Essay 3

Fast Tracks and Functional Area as Determinants of Promotions: Evidence on U.S. Executives

3.1 Introduction

Intra-firm promotions have attracted the attention of labor economists since the seminal work of Doeringer and Piore (1971). From interviews of management and union officials in US manufacturing companies, they show that wages and allocations of workers to jobs are not consistent with standard labor economics theory, but take place in an "internal labor market", characterized by its own institutional rules. Since then, economic analysis of internal labor markets have consisted in providing empirical evidence on individual careers in organizations and building theories to explain the stylized facts. Among the stylized facts that concern promotions, Lazear (1992) and Baker, Gibbs, and Holmstrom (1994a,b), using single firm data, show that promotions are a major determinant of wage growth and that the rate of promotions varies with tenure and the level in the hierarchy. Despite the central role they play in the individual's career in a firm, explaining why promotions occur has remained relatively unexplored in the empirical literature.

This paper considers the promotion of high level American executives. We estimate a dynamic reduced-form model of promotion outcomes using an employer-employee panel of over 300 of the largest corporations in the U.S. The model demonstrates the relative importance of variables that influence promotion, examines the existence and source of fast tracks in promotion and considers the role of functional area. Our econometric model of promotion allows for both an endogenous initial condition and sample attrition linked to individual heterogeneity. When analyzing the role of fast tracks, we capture their spurious effect (the effect attributable to unobserved individual heterogeneity) by conditioning individual heterogeneity on the initial speed of promotion. We are then able to capture the causal effect of fast tracks by analyzing the impact of the speed of promotion measured at each period.

This paper advances earlier investigations of promotion in the personnel economics literature and in the management literature. By analyzing the role played by the speed of past promotions on promotion outcomes, we are able to evaluate some implications from models of job assignment. We corroborate findings on promotion regarding the effect of hierarchical level, the link with firm exit and the importance of unobserved heterogeneity in the personnel economics literature (Baker, Gibbs, and Holmstrom, 1994a,b; Lazear, 1992). Moreover, this paper advances the work begun in an earlier paper (Belzil and Bognanno, 2004) and is superior in many respects. At the same time, investigating the impact that functional area may have on promotion outcomes contributes to the management science literature on this question (Vroom and MacCrimmon, 1968; Forbes and Piercy, 1991) and validates the idea of heterogeneity in task and talent within the same hierarchical rank of the firm, emerging in theoretical work (Hecker, 2009). A second major focus of the paper concerns the predictability of promotion, on which there is little evidence in the empirical literature. This has implications for tournament-related promotion incentives and the extent to which the outside labor market can infer an executive's promotability. The extent to which promotability can be inferred by the outside labor market affects the magnitude of the signal received by the labor market

when a promotion occurs. Findings on the signaling effect of promotion are appearing in the literature (DeVaro and Waldman, 2007).

A principle finding in this paper is that, when promotion is defined as a change in job title resulting in a higher pay grade midpoint, the most influential determinant of promotion by far is unobserved heterogeneity. Determinants of less importance are the speed of past advancement (*rmidage* - measured as the real pay grade midpoint divided by the executive's age), human capital (age and education), firm variables (profits, sales and size), tenure, newcomer status and reporting level in the firm. Rates of promotion diminish with advancement in level and age. The initial speed of past advancement, on which unobserved individual heterogeneity is conditioned, has a strong effect on promotion probabilities, but recent speed of past advancement has no significant effect. This indicates that fast tracks in promotions result from heterogeneity in persistent individual characteristics and do not have a structural (causal) effect. Promotion probabilities are positively correlated with sample attrition.[1] Overall, the promotion process can be characterized as a static discrete outcome model in which all serial correlation can be accounted for by persistent individual unobserved factors.

The second main finding is that functional area, measured at the beginning of the sample period, has a high explanatory power in promotion outcomes, which partially substitutes to the impact of the speed of past advancement. Higher promotion probabilities are found in marketing services, management and manufacturing. The estimation of a non-causal model of promotions, in which unobserved heterogeneity is not modeled, shows that recent past base pay growths are good predictors of future promotions. Functional area also performs well in predicting promotion probabilities.

The remaining sections of the paper are structured according to the following format. Section 3.2 discusses the economics literature on promotions. Section 3.3 contains a

[1]This results is related to the findings of both Baker, Gibbs, and Holmstrom (1994a) and Treble et al. (2001), who document fast track exit effects (those promoted more quickly having a higher exit rate from the firm). We note that individual attrition in our data occurs when the firm does not report information for an executive but does report on other executives. In this case, exit from the firm can either be caused by the worker leaving the firm (either voluntary or involuntary) or by the firm deciding not to report for the executive even when he is still present in the firm.

discussion of the data. Section 3.4 contains the empirical model and results are discussed in Section 3.5. Concluding remarks are found in Section 3.6.

3.2 Promotions in the Economics Literature

Much of the influential work on firm hierarchies comes from single firm studies of personnel records that allow for a comprehensive examination of the internal workings of the firm.[2] Key early papers include Baker, Gibbs and Holmstrom (here after BGH) 1994a; 1994b, and Lazear (1992). BGH (1994a) examined twenty years of personnel data for all management employees of a single, medium-sized U.S. firm in a service industry. Lacking information on reporting relationships, they relied on observed job transitions in the data to define levels within the firm. Since there were many lengthy careers with movement through numerous job titles, they were able to precisely identify the firm's hierarchical levels. Eight levels and seventeen primary job titles covered over 99% of management level employment. Underscoring the gains to promotion, BGH (1994b) found that levels alone explained about 70% of the variance in pay across employees in a given year. Their results regarding promotion included: evidence of fast tracks (workers promoted quickly from low levels were promoted subsequently more quickly);[3] the rate of promotion was higher at low levels in hierarchy;[4] promotion rates fell with firm tenure; positive correlation between rapid promotion and firm exit. BGH (1994b) found evidence of serial correlation in real wage growth for managers that persisted after accounting for observable differences between individuals. Observable characteristics explained only part of heterogeneity across managers. As greater wage growth was

[2]Gibbs and Hendricks (2004) summarize the findings of several single firm studies. Eriksson and Werwatz (2005) examine data perhaps most comparable to ours, a panel of 222 Danish firms with employees in multiple job classifications in each firm.

[3]Evidence of promotion fast tracks was found also in Ariga, Ohkusa, and Brunello's (1999) study of a Japanese firm, in the Seltzer and Merrett's (2000) study of the Union Bank of Australia, in Treble et al.'s (2001) study of large British financial sector firm, in Gibbs and Hendricks's (2004) study of a large US corporation and by Rosenbaum (1979). Howard and Bray (1988) find that Bell System managers with more significant job challenges in their initial years of employment had greater advancement at year twenty.

[4]Evidence of higher rates of promotion in lower hierarchical levels was also noted in Treble et al. (2001).

associated with a greater speed of promotion, BGH suggest that the presence of an unobserved variable, such as ability, drives both promotions and wage growth.

Lazear (1992) analyzed thirteen years of personnel records from a large manufacturing firm. Lazear's findings included that those who changed jobs tended to have higher starting pay upon hire and this also increased the likelihood of higher relative career pay. Hence, differences in starting pay well explained differences in career earnings between workers and made starting pay and the first job important. This account of promotions being persistently influenced by factors at the time of hire is suggestive of fast tracks.

