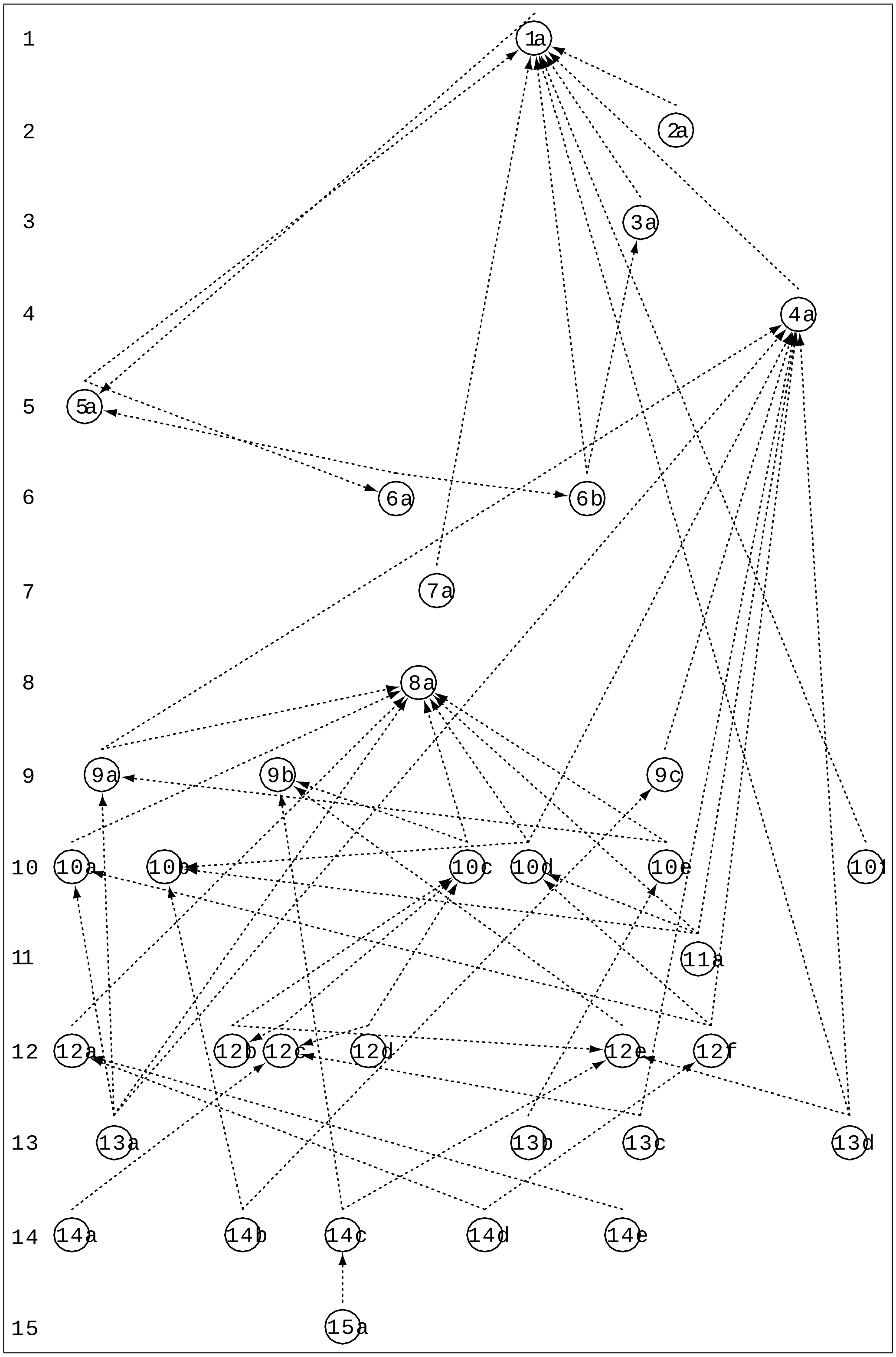

Table 1: Titles and Ranks

Rank	Code	Title(s)	# Males	# Females
R1	1a	chairman & vicechair	4135	53
	1b	schairman & sceo, chairman & sother, schairman & svicechair	1766	47
R2	2a	chairman & president & ceo	15768	193
	2b	ceo	8802	178
R3	3a	chairman & cfo	1326	46
	3b	chairman & execvp	121	3
	3c	chairman & coo	173	0
	3d	president & coo	4950	100
R4	4a	coo	1027	46
	4b	execvp	19524	1134
	4c	execvp & coo	1696	53
	4d	execvp & cfo	4464	285
R5	5a	snrvp	10692	659
	5b	spresident	5634	277
	5c	execvp & spresident	1152	77
	5d	execvp & other	2471	243
	5e	execvp & sceo, execvp & scoo	543	35
	5f	spresident & sceo, spresident & scoo	1803	80
	5g	president & execvp	120	13
R6	6a	vp	9152	524
	6b	snrvp & cfo	927	39
	6c	snrvp & spresident	3547	196
	6d	snrvp & other	1553	207
	6e	vp & other	3669	424
	6f	cfo & other	573	51
	6g	president & cfo	117	9
	6h	president & other	147	18
	6i	snrvp & coo	340	39
R7	7a	snrvp & sceo	472	22
	7b	cfo	1126	83
	7c	vp & cfo	2522	190
	7d	vp & spresident	1983	53
	7e	vp & sceo, vp & scoo	38	0
	7f	other & sceo	1640	143
	7g	scoo	550	26