Lazear states that workers may be sorted into their initial job assignment on the basis of real differences between them (unobserved individual heterogeneity to the researcher) or on the basis of a first impression that nevertheless carries a career-long effect. This unanswered question regarding the source of career-long advantages enjoyed by some workers relates to explanations of promotion fast tracks in job assignment models under alternative assumptions. Promotion fast tracks can result from both differences between workers in innate ability and from the advantage gained through early initial promotion.[5]

One distinction made between models of job assignment is whether learning about worker ability is asymmetric. In job assignment models with asymmetric learning of worker ability, the current employer is fully informed and outside firms learn worker ability through the signal provided by observing the worker's current and previous job assignments. Job assignment models with heterogeneous workers, assuming either full information or asymmetric learning, imply serial correlation in promotion outcomes (fast tracks) due to differences in worker ability, with more able workers achieving promotion more rapidly. However, in models with asymmetric learning, past promotions also have an inherent effect on promotion outcomes after conditioning on worker ability. Higher wages must be paid to workers whose promotions signal high ability to outside firms. Since workers who have been rapidly promoted in the past have already been signaled

[5]We draw these implications from two classes of models: the case of full information (e.g., Gibbons and Waldman, 1999) and the case of asymmetric learning (e.g., Waldman, 1984, and Bernhardt, 1995).

to be of high ability, their subsequent promotion is less costly and, hence, speedy past promotions will have a positive causal effect on the probability of subsequent promotion. This implies that serial persistence in individual promotion histories may simultaneously result from both persistent unobserved heterogeneity and state dependence explained by past promotion outcomes. Stated differently, fast tracks may arise both because of difference in ability and because of the advantage given fast climbers. When fast tracks arise out of differences in ability, we call this a spurious fast track because rapid initial promotion provides no inherent advantage in subsequent promotion. The latter reason gives rise to what we call a causal fast track, promotions that comes more quickly because of the speed of past promotions. Our empirical methods will distinguish between these two potential sources of fast tracks. Evidence of casual fast tracks supports the notion of promotion signaling in the job assignment models with asymmetric information.[6]

This paper is related to a previous work (Belzil and Bognanno, 2004) that's central focus was to develop an empirical model of the determinants of promotion given the executive's human capital, firm scale variables, the executive's promotion opportunities and reporting level, unmeasured individual and firm characteristics and the speed of the worker's past hierarchical advancement. The static model estimated found that the most influential factors explaining the probability of a promotion were unobserved heterogeneity, the executive's reporting level in the firm and the executive's promotion opportunities. A dynamic model of promotion examined the effects of the past speed of promotion on current promotion probabilities, after conditioning on unobserved heterogeneity. After conditioning on unobservable heterogeneity, the speed of past advancement in level negatively influenced subsequent advancement for most executives. For a minority of executives, past speed of advancement aided promotion (and a fast track was found) and was associated with executives at lower levels and with lesser human capital. The overall influence of the speed of past promotion on subsequent promotion was negligible.

[6]DeVaro and Waldman (2007) look for evidence of the signaling role of promotions in examining the returns to promotion for workers with differing productive characteristics.

There are four central improvements in this paper over the previous work of Belzil and Bognanno (2004). First, this paper includes an analysis of the role of functional area on promotion that was not examined previously and has received scant attention in the economics literature. Second, Belzil and Bognanno (2004) employed advancement in reporting level towards the CEO position as the measure of promotion. In this paper, we use changes in job titles coupled with nominal pay grade midpoint increases to define promotion. We show that this new definition of promotion exhibits more power in explaining wages than the previous promotion measure. Linking promotion to changes in job title is also more standard in the literature and gives the results greater comparability. Third, the previous paper measured past speed of advancement in reporting level at the start of the sample period (employing the executive's level, age and education to construct speed) to capture the speed of past promotion. Because advancement in level can vary in significance both within and across firms, this paper measures the speed of pay grade attainment (defined as the real pay grade midpoint divided by the worker's age) instead, a unit of measurement based on time and money that is universal across firms and workers. Last, there is significant attrition from the sample and to allow for the possibility that individual sample attrition is correlated with promotion probabilities, this paper models sample attrition better than the prior paper.

3.3 Data

The proprietary panel data set used in this study provides information on over 30,000 executives working at over 300 of the largest firms in the United States during the period from 1981 to 1988. It was assembled by a major compensation consulting firm based on annual surveys completed by a human resource professional at the respondent company on both the company and individual executives. Respondent companies paid to participate in the survey, for which they received a report on the competitiveness of their pay levels relative to the pay levels of executives at comparable firms.[7]

[7]Published papers employing these data include Abowd (1990), Bognanno (2001) and Belzil and Bognanno (2008).

The respondent company decided the number of executives to include each year and whether to participate annually or on a less frequent basis. The guidelines provided to firms suggested that they provide data on a representative sample of at least 75 executives in a variety of job families, managerial levels and organizational units. When a job title was shared by many executives and firms did not wish to report on each, they were asked to report on several representative cases. Respondent companies submitting data on more than 120 executives in a given year were subject to an additional fee. The mean number of executives reported on annually per firm was roughly 80.

The database reveals information on individual, job and firm characteristics, including: age, years of education, functional area, job title, firm tenure, base pay, bonus pay, reporting level, industry, firm profits, sales, and employment. Gender is not available in these data. The consulting firm took measures to ensure that the information for each individual and company was valid and complete. All survey data were run through a series of error checking programs and subsequently staff reviewed for follow up with the respondent company when inconsistencies were noted. The information submitted on firm characteristics was accompanied by the respondent company's most recent annual report and proxy statement to ensure the consistency of the financial data.

A unique identifier assigned to each individual allows them to be tracked over time in their given firm. However, the movement of an individual between firms cannot be tracked as they would be assigned a new identifier in the subsequent company. An individual's disappearance from these data does not necessarily indicate an exit from the firm or a transition within the firm, as the respondent company elects which jobs to include each year.

Promotion can be defined in various ways. In these data, the basic decision is whether the basis for promotion should be changes in the reporting level, pay grade or job title. Firms have more job titles than pay grades and more pay grades than reporting levels and any of these metrics can change without necessarily causing a corresponding change in the others. As well, not everyone in a particular class (reporting level, pay grade or

job title) will necessarily share the two alternative hierarchy measures with others in their class.

Using the reporting level as a measure of promotion is easy since it is already ordered and was directly reported by the firms. In previous papers, we used changes in reporting level to define promotion. The disadvantage of reporting level is that it might change for those below the CEO if, for instance, the firm hires a chief operating officer. This does not constitute a demotion in the sense of falling to a lesser position, though adding a rung between an executive and the CEO may make the climb to the top longer. Level changes in the data appear to be a somewhat noisy measure and likely overstate the extent of demotions. Using pay grades advances to define promotion requires distinguishing the promotion-induced advance in an executive's pay grade midpoint from the normal annual advance in pay grade midpoints. Programming this distinction is tricky. Simply coding as promotions cases in which an executive's pay grade midpoint advances more than the firm mean is not sufficient because pay grade midpoints do not always advance uniformly, sometimes the pay grades of higher level executives advance more in percentage terms.

In this paper, we use job title changes to define promotion. This measure has been widely used by others studying personnel data and enhances the comparability of our results. The drawback is that we assume that a person's status in an organization cannot change as long as the job title remains the same. Anecdotal evidence suggests that an executive's pecking order and responsibilities in a firm may change even though the executive continues in the same job title. Overlooking this issue, job title changes must still be ordered on some basis to determine if they are promotions or lateral moves and demotions.

We define promotions as changes in job title that result in the executive being assigned a higher nominal pay grade midpoint. Lateral moves are defined as job title changes that result in the executive being assigned the same nominal pay grade midpoint. Demotions are defined as job title changes that result in the executive being assigned to a lower nominal pay grade midpoint. Non-movers have no change in their

job title. It is important to note that we are not defining promotions based on a job title change and increase in the executive's actual base pay but rather to an increase in the pay grade. Table 3.3 provides statistics on executives classified by these four possible transitions. Like BGH, demotions are found to be rare.

Table 3.1 provides basic summary statistics for the variables used in the likelihood estimations that are the next step in this paper. This table limits the sample to only executives who appear in the first year of the data (1981). This accounts for sample size differences with other tables that do not impose this restriction. The intent of this is to show the extent of sample attrition and the progress in earnings for executives remaining in the data over the sample period. Means and standard deviations by year are provided for compensation, promotion rates and some firm variables. Means and standard deviations for executive characteristics in 1981 are also reported.

Table 3.2 considers the importance of reporting level and job title promotions in pay determination. Reporting level is measured as the number of reporting levels an executive is from the CEO (CEO= reporting level 1). The job title promotion index is set to 0 in the first year an executive appears in the data and is updated by +1 for subsequent promotions and -1 for demotions. This gives it a structure similar to reporting level. Of course, reporting level identifies a layer in the hierarchy of the firm while the job title promotion index only indicates the movements up and down in job title without specifying the executive's position in the hierarchy. This is evident in the top panel of Table 3.2 that shows the reporting level to be more influential in pay determination. It should be noted that larger values for reporting level indicate being further from the top of the company. Hence, the coefficient on reporting level has a negative value. Executives one level closer to the CEO earn 23% more in total compensation (the sum of base and bonus pay). A one-unit rise in the promotion index increases pay by 13%.

The bottom panel of Table 0.2 includes individual fixed effects. The estimation of the coefficient on reporting level is now based on executive's changing reporting levels in the data since the executive's mean pay over the sample is picked up in the individual intercept term. In this estimation, job title changes have a much larger impact

Table 3.1: Summary Statistics of the Sample Used in the Estimations

Year	1981	1982	1983	1984	1985	1986	1987	1988
Individuals	13,113	13,113	8,728	6,280	4,400	2,864	2,053	1,435
Compensation Variables								
Total Compensation	7.8	8.1	8.5	9.4	10.2	10.6	11.7	12.9
(units of 10,000 1980USD)	(6.9)	(7.2)	(7.3)	(8.2)	(9.3)	(9.8)	(11.3)	(12.5)
Mean Base Pay	6.2	6.4	6.9	7.4	7.8	8.1	8.6	9.3
(units of 10,000 1980USD)	(4.3)	(4.5)	(4.9)	(5.3)	(5.8)	(6.1)	(6.3)	(7.0)
Mean Bonus	1.6	1.7	1.6	2.0	2.4	2.5	3.2	3.6
(units of 10,000 1980USD)	(3.0)	(3.1)	(2.8)	(3.4)	(4.1)	(4.2)	(5.8)	(6.0)
Changes in Firm Variables and Promotion Rates								
%Δsales		2.9%	2.1%	0.1%	7.3%	-0.5%	10.2%	5.3%
		(22%)	(44%)	(15%)	(13%)	(26%)	(101%)	(11%)
Δprofits (units of 1,000 1980USD)		11	28	46	84	60	-3	143
		(88)	(610)	(291)	(422)	(915)	(252)	(812)
%Δemployment		2.1%	1.5%	0.1%	4.4%	1.2%	5.7%	1.8%
		(19%)	(36%)	(13%)	(19%)	(19%)	(79%)	(14%)
Annual Mean Promotion*		0.09	0.08	0.09	0.10	0.10	0.08	0.07
		(0.28)	(0.27)	(0.28)	(0.30)	(0.30)	(0.27)	(0.26)
Executive Characteristics in 1981								
Firm Tenure	15.1	(10.5)						
Reporting Level	4.3	(1.4)						
Years in Position	4.0	(3.9)						
Age	47.4	(8.7)						
Education	16.2	(1.9)						

* The promotion indicator takes the value 1 if the executive experiences a change in job title associated to a higher pay grade midpoint, 0 if not.

Table 3.2: Level versus Job Title in Pay Determination

OLS				
Dependent Variable	ln (Total Compensation)		ln (Base Pay)	
Intercept	12.08***	(0.005)	11.78***	(0.004)
Job Title Promotion Index	0.13***	(0.004)	0.10***	(0.003)
Reporting Level	-0.23***	(0.001)	-0.20***	(0.001)
N	107,359		107,359	
R^2	0.30		0.31	
Individual Fixed Effects				
Dependent Variable	ln (Total Compensation)		ln (Base Pay)	
Job Title Promotion Index	0.15***	(0.001)	0.13***	(0.001)
Change in Reporting Level	-0.02***	(0.001)	-0.02***	(0.001)
N	107,359		107,359	
R^2	0.97		0.98	

Note 1: The job title promotion index is set to 0 in the first year an executive appears in the data and is updated by +1 for subsequent promotions and -1 for demotions.

Note 2: Standard errors under parenthesis. Significance levels: *** 1%; ** 5%; * 10%.

on earnings than changes in reporting level. Job title changes are a better indicator of pay changes than changes in reporting level.

Table 3.3 provides pay changes and transitions between an executive's first and second years in the data, between the second and third years and between the third and fourth years with the changes grouped by the executive's initial transition between the first and second years. Between each executive's first two years in the data, 90% are non-movers, 8% are promoted, 1.2% are lateral movers and 0.7% are demoted. As might be expected, the percentage changes in the total compensation, base and bonus pay are largest for the promoted and smallest for the demoted (total compensation is merely the sum of the base pay and annual bonus and does not include other forms of compensation that might increase upon promotion).

Changes taking place in pay between an executive's second and third years and third and fourth years show that the beneficial effect of promotion over non-movement persists but is less evident in later years. Lateral movers, with higher rates of subsequent

Table 3.3: Pay and Transition Outcomes Subsequent to Initial Transition

Transition between years 1 and 2	Non-Mover	Promoted	Lateral Mover	Demoted
Transition Definition	Same job title	New job title & higher nominal pay grade	New job title & same nominal pay grade	New job title & lower nominal pay grade
% of sample	90.1%	8.0%	1.2%	0.7%
Δ Years 1 and 2: Initial Pay Changes and Transitions				
%ΔTotal Compensation	5.4%	11.4%	7.0%	2.9%
%ΔBase Pay	3.2%	9.2%	5.2%	1.6%
%ΔBonus	23.7%	28.1%	14.3%	3.1%
%ΔPay Grade Midpoint	8.1%	19.2%	0.0%	-10.0%
Non-Mover	100.0%			
Promoted		100.0%		
Lateral Mover			100.0%	
Demoted				100.0%
N (total=28,162)	25,380	2,247	348	187
Δ Years 2 and 3: Subsequent Pay Changes and Transitions by Initial Transition Outcome				
%ΔTotal Compensation	3.8%	6.7%	7.0%	3.3%
%ΔBase Pay	4.4%	5.4%	5.9%	4.0%
%ΔBonus	10.0%	19.5%	28.0%	0.0%
%ΔPay Grade Midpoint	6.9%	7.1%	12.9%	19.5%
Non-Mover	89.8%	81.1%	77.6%	81.5%
Promoted	7.9%	13.8%	17.1%	16.7%
Lateral Mover	1.6%	3.5%	3.3%	0.0%
Demoted	0.8%	1.7%	1.9%	13.5%
N (total=17,954)	16,126	1,510	210	108
Δ Years 3 and 4: Subsequent Pay Changes and Transitions by Initial Transition Outcome				
%ΔTotal Compensation	6.8%	8.3%	9.2%	5.3%
%ΔBase Pay	4.4%	5.7%	5.5%	3.0%
%ΔBonus	26.7%	29.4%	18.1%	6.5%
%ΔPay Grade Midpoint	7.3%	9.1%	9.3%	10.7%
Non-Mover	89.4%	82.0%	72.4%	78.8%
Promoted	8.9%	15.1%	18.1%	19.7%
Lateral Mover	0.9%	1.6%	5.2%	1.5%
Demoted	0.7%	1.3%	4.3%	0.0%
N (total=12,164)	10,942	1,040	116	66

promotion, have the highest pay increases in years subsequent to the initial move. The lesser pay growth for the demoted persists but lessens in later years.

Changes taking place between an executive's second and third years in regards to transitions show that those who moved previously are more likely to have subsequent moves. Non-movers initially have about a 90% chance of remaining non-movers. Those with an initial change in job title are substantially more likely to be promoted subsequently. The demoted are more likely to be demoted again. The higher subsequent rate of promotion for those promoted in their first two years in the data is in accord with the notion of fast tracks.

Table 3.4 considers variables that might serve as leading indicators of promotion. Executives are grouped according to the transition they experience between their second and third year in the data. Transitions between the second and third years are used to allow pay changes to be constructed based on prior data (years one and two). The sample is restricted to executives present for at least three consecutive years. It is evident from the table that promoted executives received larger pay increases prior to promotion, followed by lateral movers and non-movers. The demoted between years two and three also received the smallest pay increases between years one and two.

Table 3.4 also shows that promoted executives tend to be younger and have less firm tenure. The promoted are followed in youth and inexperience by lateral movers and non-movers. The promoted spent the least time in their positions prior to promotion while the non-movers spent the most time. Differences between the groups in education are slight but orderly. The promoted are the most educated and the demoted are the least educated. All three classes of job title changers were likely to have had a prior job title change, particularly a previous promotion. Compensation, age, education, tenure and level are included in the formal empirical models of promotion to follow.