Table 2A: Probability Transition Matrix

(percent from base rank)

	R1	R2	R3	R4	R5	R6	R7	# observations	# exit	% exit
R1	88	6	3	1	1	0	0	3995	487	12
R2	4	95	0	0	0	0	0	20150	929	5
R3	3	14	78	3	1	1	0	6272	1370	22
R4	1	2	3	86	4	2	1	19359	2624	14
R5	1	1	2	7	85	2	1	15781	2356	15
R6	0	0	1	6	6	85	2	14646	2248	15
R7	0	1	1	6	3	7	81	5581	1035	19
# entries	1303	1872	1447	2634	1981	1086	726			
% entries	33	9	23	14	13	7	12			

Table 2B : Turnover

(number of moves)

	R1	R2	R3	R4	R5	R6	R7	# moves	% exit
R1	52	36	8	4	1	0	0	165	4.1
R2	19	58	9	5	7	1	0	389	1.9
R3	10	40	26	14	9	1	1	140	2.2
R4	3	21	7	40	12	11	5	281	1.5
R5	2	36	10	14	34	3	1	211	1.3
R6	0	9	8	30	8	34	10	130	0.9
R7	2	13	4	30	6	19	26	53	0.9
Total	188	496	141	244	160	96	44	1369	1.6

Table 2C: Female Probability Transition Matrix

(percent from base rank)

	R1	R2	R3	R4	R5	R6	R7	# observations	# exit	% exit
R1	86	5	2	2	0	0	5	41	6	15
R2	5	95	0	0	1	0	0	220	10	5
R3	3	9	80	3	2	3	0	116	24	21
R4	1	1	3	85	6	3	2	519	80	15
R5	1	2	2	9	84	1	1	448	71	16
R6	0	0	0	4	7	87	2	407	55	13
R7	0	0	0	8	3	10	79	101	21	21
# entries	22	28	25	71	66	32	23			
% entries	53	13	21	14	15	32	23			

Table 3: Executive Background by Gender

(Salary and Compensation are measured in thousands of 2006 US$)

Variable	Overall	Male	Female
	Matched	Sample	
Age	53.7 (9.3)	53.8 (9.3)	50.9 (10.1)
No Degree	0.21	0.21	0.23
Bachelor	0.79	0.79	0.77
MBA	0.23	0.23	0.23
MS/MA	0.19	0.19	0.17
Ph.D.	0.18	0.17	0.21
Professional Certification	0.22	0.22	0.24
Executive Experience	18.32 (42.8)	18.5 (43.7)	15.0 (11.5)
Tenure	14.37 (11.48)	14.5 (11.5)	12.54 (10.8)
# of past moves	2.04 (2.00)	2.04 (2.00)	1.97 (1.9)
# of executive moves	0.82 (1.34)	0.82 (1.35)	0.77 (1.24)
retirement	0.231 (0.42)	0.228 (0.42)	0.30 (0.46)
Promotion	0.083 (0.28)	0.083 (0.28)	0.083 (0.28)
Salary	461 (299)	465 (301)	381 (244)
Compensation	2,460 (11,842)	2,480 (11,952)	2,040 (9,128)
	Full	Sample	
retirement	0.195 (0.37)	0.194 (0.39)	0.219 (0.41)
Promotion	0.082 (0.29)	0.082 (0.27)	0.082 (0.28)
Salary	410 (287)	414 (290)	333 (222)
Total Compensation	1,855 (11,044)	1,882 (11,130)	1,342 (11,542)

Table 4: Executive Background by Firm Type

(Salary and Compensation are measured in thousands of 2006 US$)

Variable	Service	Primary	Consumer	Asset Small	Asset Large	Employee Small	Employee Large
	Matched	Sample					
Age	52.7	54.8	53.6	53.9	53.7	53.7	53.8
	(9.5)	(9.2)	(9.4)	(10.3)	(9.3)	(11.2)	(9.3)
Female	0.056	0.03	0.06	0.06	0.04	0.05	0.04
No Degree	0.20	0.18	0.26	0.23	0.21	0.21	0.21
Bachelor	0.82	0.81	0.73	0.77	0.79	0.78	0.78
MBA	0.23	0.24	0.22	0.19	0.23	0.18	0.23
MS/MA	0.22	0.19	0.15	0.24	0.18	0.23	0.19
Ph.D.	0.18	0.20	0.15	0.18	0.18	0.21	0.17
Professional Certification	0.21	0.24	0.21	0.26	0.21	0.27	0.21
Executive Experience	18.28	18.7	17.9	20.6	17.1	19.4	17.2
	(53.3)	(49.8)	(18.7)	(12.3)	(11.3)	(12.1)	(11.3)
Tenure	13.62	15.0	14.28	16.2	14.1	15.7	14.1
	(10.93)	(11.5)	(11.5)	(12.07)	(11.4)	(12.1)	(11.4)
# of past moves	2.11	2.02	2.00	2.5	2.0	2.3	2.0
	(1.98)	(2.01)	(2.00)	(2.2)	(2.0)	(2.1)	(2.0)
# of executive moves	0.82	0.82	0.85	0.93	0.81	0.86	0.82
	(1.32)	(1.34)	(1.39)	(1.5)	(1.3)	(1.4)	(1.33)
Retirement	0.26	0.22	0.24	0.31	0.23	0.27	0.23
	(0.43)	(0.41)	(0.42)	(0.46)	(0.42)	(0.44)	(0.42)
Promotion	0.085	0.089	0.080	0.068	0.088	0.072	0.088
	(0.28)	(0.28)	(0.28)	(0.25)	(0.28)	(0.25)	(0.28)
Salary	442	496	584	327	544	361	546
	(271)	(296)	(392)	(185)	(334)	(233)	(334)
Compensation	3,270	1,841	2,041	1,350	3,022	1,538	3,056
	(14,435)	(8461)	(12,153)	(10,188)	(13,858)	(11,311)	(13,753)
	Full	Sample					
Female	0.047	0.031	0.063	0.055	0.046	0.053	0.045
Retirement	0.21	0.19	0.19	0.22	0.20	0.20	0.19
	(0.40)	(0.39)	(0.39)	(0.41)	(0.4)	(0.40)	(0.39)
Promotion	0.085	0.085	0.079	0.074	0.086	0.077	0.084
	(0.28)	(0.28)	(0.27)	(0.26)	(0.28)	(0.27)	(0.28)
Salary	424	428	506	311	524	324	506
	(273)	(270)	(358)	(178)	(344)	(204)	(331)
Total Compensation	3,052	1,849	1,925	1,372	2,851	1,531	2,551
	(13,624)	(8,101)	(11,542)	(8,870)	(12,875)	(9275)	(12,271)

Table 5: Executive Background by Rank

(Salary and Compensation are measured in thousands of 2006 US$)

Variable	R1	R2	R3	R4	R5	R6	R7
	Matched	Sample					
Age	59.6	55.7	52.4	52.0	52.8	52.4	52.2
	(9.8)	(7.6)	(8.0)	(8.8)	(10)	(10.3)	(11.2)
Female	0.02	0.02	0.03	0.05	0.06	0.06	0.05
	(0.13)	(0.12)	(0.16)	(0.23)	(0.24)	(0.24)	(0.21)
No Degree	0.25	0.21	0.25	0.21	0.21	0.17	0.21
	(0.43)	(0.41)	(0.43)	(0.40)	(0.41)	(0.37)	(0.41)
MBA	0.24	0.26	0.23	0.27	0.19	0.18	0.22
	(0.42)	(0.44)	(0.42)	(0.44)	(0.39)	(0.39)	(0.41)
MS/MA	0.16	0.17	0.17	0.19	0.21	0.21	0.21
	(0.37)	(0.37)	(0.37)	(0.39)	(0.41)	(0.40)	(0.40)
Ph.D.	0.15	0.15	0.14	0.13	0.21	0.27	0.17
	(0.37)	(0.35)	(0.34)	(0.33)	(0.41)	(0.44)	(0.38)
Prof. Certification	0.15	0.14	0.15	0.22	0.24	0.37	0.30
	(0.36)	(0.34)	(0.35)	(0.42)	(0.43)	(0.47)	(0.45)
Retirement	0.34	0.13	0.20	0.25	0.28	0.27	0.29
	(0.47)	(0.34)	(0.40)	(0.43)	(0.45)	(0.44)	(0.45)
Exec. Experience	22.3	19.8	16.1	15.9	16.6	16.5	16.9
	(13.0)	(10.5)	(10.7)	(11.0)	(12)	(11.7)	(11.7)
Tenure	17.1	15.1	13.7	13.8	14.1	13.7	14.2
	(13.5)	(11.7)	(11.4)	(11.2)	(12)	(11.0)	(10.8)
# of Past Moves	1.9	1.9	1.7	1.9	2.2	2.3	2.3
	(2.0)	(1.9)	(1.9)	(1.9)	(2.0)	(2.1)	(2.1)
# of Exec. Moves	0.9	0.93	0.73	0.76	0.77	0.80	0.84
	(1.4)	(1.38)	(1.3)	(0.13)	(1.32)	(1.3)	(1.4)
Salary	640	767	591	438	408	323	340
	(375)	(398)	(320)	(197)	(190)	(141)	(217)
Total Compensation	2682	4199	4055	2587	2311	1598	1867
	(18229)	(20198)	(14892)	(8536)	(7319)	(5539)	(6634)
	Full	Sample					
Female	0.02	0.02	0.03	0.05	0.06	0.07	0.06
	(0.13)	(0.12)	(0.16)	(0.22)	(0.23)	(0.25)	(0.24)
Retirement	0.35	0.16	0.22	0.27	0.31	0.31	0.31
	(0.47)	(0.36)	(0.41)	(0.44)	(0.46)	(0.46)	(0.46)
Salary	612	707	535	394	369	369	306
	(360)	(405)	(314)	(182)	(175)	(175)	(183)
Compensation	2,603	3,843	3,383	2,113	1,874	1,279	1,466
	(16,618)	(18,377)	(13,336)	(7,912)	(6,717)	(5,117)	(6,447)

Table 6: Logit of Promotion and Turnover

(Standard errors in parentheses)