Table 3.4: Potential Leading Indicators of Promotion: Prior Pay, Human Capital and Transitions

Transition between Years 2 and 3	Non-Mover	Promoted	Lateral Mover	Demoted
Transition Definition	Same job title	New job title & higher nominal pay grade	New job title & same nominal pay grade	New job title & lower nominal pay grade
% of sample	88.9%	8.5%	1.8%	0.9%
N (total=17,954)	15,957	1,529	315	153
Δ Years 1 and 2: Compensation Variables				
%ΔTotal Compensation	6.3%	8.4%	7.0%	5.4%
ΔTotal Compensation	$4,460	$6,342	$4,860	$5,472
%ΔBase Pay	4.0%	5.4%	3.5%	3.2%
ΔBase Pay	$2,414	$3,465	$1,894	$2,435
%ΔBonus	26.6%	24.6%	34.0%	20.7%
ΔBonus	$2,045	$2,877	$2,966	$3,036
%ΔPay Grade Midpoint	9.0%	9.9%	10.7%	11.0%
ΔPay Grade Midpoint	$6,588	$7,438	$7,617	$9,857
Year 2: Compensation Variables Minus Mean for Firm, Year, Job Title				
Total Comp − Job Mean	$410	$1,178	$3,126	$2,781
Base Pay − Job Mean	$93	$596	$1,053	$2,167
Bonus − Job Mean	$342	$653	$2,073	$614
Base − Grade Midpoint*	-$1,553	-$1,121	-$2,389	-$5,642
Year 2: Human Capital Variables				
Age	47.3	44.8	46.7	48.3
Age − Job Mean	-0.04	-0.80	-0.30	-0.14
Years in Position(inpost)	4.1	2.9	3.0	3.1
Inpost − Job Mean	-0.02	-0.26	-0.07	-0.11
Age − Education − 5	25.9	23.3	25.3	27.0
Tenure	14.8	13.2	14.4	15.2
Education	16.4	16.5	16.4	16.3
Reporting Level:1=CEO	4.3	4.3	4.2	4.0
Prior Transition between Years 1 and 2				
Non-Mover	90.8%	82.9%	81.0%	79.7%
Promoted	7.7%	13.6%	16.8%	16.3%
Lateral Mover	1.0%	2.4%	2.2%	2.6%
Demoted	0.6%	1.2%	0.0%	1.3%

* Only 43% of executives receive base pay at or above their real pay grade midpoint.

3.4 Econometric Model

We build a dynamic model of promotion in which the probability of promotion at a point in time is a function of individual and firm characteristics and the executive's past speed of promotion. We model individual unobserved heterogeneity in a flexible way to account for persistent characteristics unobserved by the econometrician that affect promotions (like innate ability or motivation).[8]

Our model addresses two important issues. The first one is the so called initial condition problem. The initial level at which the worker is observed in a firm is likely to be influenced by permanent unobserved factors that also affect the subsequent moves of the worker in the firm's hierarchy. We address this issue using Wooldridge's (2005) method, by conditioning the distribution of unobserved heterogeneity on the initial level. The second issue concerns endogenous attrition. As shown in Table 3.1, a significant number of executives leave the sample each year. Dropping out of the sample at a point in time is caused either by the firm not participating in the survey at all, or not reporting on an executive still with the firm or no longer with the firm. As mentioned in the data section, firms were asked to report on a representative sample of jobs, levels and units. In the case of job titles with multiple incumbents, several representative cases were requested. Job transitions might affect both the probability of firm exits (a link between promotion and firm exits exists in the literature) and the probability of being sampled in the case of continued employment (the likelihood of being sampled in the firm appears to rise at higher levels). For these reasons, sample attrition not due to firm non-participation is likely to be related to persistent individual factors that also affect promotion outcomes, making it endogenous. We therefore write the response probability (i.e. the probability that the worker is still present in the sample) as a function of the unobserved heterogeneity distribution and include the non-response probability in the

[8] As already stated, movements of individuals across firms can not be identified. Therefore, we can not distinguish individual from firm persistent attributes. Without loss of generality, we refer to unobserved factors as individual specific.

individual's contribution to the likelihood when the firm is participating in the survey but not reporting on a particular executive.

We turn now to a formal description of the model. We first describe the promotion probabilities and then turn to attrition and unobserved heterogeneity. Finally, we write the likelihood function that is estimated.

3.4.1 Promotion Probability

As already stated, the promotion indicator at year t is defined as a job title change associated with a higher nominal pay grade midpoint between the year $t-1$ and year t.

The probability that individual i, belonging to firm j, is promoted at year t is defined by the following equation:

$$\begin{aligned}\Pr(Y_{ijt}=1) = \Lambda(&\beta_r rmidage_{ijt-1} + \beta_q L_{qit-1} + \beta_{F1} F_{jt-1} + \beta_{F2}(F_{jt} - F_{jt-1}) \\ &+ \beta_{PO} PO_{ijt-1} + \alpha_i),\end{aligned}$$

where:

- $\Lambda(.)$ is the logistic cumulative distribution function.
- $rmidage_{ijt-1}$ is the real pay grade midpoint divided by the executive's age. This variable measures the speed of past promotion.
- L_{qit-1} is a set of binary variables indicating the reporting level of the executive in the firm. The value of the level, denoted q, is the number of reporting levels an executive is from the CEO position (level 1). Level 6 (or more) is the reference group and level 1 is not included because CEOs cannot be promoted internally.
- F_{jt} is a set of firm-specific variables. It includes profits, sales and total employment. The variation of those variables between periods $t-1$ and t is also included.
- PO_{ijt-1} measures the promotion opportunities in the firm. This variable is defined as the percentage of executives hired from outside the firm into positions above the given worker.

- α_i is an individual specific term that represents individual unobserved heterogeneity. In order to resolve the initial condition problem, we specify its distribution conditional on the initial level (Wooldridge, 2005). Therefore, this term is decomposed into the sum of a regression component and an orthogonal unobserved component. More precisely, it takes the following form:

$$\alpha_i = \alpha_X X_{i0} + \alpha_r rmidage_{i0} + \widetilde{\alpha}_i$$

where X_{i0} contains human capital variables (age, education and tenure) and an indicator for newcomer status in the firm. All of these variables are measured as of the individual's first observation in the sample, that is before the first observable promotion occurs. $rmidage_{i0}$ is the past speed of promotion (as defined before) also measured as of the first observation. It captures the extent to which an executive has already achieved a rate of promotion higher than average and thus accounts for the spurious fast track effect. $\widetilde{\alpha}_i$ is the orthogonal unobserved component; its distribution is defined more precisely below.

3.4.2 Response Probability

As noted previously, attrition for an executive is caused either by the firm not participating in the survey or by the firm participating but not reporting on the particular executive. In our framework, we consider attrition as endogenous only when it is due to the latter reason. Attrition due to firm non-participation in the survey is considered as exogenous and is not included in the contribution to the likelihood.

The response probability at each period is written as a function of individual characteristics (the same unobserved heterogeneity component as in the promotion probability) and the variation of the number of executives reported by the firm from the previous period. More precisely, the probability that worker i, belonging to firm j, is observed at

year t is determined by the following expression:

$$\Pr(Z_{ijt} = 1) = \Lambda(\delta_n \Delta nbobs_{jt} + \gamma_i),$$

where:

- $\Delta nbobs_{jt}$ is the relative variation of the number of workers reported by firm j between years $t-1$ and t.

- γ_i is an individual specific term that represents individual unobserved heterogeneity. Its expression takes a form close to the one adopted for α_i:

  $$\gamma_i = \gamma_X X_{i0} + \widetilde{\gamma}_i,$$

  where X_{i0} is the same set of variables as defined before, and $\widetilde{\gamma}_i$ is the orthogonal unobserved component. $\widetilde{\gamma}_i$ shares the same distribution as $\widetilde{\alpha}_i$, which is defined below. Endogeneity of attrition is thus corrected by allowing the same unobserved individual specific factors to affect promotion and response probabilities.

3.4.3 Unobserved Heterogeneity

In order to minimize the impact of distributional assumptions needed to implement this model, we assume that $\widetilde{\alpha}_i$ and $\widetilde{\gamma}_i$ are characterized by an unknown cumulative distribution function, $H(.)$, that is approximated using a discrete distribution (Heckman and Singer, 1984). The probability associated with type k is

$$p_k = \Pr(\widetilde{\alpha}_i = \alpha_k, \widetilde{\gamma}_i = \gamma_k),$$

where $k = 1, \ldots, K$. The optimal number of types, K, is determined from the minimization of the Bayesian Information Criterion when the model is estimated with K ranging

between 2 and 6. The type probability, p_k, is estimated using a logistic transform:

$$p_k = \frac{\exp q_k}{\sum_{s=1}^{K} \exp q_s} \qquad k = 1, \ldots, K,$$

where q_ks are parameters to be estimated with the restriction that $q_K = 0$.