Current Variable	Promotion	External Promotion	Turnover	Retirement
Compensation	-0.001	0.006	0.007	-5.9e-03
	(0.001)	(0.007)	(0.003)*	(1.9e-03)**
ER	-0.21	-0.197	-0.422	-0.147
	(0.030)**	(0.156)	(0.093)**	(0.102)**
ER Lagged	-0.124	0.054	-0.229	-0.172
	(0.025)**	(0.199)	(0.076)**	(0.038)**
R2	-2.2	-2.993	-0.434	-1.254
	(0.058)**	(0.496)**	(0.114)**	(0.078)**
R3	-0.999	-1.797	-0.103	-0.688
	(0.066)**	(0.542)**	(0.146)	(0.103)**
R4	-0.99	-1.56	-0.263	-0.38
	(0.053)**	(0.505)**	(0.120)*	(0.077)**
R5	-0.658	-0.471	-0.553	-0.218
	(0.054)**	(0.58)	(0.134)**	(0.077)**
R6	-0.743	-0.963	-0.558	-0.334
	(0.055)**	(0.552)	(0.139)**	(0.079)**
R7			-0.532	-0.251
			(0.140)**	(0.102)**
Consumer	-0.021	0.318	-0.152	0.11
	(0.037)	(0.265)	(0.091)	(0.051)**
Services	0.075	0.025	-0.001	0.301
	(0.034)*	(0.22)	(0.083)	(0.046)**
Assets	0.000	0.001	0.000	2.9e-04
	(0.000)	(0.005)	(0.001)	(3.9e-04)
Employees	0.001	0.008	0.001	0.0001
	(0.000)**	(0.004)*	(0.000)*	(0.0003)
Observations	28443	757	30343	14774

* significant at 5%; ** significant at 1%

Table 6 cont.: Logit of Promotion and Turnover

(Standard errors in parentheses)

Current Variable	Promotion	External Promotion	Turnover	Retirement
Executive Experience	0.000	0.002	0.000	0.000
	(0.000)	(0.004)	(0.001)	(0.000)
Tenure	0.011	0.000	-0.041	0.003
	(0.001)**	(0.011)	(0.004)**	(0.002)
# of Executive Moves	0.059	-0.227	0.092	0.004
	(0.014)**	(0.111)*	(0.037)*	(0.019)
# of past moves	0.016	0.095	-0.08	0.043
	(0.011)	(0.083)	(0.030)**	(0.015)
Age	-0.107	0.008	0.185	0.022
	(0.010)**	(0.111)	(0.041)**	(0.014)
Age Square	0.001	0.000	-0.002	0.000
	(0.000)**	(0.001)	(0.000)**	(0.000)
Female	0.053	-1.153	0.012	0.482
	(0.071)	(0.483)*	(0.198)	(0.117)**
No Degree	-0.058	-0.562	0.181	-0.138
	(0.043)	(0.292)	(0.105)	(0.062)*
MBA	-0.043	-0.255	0.287	-0.059
	(0.037)	0.235)	(0.086)**	-0.052)
MSMA	0.008	0.212	-0.11	0.021
	(0.037)	(0.26)	(0.098)	(0.049)
Ph.D.	-0.05	-0.574	-0.031	-0.071
	(0.039)	(0.274)*	(0.103)	(0.053)
Prof. Certification	-0.151	-0.538	-0.044	-0.007
	(0.036)**	(0.253)*	(0.094)	(0.048)
Turnover	2.14			-0.21
	(0.088)**			(0.164)
Constant	3.583	3.366	-8.038	-1.927
	(0.292)**	(3.188)	(1.150)**	(0.421)**
Observations	28443	757	30343	14774

* significant at 5%; ** significant at 1%

Table 7: Transition logit

Rank Next Period	Int						Extl						
	1	3	4	5	6	7	1	2	3	4	5	6	7
Constant	0.92	4.04	3.73	3.01	2.71	3.27	-22.6	3.58	0.64	0.04	-20.8	-22.0	-24.7
	(1.71)	(1.53)**	(1.5)*	(1.60)	(1.72)	(2.01)	(8.0)**	(2.05)	(4.01)	(2.84)	(0.14)**	(0.01)**	(0.01)**
R2	-6.06	-5.31	-4.88	-4.49	-6.19	-4.12	-5.02	-2.93	-3.31	-4.39	14.2	11.8	16.3
	(0.15)**	(0.30)**	(0.46)**	(0.56)**	(1.13)**	(0.88)**	(0.28)**	(0.24)**	(0.52)**	(0.56)**	(4.3)**	(4.7)*	(6.3)*
R3	-4.11	2.23	-0.14	-0.19	-0.37	-0.01	-3.04	-1.31	0.14	-1.36	17.4	15.1	-12.4
	(0.19)**	(0.22)**	(0.37)	(0.49)	(0.61)	(0.82)	(0.44)**	(0.29)**	(0.51)	(0.60)*	(4.26)**	(4.7)**	(87.7)
R4	-3.38	0.88	5.29	2.86	2.41	2.62	-2.96	-0.62	0.19	1.84	18.5	19.1	22.6
	(0.21)**	(0.24)**	(0.34)**	(0.45)**	(0.54)**	(0.74)**	(0.62)**	(0.30)*	(0.55)	(0.46)**	(4.3)**	(4.6)**	(6.3)**
R5	-2.64	1.6	3.84	6.84	3.85	3.64	-2.94	0.84	1.08	1.49	20.5	19.1	22.7
	(0.26)**	(0.27)**	(0.37)**	(0.46)**	(0.55)**	(0.76)**	(1.04)**	(0.32)**	(0.58)	(0.53)**	(4.2)**	(4.6)**	(6.3)**
R6	-3.55	1.16	4.34	4.91	8.03	4.88	-28.4	0.17	1.14	2.99	20.4	21.1	24.4
	(0.49)**	(0.35)**	(0.41)**	(0.49)**	(0.57)**	(0.77)**	(52.2)	(0.47)	(0.69)	(0.53)**	(4.3)**	(4.6)**	(6.3)**
R7	-3.54	0.99	3.89	4.0	4.94	8.22	-39.9	-0.68	0.82	2.82	18.4	20.5	25.2
	(0.67)**	(0.46*	(0.47)**	(0.56)**	(0.62)**	(0.79)**	(240)	(0.81)	(0.91)	(0.60)**	(4.4)**	(4.6)**	(6.3)**
Female	-0.18	0.11	0.95	1.08	1.14	1.83	0.34	1.0	-0.37	0.93	0.68	1.07	1.94
	(0.41)	(0.32)	(0.3)**	(0.31)**	(0.33)**	(0.36)**	(1.04)	(0.32)**	(1.03)	(0.50)	(0.64)	(0.59)	(0.68)**
Age	-0.04	-0.19	-0.25	-0.26	-0.27	-0.32	0.73	-0.19	-0.10	-0.14	-0.02	0.05	-0.04
	(0.06)	(0.06)**	(0.06)**	(0.06)**	(0.06)**	(0.07)**	(0.28)**	(0.07)*	(0.15)	(0.11)	(0.16)	(0.18)	(0.25)
Age Sq.	0.00	0.00	0.00	0.00	0.01	0.00	-0.01	0.00	0.00	0.00	0.00	-0.001	0.00
	(0.00)*	(0.00)**	(0.00)**	(0.00)**	(0.00)**	(0.00)**	(0.00)*	(0.00)**	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Exec. Exp.	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-0.02	0.01	-0.03
	(0.01)	(0.02)	(0.01)	(0.01)*	(0.01)	(0.01)	(0.01)	(0.01)*	(0.01)	(0.01)	(0.02)	(0.01)	(0.03)
Tenure	0.01	0.01	0.01	0.01	0.01	0.02	-0.06	-0.03	-0.03	-0.04	-0.01	-0.03	0.03
	(0.01)*	(0.01)	(0.01)	(0.01)*	(0.01)	(0.01)*	(0.02)**	(0.01)**	(0.01)*	(0.01)**	(0.02)	(0.02)	(0.03)
# Exec. Moves	-0.01	-0.07	-0.07	-0.14	-0.11	-0.11	0.30	0.06	-0.01	-0.20	0.05	-0.09	0.29
	(0.06)	(0.05)	(0.05)	(0.06)*	(0.06)	(0.07)	(0.16)	(0.07)	(0.13)	(0.10)*	(0.13)	(0.13)	(0.21)
# Past Moves	0.07	0.05	0.11	0.16	0.18	0.17	-0.19	0.01	-0.03	0.14	0.15	0.01	0.06
	(0.04)	(0.04)	(0.04)**	(0.04)**	(0.04)**	(0.05)**	(0.13)	(0.05)	(0.1)	(0.07)*	(0.09)	(0.10)	(0.15)

Standard errors in parentheses

* significant at 5%; ** significant at 1%

Table 8: Compensation Regressions

(Standard errors in parentheses)

Level	LS	LAD	Slope of ER	LS	LAD
Constant	804	1,222	ER	3,520	8,478
	(260)**	(192)**		(178)**	(129)**
			ER squared	-221	-238
				(5)**	(3.6)**
Consumer	26	83	ER × Consumer	-263	334
	(30)	(21)**		(66)**	(47)**
Service	265	519	ER × Service	338	1,427
	(28)**	(20)**		(54)**	(39.)**
Assets	0.026	0.03	ER × Asset	0.034	0.086
	(0.001)**	(0.0)**		(0.001)**	(0.001)**
Employees	12	17	ER × Employees	25	32.
	(0.3)**	(0.2)**		(0.82)**	(0.6)**
R2	1,043	1,388	ER × R2	2,428	1,423
	(53)**	(39)**		(120)**	(88)**
R3	269	66	ER × R3	-1,212	-5,254
	(64)**	(47)		(137)**	(100)**
R4	-253	-767	ER × R4	-2,553	-8,068
	(56)**	(41)**		(122)**	(89)**
R5	-357	-932	ER × R5	-3,237	-8,921
	(56)**	(42)**		(124)**	(90)**
R6	-610	-1,139	ER × R6	-3,462	-9,188
	(58)**	(42)**		(123)**	(90)**
R7	-529	-1,109	ER × R7	-3,417	-9,227
	(70)**	(51)**		(137)**	(100)**

* significant at 5%; ** significant at 1%

Table 8 (cont.): Compensation Regressions

(Standard errors in parentheses)

Level	LS	LAD	Slope of ER	LS	LAD
Age	26	20	ER × Age	28	29
	(8.8)**	(6)**		(2.4)**	(1.7)**
Age Squared	-0.22	-0.16			
	(0.08)**	(0.06)**			
Female	160	92	ER × Female	-41	-286
	(62)*	(46)*		(111)	(75)**
No Degree	1.1	12	ER × No Degree	-92	-68
	(34)	(25)		(60)	(44)
MBA	110	130	ER × MBA	107	234.566
	(30)**	(22)**		(58)	(43)**
MS/MA	-94	-74	ER × MS/MA	-372	-356
	(30)**	(22)**		(55)	(41)**
Ph.D.	-2.2	32	ER × Ph.D.	-31	101
	(32)	(23)		(58)	(42)*
Prof. Cert.	-76	-102	ER × Prof. Cert.	-8.3	-200
	(29)**	(22)**		(52)	(38)**
Exec. Exp.	-0.07	-0.08	ER × Exec. Exp.	-0.5	-1.1
	(0.29)	(0.2)		(0.4)	(0.2)**
Tenure	-5.6	-4.6	ER × Tenure	5.4	9
	(1.2)**	(0.9)**		(2)**	(1.5)**
# of Past Moves	-35	-321	ER × # of Past Moves	-70	-81
	(9)**	(6.6)**		(16)**	(11)**
# of Exec. Moves	21	22	ER × # of Exec. Moves	-23	11
	(12)	(8.8)*		(21)	(15)
First Year	250	552	ER × First Year	-1,176	-514
	(85)**	(63)**		(157)**	(116)**
R^2	0.64				
Observations	35602	35602			