3.4.4 Likelihood Function

For a given year, the individual's contribution to the likelihood is the product of the response probability and the promotion probability. When the worker leaves the sample, he contributes to the likelihood only if this non-reporting does not result from the firm's decision not to participate in the survey at all. The likelihood for an individual i of type k who is observed during s periods, $s = 1, \ldots, 7$, takes the following form:

$$\begin{aligned} L_i^s(k) = &\prod_{t=1}^{s} \left[\Pr(Z_{ijt}(k) = 1) \cdot (\Pr(Y_{ijt}(k) = 1))^{d_{it}} \cdot (1 - \Pr(Y_{ijt}(k) = 1))^{1-d_{it}} \right] \\ &\cdot (1 - \Pr(Z_{ijs+1}(k) = 1))^{(att_i)}. \end{aligned}$$

When the individual is only observed at the initial period and thus has no promotion observation, $s = 0$, the likelihood function appears as:

$$L_i^0(k) = (1 - \Pr(Z_{ij1}(k) = 1))^{(att_i)}.$$

The variable d_{it} is an indicator taking the value 1 if the individual is observed at period t and att_i is the attrition indicator variable equal to 1 when the worker has no observation at period t and the firm is participating in the survey. Therefore, the likelihood of an individual of type k is the following:

$$L_i(k) = \prod_{s=0}^{7} [(L_i^s(k))^{e_{is}}],$$

where e_{is} is an indicator variable taking the value 1 if the individual i is observed during s periods.

As a consequence, the mixed likelihood, for an individual i, is simply:

$$L_i = \sum_{k=1}^{K} p_k \cdot L_i(k).$$

The model is estimated by maximization of the sum of all individual (mixed) log likelihoods.

3.5 Results

3.5.1 A Model of fast tracks

The first step of our analysis is devoted to the basic model specification in which we distinguish between the spurious and the causal fast track effects. As explained earlier, the distribution of unobserved heterogeneity includes a variable ($rmidage_0$) that measures individual earnings achievements per year (real pay grade midpoint divided by age) as recorded when the executive enters the sample. This variable therefore captures the spurious fast track effect, whereas the variable ($rmidage_t$), which measures past advancement up to year t, captures the causal fast track effect.

We estimated several different versions of the model. These included specifications that modeled attrition and those that ignored the potential endogeneity of non-response. We also estimated both a static version of the model (with no causal fast track) and a dynamic version. All versions were estimated with the unobserved heterogeneity distribution ranging from two to six types.

For brevity, we focus our presentation on the model that includes the optimal number of types according to the Bayesian Information Criterion (values are provided in Table 3.5). Because virtually all models that incorporate an explicit modeling of non-response indicate a non-trivial degree of correlation between the unobserved heterogeneity component affecting non-response and the heterogeneity affecting promotions, we also focus on the model in which non-response (sample attrition) is endogenous.

Table 3.5: Bayesian Information Criterion Values for Model Selection

	Model of Fast Tracks		Model with Functional Area	
	log(L)	BIC	log(L)	BIC
1 type	-72,431.40	145,126.13	-58,462.73	117,370.48
2 types	-72,303.07	144,901.07	-58,374.03	117,224.11
3 types	-72,286.20	144,898.93	-58,363.38	117,233.87
4 types	-72,284.74	144,927.61	-58,362.89	117,263.94
5 types	72,285.90	144,961.53	58,363.25	117,295.70
6 types	72,283.89	144,989.10	58,362.74	117,325.73

The results are reported in three distinct tables. The parameter estimates as well as their associated marginal effects are in Table 3.6. In Table 3.7, we report some variance decomposition indicators. Those allow us to illustrate the relative importance of the main group of variables (unobserved heterogeneity, firm variables and the speed of past advancement). Finally, in Table 3.8, we also report measures of the correlation between the unobserved heterogeneity components explaining promotion and response, as well as the correlation between the total response and promotion probabilities.

The first striking result is the coexistence of the very weak effect that the speed of past advancement measured at time t has on future promotion outcomes (the structural fast track) with a strong effect of the initial speed of advancement on which individual unobserved heterogeneity is conditioned (the spurious fast track). The parameter estimate for the structural fast track, 0.0601, is insignificant.[9] The estimate implies that, after conditioning on unobserved heterogeneity, the increase in promotion probability for each 1,000 dollars of average wage gain per year is only equal to 0.0025. At the opposite, the average lifetime yearly earnings gain measured at the start of the sample is the main component of the unobserved heterogeneity equation, as indicated by the estimate (0.4473) and its standard error (0.056). An increase in the average initial pay grade per year of $1,000 increases the promotion probability by 0.02. Human capital

[9] As a comparison, Belzil and Bognanno (2004) report a negative causal fast track effect for a majority of the population whose magnitude is almost negligible. The different result found here is likely to be caused by a different definition of the promotion indicator.

Table 3.6: Model of Fast Tracks: Parameter Estimates and Marginal Effects

	Parameters (S.E.)		Marginal effects (S.E.)	
$\widetilde{\alpha}$ and $\widetilde{\gamma}$ distribution parameters				
q1	0.2074***	(0.0187)	-	
q2	0.1918***	(0.0197)	-	
Promotion probability				
Individual specific characteristics				
$\widetilde{\alpha}_1$	-2.5475***	(0.1957)	-	
$\widetilde{\alpha}_2$	-2.6131***	(0.1985)	-	
$\widetilde{\alpha}_3$	-0.9677***	(0.1780)	-	
Age	-0.2580***	(0.0227)	-0.0011***	(0.0001)
Education	0.0005	(0.0952)	0.0000	(0.0004)
Tenure	0.0507***	(0.0177)	0.0002***	(0.0001)
New comer	-0.1586**	(0.0788)	-0.0062**	(0.0029)
rmidage_0 (in \$1,000)	0.4473***	(0.0563)	0.0187***	(0.0024)
Past speed of promotions				
rmidage (in \$1,000)	0.0601	(0.0625)	0.0025	(0.0026)
Level in the firm				
Level 2	-0.3909***	(0.0518)	-0.0137***	(0.0016)
Level 3	-0.1648***	(0.0376)	-0.0064***	(0.0014)
Level 4	0.0358	(0.0230)	0.0015	(0.0010)
Level 5	0.0486*	(0.0277)	0.0021*	(0.0012)
Level 6	ref.		ref.	
Firm variables				
PO	0.2193***	(0.0456)	0.0097***	(0.0022)
Sales (in \$1M)	-0.0241***	(0.0062)	-0.0010***	(0.0003)
%Δsales	-0.0002	(0.0006)	0.0000	(0.0000)
Profit (in \$10,000)	0.0005	(0.0010)	0.0000	(0.0000)
Δprofit (in \$10,000)	0.0019*	(0.0011)	0.0001*	(0.0000)
Employment (in 10,000)	-0.0272***	(0.0048)	-0.0011***	(0.0002)
%Δemployment	0.0026***	(0.0007)	0.0001***	(0.0000)
Response probability				
Individual specific parameters				
$\widetilde{\gamma}_1$	0.2967***	(0.050)	-	
$\widetilde{\gamma}_2$	1.1458***	(0.059)	-	
$\widetilde{\gamma}_3$	1.0090***	(0.069)	-	
Age	-0.0991***	(0.009)	-0.2268***	(0.0206)
Education	0.3709***	(0.034)	0.8491***	(0.0758)
Tenure	0.0760***	(0.009)	0.1740***	(0.0210)
New comer	-0.0753	(0.058)	-0.0174	(0.0136)
rmidage_0 (in \$1,000)	0.1530***	(0.014)	0.0350***	(0.0033)
Firm variable				
%Δnbobs	-0.0132***	(0.000)	-0.0030***	(0.0001)
Individuals	37,541			
Mean log-likelihood	-1.926			

Note 1: Marginal effects computed at the means and modes of covariates, for type 1s.
Note 2: Significance levels: *** 1%; ** 5%; * 10%.

Table 3.7: Model of Fast Tracks: Variance Decomposition of the Promotion Probability

Individual specific characteristics	0.883
rmidage	0.054
Level in the firm	0.004
Firm variables	0.022
All variables	**0.929**
Individuals	7,273

Note 1: The variance decomposition is performed on all individuals who have a promotion observation at period 4.