* significant at 5%; ** significant at 1%

Table 9: Initial Conditional by Gender

Variables	39 Female	Cohort Male	49 Female	Cohort Male
Rank 1	0.01	0.03	0.02	0.03
Rank 2	0.00	0.10	0.10	0.19
Rank 3	0.02	0.08	0.05	0.09
Rank 4	0.31	0.25	0.30	0.25
Rank 5	0.21	0.20	0.26	0.19
Rank 6	0.29	0.24	0.22	0.18
Rank 7	0.17	0.11	0.07	0.07
Exec. Experience	11.2 (9.0)	11.2 (9.3)	12.9 (9.1)	13.2 (8.8)
Tenure	8.9 (7.8)	9.5 (9.2)	10.0 (8.3)	11.1 (9.3)
# of Past Moves	2.2 (1.7)	1.8 (1.6)	2.0 (1.8)	1.9 (1.8)
# of Exec. Moves	0.6 (1.0)	0.5 (0.9)	0.8 (1.1)	0.7 (1.2)

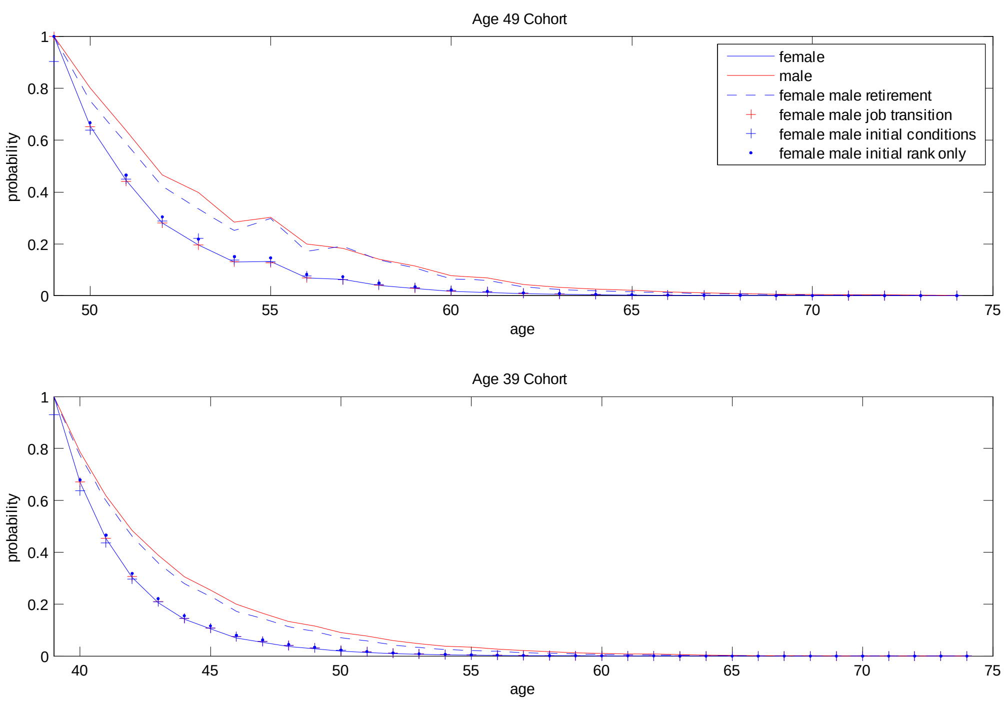

Figure 2: Survival Probabilities

Table 10: Dynamic Gender Gaps Decomposition

	Epected Career Length (T)	Average Career Wage (W/T)	Discounted Earnings
	Age 49 assignment	Career Length	
Male	4.8519	2,195,200	7,606,800
Female	3.0901	2,106,100	5,303,700
Female with Male Initial Assignment (q_0)	3.0524	2,240,700	5,494,000
Female with Male Job Transition (p_{rs})	3.0887	2,171,600	5,415,700
Female with Male Retirement (p_{r0})	4.5186	2,061,400	6,907,800
Female with Male Initial Rank Assignment	3.2660	2,296,800	6,028,800
Female with Male Career Distribution	4.8519	2,298,500	8,092,300
	Age 39 assignment	Career Length	
Male	4.9251	1,931,400	6,395,200
Female	3.1381	1,820,900	4,540,800
Female with Male Initial Assignment (q_0)	3.0495	1,897,300	4,534,500
Female with Male Job Transition (p_{rs})	3.1853	1,876,800	4,672,200
Female with Male Retirement (p_{r0})	4.5752	1,890,000	6,146,000
Female with Male Initial Rank Assignment	3.2653	1,875,800	4,790,100
Female with Male Career Distribution	4.9251	2,034,400	6,862,000

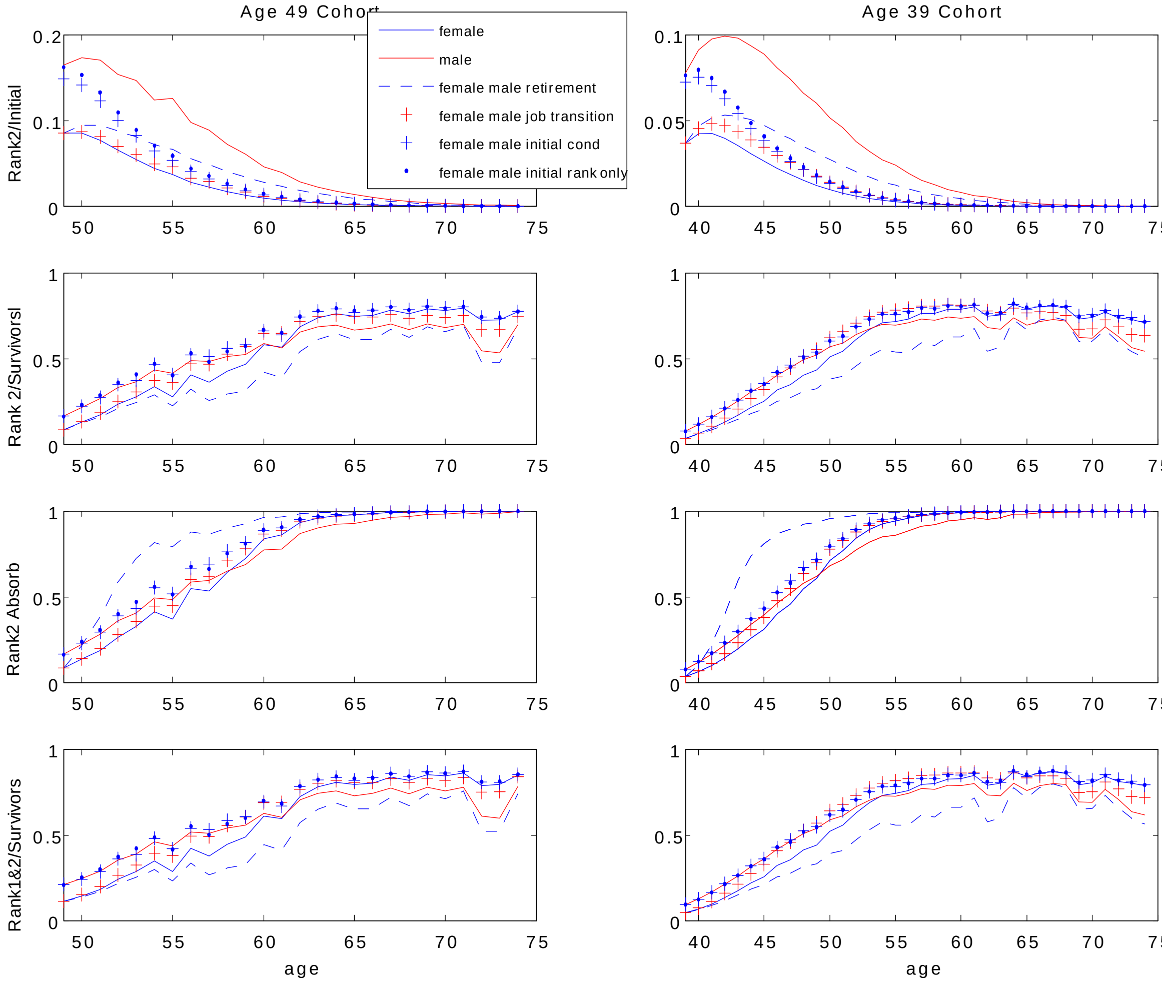

Figure 3: Glass Ceiling

XII. Appendix A: Additional Tables

Table A: Logit of Promotion and Turnover

Current Variable	Promotion	Promotion	External Promotion	External Promotion	Turnover	Turnover	Retirement	Retirement
Sample	Full	Matched	Full	Matched	Full	Matched	Full	Matched
Compensation	0.012	0.000	-0.004	0.000	0.011	0.008	-6.9e-03	0.000
	(0.002)**	(0.001)	(0.008)	(0.005)	(0.002)**	(0.002)**	(1.2e-03)**	(0.000)**
ER	-0.121	-0.223	-0.067	-0.134	-0.346	-0.409	-0.201	-0.232
	(0.028)**	(0.026)**	(0.175)	(0.133)	(0.065)**	(0.076)**	(0.021)**	(0.038)**
ER Lagged	-0.003	-0.095	0.069	-0.019	-0.36	-0.235	-0.117	-0.148
	(0.021)	(0.020)**	(0.156)	(0.17)	(0.061)**	(0.062)**	(0.018)**	(0.031)**
R2	-5.457	-2.217	-3.981	-2.991	-0.311	-0.683	-1.07	-1.296
	(0.246)**	(0.048)**	(0.497)**	(0.410)**	(0.091)**	(0.108)**	(0.052)**	(0.067)**
R3	-0.318	-0.973	-1.75	-1.457	-0.058	-0.436	-0.678	-0.796
	(0.057)**	(0.054)**	(0.484)**	(0.460)**	(0.115)	(0.131)**	(0.063)**	(0.085)**
R4	-1.367	-0.991	-2.342	-1.466	-0.299	-0.552	-0.414	-0.481
	(0.052)**	(0.043)**	(0.456)**	(0.418)**	(0.090)	(0.109)**	(0.048)**	(0.063)**
R5	-0.656	-0.662	-1.047	-0.465	-0.541	-0.835	-0.237	-0.328
	(0.047)**	(0.044)**	(0.468)*	(0.479)	(0.098)**	(0.119)**	(0.047)**	(0.063)**
R6	-0.404	-0.709	-1.447	-0.776	-0.738	-0.956	-0.281	-0.445
	(0.047)**	(0.045)**	(0.476)**	(0.467)	(0.105)**	(0.125)**	(0.048)**	(0.065)**
R7					-0.514	-0.799	-0.244	-0.354
					(0.087)**	(0.164)**	(0057)**	(0.085)**
Consumer	-0.06	0.025	0.145	0.396	-0.106	-0.2	0.08	0.097
	(0.037)	(0.03)	(0.236)	(0.213)	(0.071)	(0.076)**	(0.028)**	(0.042)*
Services	-0.015	0.126	0.178	0.266	0.074	0.079	0.292	0.271
	(0.034)	(0.027)**	(0.211)	(0.179)	(0.064)	(0.068)	(0.025)**	(0.039)**
Assets	0.000	0.000	0.012	0.001	0.000	0.000	-2.8e-04	0.000
	(0.000)	(0.000)	(0.005)*	(0.004)	(0.000)	(0.001)	(2.8e-04)	(0.000)
Employees	0.001	0.001	0.001	0.004	0.001	0.001	-0.0002	0.000
	(0.000)**	(0.000)**	(0.002)	(0.002)	(0.000)**	(0.000)*	(0.0002)	(0.000)
Female	-0.269	0.115	-0.446	-0.489	-0.087	0.071	0.3	0.242
	(0.073)**	(0.056)*	(0.466)	(0.379)	(0.146)	(0.154)	(0.052)**	(0.089)**
Turnover	2.321	2.273					-0.148	-0.238
	(0.094)**	(0.075)**					(0.088)	(0.133)