Note 2: The share of the variance explained by each factor is measured by the R^2 of the predicted promotion probability regressed on the variables associated to the factor.

variables have a very limited impact: the marginal effects of age and tenure are less than 1 percentage point and education is insignificant.[10]

In order to assess the relative importance of each group of explanatory factors, we decompose the variance of the predicted probability of promotion. The explanatory power of each group of variables is measured by the R^2 of the regression of the predicted promotion probability on the given group of variables. Results reported in Table 3.7 show that 90% of the total variation in promotion probabilities is explained by persistent unobserved heterogeneity and confirm the limited importance of promotion dynamics. Even firm variables, as measured by sales, profits, size (levels and variations) and the indicator of promotion opportunities, appear to have a minimal explanatory power.

The coefficient of correlation between promotion and response probabilities presented in Table 3.8 (0.310) shows the importance of the link between attrition and promotion. Moreover, we can note that the correlation between the unobserved heterogeneity components of the promotion and response probabilities is relatively large as well (0.368).

To summarize, empirical evidence displayed in Tables 3.6, 3.7 and 3.8, as well as results obtained from specifications that are not reported, suggest that the promotion pro-

[10]Howard and Bray (1988) find a college degree to be the best predictor of promotion. Forbes and Piercy (1991, p. 165) find that the time to the CEO position is reduced through higher levels of education. Useem and Karabel (1986) show the importance of earning a degree from an elite institution when the executive is not from elite social origins.

Table 3.8: Model of Fast Tracks: Correlation Between Promotability and Response

corr(α_i,γ_i)	0.368
corr(Pr($Y_{ij4} = 1$),Pr($Z_{ij4} = 1$))	0.310

Note: The first line corresponds to the coefficient of correlation between the individual specific components of promotion and response probabilities. The second line corresponds to the coefficient of correlation between the probabilities of promotion and response at period 4.

cess may be summarized by a static discrete outcome model, where all serial correlation is accounted for by persistent individual unobserved factors.

3.5.2 Analysis of Functional Area

The potential role of functional area has received little empirical or theoretical attention in the economics literature. However, this topic has appeared in the management literature. Vroom and MacCrimmon (1968) found that promotion opportunities varied with functional area and were better in finance and marketing. Forbes and Piercy (1991) found that the functional area backgrounds of CEOs varied by industry and, with regards to the eventual CEOs, the time to reach various top positions in the organization varied by functional area. At the outset, it should be clear that our objective is not to treat functional area as an endogenous choice variable. We treat functional area as an element of the initial endogenous condition.

Our analysis is based on two possible interpretations. First, if firms assign individuals to functional areas based on skills and factors that are correlated with factors explaining promotability, we may expect the initial functional area to account for a non-trivial share of persistent unobserved heterogeneity. A second possibility, more in line with a causal effect, is that individuals move across different possible functional areas during their careers, but target those areas that are known to provide better promotion opportunities. If so, the promotion process should display serial correlation, even after conditioning on unobserved heterogeneity.

Table 3.9: Model of Fast Tracks with Functional Area: Parameter Estimates and Marginal Effects

	Parameters (S.E.)		Marginal effects (S.E.)	
$\widetilde{\alpha}$ and $\widetilde{\gamma}$ distribution parameter				
q1	-1.1593***	(0.3362)	-	
Promotion probability				
Individual specific characteristics				
$\widetilde{\alpha}_1$	-1.2400***	(0.1772)	-	
$\widetilde{\alpha}_2$	-2.7988***	(0.2591)	-	
Age	-0.3400***	(0.0305)	-0.0013***	(0.0003)
Education	0.3670***	(0.0730)	0.0014***	(0.0004)
Tenure	0.0449	(0.0461)	0.0002	(0.0002)
New comer	-0.1951	(0.1529)	-0.0068*	(0.0039)
rmidage_0 (in \$1,000)	0.4689**	(0.2142)	0.0180***	(0.0054)
Legal	-0.2378***	(0.0557)	-0.0082***	(0.0028)
Employee relations	-0.2967***	(0.0503)	-0.0099***	(0.0028)
Manufacturing	0.3040***	(0.0573)	0.0134***	(0.0022)
Marketing	0.3723***	(0.0609)	0.0170***	(0.0025)
Finance	-0.0141	(0.0475)	-0.0005	(0.0019)
Mgt. info systems	-0.2132***	(0.0787)	-0.0074***	(0.0020)
Research engineering	0.1607*	(0.0879)	0.0066**	(0.0030)
Public gvt relations	0.0198	(0.0648)	0.0008	(0.0026)
General mgt.	0.4050***	(0.0911)	0.0188***	(0.0045)
Material	ref.		ref.	
Past speed of promotions				
rmidage (in \$1,000)	-0.0442	(0.2096)	-0.0017	(0.0078)
Level in the firm				
Level 2	-0.3766***	(0.1255)	-0.0122**	(0.0054)
Level 3	-0.1093***	(0.0294)	-0.0040***	(0.0012)
Level 4	0.1058***	(0.0351)	0.0039**	(0.0018)
Level 5	0.0811*	(0.0439)	0.0032**	(0.0015)
Level 6	ref.		ref.	
Firm variables				
PO	0.1606**	(0.0701)	0.0064	(0.0040)
Sales (in \$1M)	-0.0172**	(0.0074)	-0.0007**	(0.0003)
%Δsales	-0.0007	(0.0007)	0.0000	(0.0000)
Profit (in \$10,000)	0.0006	(0.0012)	0.0000	(0.0000)
Δprofit (in \$10,000)	0.0035***	(0.0013)	0.0001**	(0.0001)
Employment (in 10,000)	-0.0288**	(0.0120)	-0.0011*	(0.0006)
%Δemployment	0.0029***	(0.0009)	0.0001***	(0.0000)
Response probability				
Individual specific parameters				
$\widetilde{\gamma}_1$	1.4288***	(0.1879)	-	
$\widetilde{\gamma}_2$	1.0591***	(0.1673)	-	
Age	-0.0675***	(0.0098)	-0.0012***	(0.0002)
Education	0.1251	(0.1045)	0.0022	(0.0019)
Tenure	0.0561***	(0.0101)	0.0010***	(0.0002)
New comer	-0.1026***	(0.0332)	-0.0187***	(0.0062)
rmidage_0 (in \$1,000)	0.1942***	(0.0371)	0.0345***	(0.0066)
Legal	0.3341***	(0.0696)	0.0539***	(0.0101)
Employee relations	0.0376	(0.0947)	0.0066	(0.0164)

Continued on next page

Table 3.9: Continued

	Parameters (S.E.)		Marginal effects (S.E.)	
Manufacturing	-0.1265	(0.0935)	-0.0232	(0.0177)
Marketing	-0.3441***	(0.0740)	-0.0665***	(0.0155)
Finance	0.0986**	(0.0495)	0.0180**	(0.0092)
Mgt. info systems	-0.2323***	(0.0870)	-0.0438**	(0.0174)
Research engineering	-0.1770**	(0.0790)	-0.0329**	(0.0154)
Public gvt relations	0.1345*	(0.0748)	0.0230*	(0.0123)
General mgt.	-0.2230***	(0.0813)	-0.0419***	(0.0162)
Material	ref.		ref.	
Firm variable				
%Δnbobs	-0.0138***	(0.0003)	-0.0024***	(0.0001)
Individuals	31,229			
Mean log-likelihood	-1.869			

Note 1: Marginal effects computed at the means and modes of covariates, for type 1s.
Note 2: Significance levels: *** 1%; ** 5%; * 10%.

Although we cannot distinguish between these two hypotheses, both of them imply that, after some elapsed career duration, the prevailing functional area of a given executive is likely to exhibit some correlation with subsequent promotion outcomes. As a consequence, we re-estimate the model of promotion allowing for fast tracks after including functional area (recorded at the beginning of the sample period) in the unobserved heterogeneity equation. To a certain extent, and as will be discussed in a further section, this will allow us to investigate the predictive power that functional area may convey to an external person.

The parameter estimates and marginal effects of the model with functional area are in Table 3.9.[11] First, the inclusion of functional area has an impact on the sign of the past promotion variable (the structural fast track effect). The estimate, which was positive before, is now negative (-0.0442). However, it is still highly insignificant. This is also the case with the marginal effect (-0.0017). Introducing functional area has also an impact on the significance level of the effect of the variable measuring speed of promotion at the beginning of the sample ($rmidage_0$). This is readily seen upon examining that the

[11] As shown in Table 3.5, the optimal number of types for this model is 2.