Constant	-1.537	-0.054	1.326	2.454	-3.76	-2.957	-0.687	-0.719
	(0.042)**	(0.054)	(0.433)**	(0.403)**	(0.080)**	(1.101)**	(0.045)**	(0.058)**
Observations	66546	41197	1369	1094	76715	43842	44682	20757

Standard errors in parentheses

* significant at 5%; ** significant at 1%

Table A2: Compensation (w\o backgroung variables) Regressions

(Standard errors in parentheses)

Level	LS	LS	LAD	LAD	Slope of ER	LS	LS	LAD	LAD
	Full	Matched	Full	Matched		Full	Matched	Full	Matched
Constant	1,341	1823	1,586	1668.95	ER	3,747	18,584	8,164	9,612
	(27)**	(235)**	(24)**	(34)**		(60)**	(550)**	(53)**	(79)**
					ER squared	-228	-891	-100	-158
						(1.7)**	(21)**	(1.5)*	(3.2)**
Consumer	49	145	63	107	ER × Consumer	-125	2,013	-6.8	283
	(14)**	(132)	(12)**	(19)**		(27)**	(292)**	(24)	(42)**
Service	257	1159	405	515	ER × Service	268	2,278	994	1,245
	(13)**	(123)**	(11)**	(17)**		(22)**	(242)**	(19)**	(34)**
Assets	0.022	0.026	0.022	0.029	ER × Asset	0.046	0.118	0.064	0.087
	(0.001)**	(0.001)**	(0.001)	(0.000)**		(0.001)**	(0.005)**	(0.001)**	(0.000)**
Employees	12	15	14	15.9	ER × Employees	15	31.18	29	26
	(0.11)**	(1.06)**	(0.1)**	(0.15)**		(0.36)**	(3.44)**	(0.32)**	(0.49)**
R2	666	2,316	1,288	1,487	ER × R2	841	-904.65	1,146	1,951
	(29)**	(244)**	(25)**	(35)**		(61)**	(550)	(54)**	(79)**
R3	164	1,418	46	230	ER × R3	-949	-9,016	-4,598	-4,907
	(33)**	(289)**	(29)	(41)**		(67)**	(618.3)**	(59)**	(88)**
R4	-320	-282	-661	-683	ER × R4	-2,033	-13,420	-6,455	-7,641
	(29)**	(248)	(25)**	(35)**		(60)**	(554.3)**	(53)**	(79)**
R5	-427	-160	-866	-902	ER × R5	-2,424	-14,829	-7,233	-8,663
	(29)**	(254)	(25)**	(36)**		(60)**	(566.16)**	(53)**	(81)**
R6	-630	-654	-1,077	-1,119	ER × R6	-2,574	-14,477	-7,508	-8,954
	(29)**	(257)**	(26)**	(37)**		(60)**	(558)**	(53)**	(80)**
R7	-587	-513	-1,026	-1,069	ER × R7	-2,506	-13,002	-7,361	-8,874
	(32)**	(312)	(29)**	(44)**		(63)**	(609)**	(55)**	(87)**
Female	-26	198	-64	52.55	ER × Female	-184	-255	-265	-170
	(123)	(269)	(22)**	(38.7)		(36)**	(473)	(32)**	(68)**
First Year	577	1202	922	582	ER × First Year	-1,390	-1,966	-1,806	-514
	(38)**	(396)**	(33)**	(56)**		(58)**	(734)**	(51)**	(116)**
R^2	0.6	0.23							
Observations	101076	51,668	101076	51,668					

* significant at 5%; ** significant at 1%