Table 3.10: Model of Fast Tracks with Functional Area: Variance Decomposition of the Promotion Probability

Individual specific characteristics	0.865
rmidage	0.020
Level in the firm	0.007
Firm variables	0.031
All variables	**0.906**
Individuals	6,051

Note 1: The variance decomposition is performed on all individuals who have a promotion observation at period 4.

Note 2: The share of the variance explained by each factor is measured by the R^2 of the predicted promotion probability regressed on the variables associated to the factor.

standard error of the corresponding parameter has increased, compared to the first specification (from 0.056 to 0.2142), whereas the parameter estimate has remained almost stable (0.4473 to 0.4689). This conveys the idea that the average lifetime yearly wage gain and the functional area are indeed partially substitute ways to infer individual persistent promotability.

What is particularly interesting is the degree of asymmetry in the effect and the level of significance of functional area indicators. The estimates indicate that those who work in marketing services, management areas and manufacturing seem to have a clear advantage in terms of future promotions (0.3723, 0.4050 and 0.3040 respectively). In terms of marginal effects, these estimates imply a higher promotion probability of 0.0188 for management, 0.0170 for marketing and 0.0134 for manufacturing, relative to a material position (the reference functional area). That differences in promotion probabilities by functional area exist came to light in the management literature and are confirmed here.

The variance decomposition of the predicted promotion probability, whose results are found in Table 3.10, confirms the importance of functional area as a determinant of promototability. Indeed, individual specific characteristics (which includes the functional area) still explain almost 90% of the variance of the promotion probability. The lower magnitude of the past speed of promotion consecutive to the inclusion of functional area

in the model is confirmed by its importance in explaining the variance, which has fallen from 5 to 2%.

3.5.3 Non-causal Models and Promotion Predictability

The models discussed in Parts 3.5.1 and 3.5.2 were constructed so to distinguish the structural effect from the spurious effect explaining serial correlation in individual promotion histories. In micro-economic theory, it is customary to analyze individual promotion histories in imperfect information contexts. In particular, the mechanism through which outside firms try to infer managers' quality is a fundamental issue in this literature. Because outside firms may not have access to all individual ability indicators, it is interesting to ask to what extent observable promotion histories may help predict future performance. To do so, we build five different models. All models include only variables that are likely to be observable to outside firms, but each one focuses on a different predictor.

We first consider our main speed promotion variable, *rmidage*, as defined by the average lifetime wage gain at a particular date. The second predictor ignores financial promotion indicators and uses only functional area. We do so because the results reported in Part 3.5.2 point out the strong impact of functional area on promotion histories. The third predictor is the individual's past annual total compensation growth. We construct the wage growth variable from the compensation observed during the first four years. Because the total compensation contains both a base pay component as well as a bonus component, we redo the analysis with the yearly base and bonus pay growth (fourth and fifth predictors). The wage growths measures during the first four years are associated to the $rmidage_0$ variable, which measures less recent wage growth (measured at the entry in the sample).[12]

All five models are estimated without unobserved heterogeneity. In order to make the results obtained with each predictor comparable, we estimate the models from the

[12]The causal effect of past promotions and wage growth indicators on the current wage growth is investigated in Belzil and Bognanno (2008).

same sample. Since the observations of the first four years are used to compute recent wage growths, we restrict our sample to executives who are still present after the fourth year and model only the promotions from years four to eight. The functional area used to estimate the second model is observed at year four. Ultimately, the performance of each model will indicate what variable is likely to be more informative of future promotions. Parameter estimates of models 1 and 2 are found in Table 3.11 and the ones of models 3, 4 and 5 in Table 3.12. Some variance decompositions are reported in Table 3.13. Table 3.14 reports measures of the fit for each model to determine the best predictor.

As might be expected, parameters reported in Table 3.11 show that the effects of the average earnings growth per year (*rmidage*) and the effect of functional area are now much stronger than in the model specifications described earlier. This is a clear consequence of building a model in which true and spurious correlations are not distinguished. The three other predictors considered are yearly earnings growth for the first four periods. Table 3.12 provides clear evidence that the correlation between base pay and promotion is much stronger than the correlation between total compensation and promotion. The parameter estimates for base pay are sometimes twice as large as those for total pay and parameter estimates for bonus pay are very low and insignificant.

Because all four model specifications include the same variables (age, tenure, firms variables,...), it is informative to quantify how much of the explained part of the model may be attributed to every specific predictor. In Table 3.13, we report shares of the promotion probabilities explained by all the candidates. The shares differ from one predictor to the other and range between 4% and 30%. The past base wage growth appears to be a powerful variable. It outperforms the average yearly earnings gain *rmidage*, as well as the past total and bonus compensation growths. However, it is striking to see that functional area, a set of variables rarely considered in personnel economics, contributes to 30% of the total variation.

Table 3.11: Non Causal Models 1 and 2: Parameter Estimates

Model	(1) Past speed of promotions		(2) Functional area	
Individual specific characteristics				
$\widetilde{\alpha}$	-0.5481**	(0.2684)	-1.2325	(1.0149)
Age	-0.4734***	(0.0527)	-0.5143***	(0.0929)
Education	-0.1346	(0.1324)	0.2080	(0.4851)
Tenure	0.1916***	(0.0489)	0.1530	(0.1253)
New comer	-0.1393**	(0.0691)	-0.1330	(0.4333)
Legal	-		0.2865	(0.2215)
Employee relations	-		0.1544	(0.3076)
Manufacturing	-		0.6496**	(0.2705)
Marketing	-		1.0456***	(0.2438)
Finance	-		0.4620**	(0.1862)
Mgt. info systems	-		0.4227	(0.3219)
Research engineering	-		0.6382***	(0.2347)
Public gvt relations	-		0.4462*	(0.2523)
General mgt.	-		1.1019***	(0.2373)
Material	-		ref.	
Firm variables				
PO	0.0629	(0.2089)	-0.0108	(0.1523)
Sales (in \$1M)	-0.0429**	(0.0207)	-0.0235	(0.0233)
%Δsales	-0.0012	(0.0016)	-0.0013	(0.0017)
Profit (in \$10,000)	-0.0002	(0.0031)	0.0008	(0.0046)
Δprofit (in \$10,000)	0.0019	(0.0027)	0.0027	(0.0029)
Employment (in 10,000)	-0.0424***	(0.0152)	-0.0265	(0.0168)
%Δemployment	0.0037*	(0.0021)	0.0038*	(0.0022)
Level in the firm				
Level 2	-0.4362***	(0.1665)	0.1786	(0.2675)
Level 3	-0.3076***	(0.1077)	0.0460	(0.2632)
Level 4	-0.0897	(0.0932)	0.1346	(0.2569)
Level 5	-0.0483	(0.0843)	0.0729	(0.2626)
Level 6	ref.		ref.	
Past speed of promotions				
rmidage_0 (in \$1,000)	-0.0143	(0.1251)	-	
rmidage (in \$1,000)	0.4093***	(0.1096)	-	
Individuals	5,927		5,927	
Mean log-likelihood	-0.558		-0.553	

Note 1: Standard errors under parenthesis.
Note 2: Significance levels: *** 1%; ** 5%; * 10%.

Table 3.12: Non Causal Models 3, 4 and 5: Parameter Estimates

Model	(3) Past wage growths (total compensation)		(4) Past wage growths (base pay)		(5) Past wage growths (bonus pay)	
Individual specific characteristics						
$\tilde{\alpha}$	-0.6958**	(0.3313)	-0.8600**	(0.3683)	-0.5378*	(0.2922)
Age	-0.4587***	(0.0559)	-0.4230***	(0.0564)	-0.4925***	(0.1890)
Education	-0.1129	(0.1393)	-0.1390	(0.2058)	-0.0825	(0.5365)
Tenure	0.1949***	(0.0456)	0.1856***	(0.0519)	0.1917	(0.1606)
New comer	-0.1941*	(0.1001)	-0.1128	(0.1007)	-0.1371	(0.3199)
Firm variables						
PO	0.0111	(0.0626)	0.0185	(0.1391)	0.0671	(0.8207)
Sales (in \$1M)	-0.0397*	(0.0211)	-0.0418*	(0.0216)	-0.0420*	(0.0239)
%Δsales	-0.0012	(0.0017)	-0.0014	(0.0017)	-0.0012	(0.0017)
Profit (in \$10,000)	-0.0011	(0.0032)	-0.0005	(0.0031)	0.0006	(0.0033)
Δprofit (in \$10,000)	0.0018	(0.0028)	0.0018	(0.0027)	0.0023	(0.0029)
Employment (in 10,000)	-0.0438***	(0.0144)	-0.0425***	(0.0151)	-0.0412***	(0.0150)
%Δemployment	0.0037*	(0.0021)	0.0039*	(0.0021)	0.0037*	(0.0022)
Level in the firm						
Level 2	-0.3441**	(0.1759)	-0.4015**	(0.1760)	-0.2800	(0.1728)
Level 3	-0.2739**	(0.1200)	-0.3032***	(0.1165)	-0.2444	(0.1695)
Level 4	-0.0798	(0.0977)	-0.0953	(0.1009)	-0.0669	(0.2242)
Level 5	-0.0483	(0.1092)	-0.0586	(0.1112)	-0.0418	(0.2094)
Level 6	ref.		ref.		ref.	
Past speed of promotions						
rmidage_0 (in \$1,000)	0.3623***	(0.0808)	0.3578***	(0.0806)	0.3594***	(0.0990)
rmidage (in \$1,000)	-		-		-	
Past wage growths (total compensation, base pay or bonus pay)						
$\%(w_2 - w_1)$	0.0031	(0.0028)	0.0123***	(0.0041)	-0.0003	(0.0004)
$\%(w_3 - w_2)$	0.0099***	(0.0030)	0.0110**	(0.0051)	0.0003	(0.0002)
$\%(w_4 - w_3)$	0.0062**	(0.0028)	0.0155***	(0.0046)	0.0005	(0.0003)
Individuals	5,927		5,927		5,927	
Mean log-likelihood	-0.557		-0.557		-0.558	

Note 1: Standard errors under parenthesis.
Note 2: Significance levels: *** 1%; ** 5%; * 10%.

Table 3.13: Non Causal Models: Variance Decomposition

Model	(1) Past speed of promotions	(2) Functional areas	(3) Past wage growths (total compensation)	(4) Past wage growths (base pay)	(5) Past wage growths (bonus pay)
Age, education	0.545	0.401	0.527	0.498	0.558
Tenure, new comer	0.044	0.034	0.044	0.043	0.045
Firm variables	0.256	0.176	0.235	0.230	0.257
Level in the firm	0.028	0.016	0.022	0.021	0.024
$rmidage_0$,rmidage	0.042	-	-	-	-
Functional areas	-	0.297	-	-	-
$rmidage_0$, past total compensation growths	-	-	0.131	-	-
$rmidage_0$, past base pay growths	-	-	-	0.256	-
$rmidage_0$, past bonus pay growths	-	-	-	-	0.044
All variables	**0.934**	**0.846**	**0.931**	**0.932**	**0.940**
Individuals	5,927	5,927	5,927	5,927	5,927

Note 1: The variance decomposition is performed on all individuals who have a promotion observation at period 4.

Note 2: The share of the variance explained by each factor is measured by the R^2 of the predicted promotion probability regressed on the variables associated to the factor.

In order to assess the ability of each indicator to predict future promotions, we compare the fit of the different models. A large variety of fitting measures have been proposed in the literature on qualitative response models (see Amemiya, 1981, for a discussion). Hereafter, we report three of those different measures. The first one is the measure of Efron (1978), an analogue of R^2 in linear regressions:

$$R^2_{Ef} = 1 - \frac{\sum_{i=1}^{n} (y_i - \widehat{P}_i)^2}{\sum_{i=1}^{n} (y_i - \overline{y})^2},$$

where y_i is the realized outcome, $\overline{y}$ is the frequency of realized outcomes and $\widehat{P}_i$ the predicted probability. In this formula, the ratio can be seen as the sum of squared residuals divided by the sum of squared of observations. This measure takes values ranging between 0 and 1.

The second measure is still based on the residual sum of squares, but the sum is weighted by the predicted probabilities at the denominator:[13]

$$SSRW = \sum_{i=1}^{n} \frac{(y_i - \widehat{P}_i)^2}{\widehat{P}_i(1 - \widehat{P}_i)}.$$

The last measure is the Akaike Information Criterion, which takes into account the number of parameters and the number of individuals on which the model is estimated:

$$AIC = -2 \ln L + 2K,$$

where L is the value of the likelihood and K the number of parameters.

Table 3.14 reports the values of those three indicators for each model. These indicators lead to very similar conclusions about the ranking of the models regarding their fit. Functional area appears to be the best predictor, followed by past base wage growths. Then, the measure of the past speed of promotions appears to be as a good predictor as the past total compensation wage growths. Ranked fifth, past bonus wage growths appears to be the poorest predictor of promotions.

[13]The acronym SSRW stands for Sum of Squared Residuals Weighted by estimated probabilities.

Table 3.14: Non Causal Models: Comparison of Model Fits

Model	(1) Past speed of promotions		(2) Functional areas		(3) Past wage growths (total compensation)		(4) Past wage growths (base pay)		(5) Past wage growths (bonus pay)	
R^2_{Ef}	0.017	(3)	0.021	(1)	0.017	(3)	0.018	(2)	0.016	(5)
$SSRW$	12191.300	(4)	12089.700	(1)	12190.170	(3)	12189.010	(2)	12198.08	(5)
AIC	6646.934	(3)	6607.124	(1)	6648.116	(4)	6639.437	(2)	6657.657	(5)

Note 1: The model that performs the best is the one having the highest R^2_{Ef} and the lowest $SSRW$ and AIC.

Note 2: Under parenthesis: ranking of models' fit according to the corresponding indicator (by row).

3.6 Conclusion

In this paper, we estimate a dynamic model of promotions on a panel of American executives employed in 300 corporations. Promotion is defined as a change in job title resulting in a higher pay grade midpoint. The promotion probability is written as a function of individual attributes (age education, tenure), the level of the executive in the firm, firm characteristics (indicator of promotion opportunities, sales, profit and size as well as their variation) and a measure of the speed of past advancement of the individual in the wage scale relative to his age. Our baseline specification controls for individual unobserved heterogeneity, addresses the initial condition problem and models endogenously sample attrition. In a second specification, we investigate the role played by the executives' functional area in the promotion probability. Lastly, we estimate non-causal models (models where unobserved heterogeneity and attrition are not modeled) to compare the ability of five indicators to predict future promotions. The five indicators considered are the measure of speed of past wage advancement, functional area and three measures of recent earning growths on total compensation, base pay and bonus pay.

The estimation of these different specifications lead to the following results:

- The speed of past advancement measured at each period has a negligible impact on the promotion probability, whereas the initial speed of past advancement is an important determinant. Fast tracks result principally on heterogeneity in individual persistent characteristics and do not have a structural (causal) impact: 90% of the variance of the promotability index is explained by individual heterogeneity.

- Functional area observed at the beginning of the observation spell is an important determinant affecting the propensity to be promoted. Introducing the functional area in model of Fast Tracks lowers the significance of the impact of the initial past speed of past advancement.

- In non-causal models, functional area appears to be the best predictor of future promotions. Recent growth in base pay combined with the initial speed of past advancement is the second best predictor. The past speed of advancement (measured annually) comes third, and has a comparable predictive power than the total compensation growths combined with the initial speed. The growths in the bonus part of the compensation is the poorest predictor.

Theoretical models of job assignment support the existence of fast tracks. When learning is symmetric, fast tracks only result from differences in ability. However, in the case of asymmetric learning with promotion signaling, not only fast tracks reflect heterogeneity in ability, but they also have an inherent effect, since promoting workers already promoted in the past is less costly than promoting workers who have not been promoted yet. Our results indicate the presence of a spurious fast track (related to individual unobserved heterogeneity) but do not show a significant effect of causal fast tracks. A promotion signaling interpretation seems therefore to be unnecessary to explain the presence of fast tracks.

Testing other implications of the signaling role of promotions can be achieved by extending the analysis of promotion predictability models considered in the last section of the results. Indeed, in job assignment models with asymmetric learning and promotion signaling, firms have an incentive to promote workers already promoted in the past to limit the wage increase necessary to retain the promoted workers. Therefore, wage increases should be more important for promoted workers who were less likely to be promoted, from the point of view of outside employers. Testing this implication could be achieved by analyzing wage growth as a function of the predicted promotion probability: the lower the probability of predicted promotion, the higher the wage increase upon promotion. This analysis is left for future research.