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Evidence from Linked Employer-Employee Data**

Anders Frederiksen  
Takao Kato

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**Anders Frederiksen**

*ICOA, Aarhus University,  
CCP and IZA*

**Takao Kato**

*Colgate University, CJEB (Columbia),  
TCER (Tokyo), CCP (Aarhus) and IZA*

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IZA

P.O. Box 7240  
53072 Bonn  
Germany

Phone: +49-228-3894-0

Fax: +49-228-3894-180

E-mail: [iza@iza.org](mailto:iza@iza.org)

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## ABSTRACT

### **Human Capital and Career Success: Evidence from Linked Employer-Employee Data\***

Denmark's registry data provide accurate and complete career history data along with detailed personal characteristics (e.g., education, gender, work experience, tenure and others) for the population of Danish workers longitudinally. By using such data from 1992 to 2002, we provide rigorous evidence for the first time for the population of workers in an entire economy (as opposed to case study evidence) on the effects of the nature and scope of human capital on career success (measured by appointments to top management). First, we confirm the beneficial effect of acquiring general human capital formally through schooling for career success, as well as the gender gap in career success rates. Second, broadening the scope of human capital by experiencing various occupations (becoming a generalist) is found to be advantageous for career success. Third, initial human capital earned through formal schooling and subsequent human capital obtained informally on the job are found to be complements in the production of career success. Fourth, though there is a large body of the literature on the relationship between firm-specific human capital and wages, the relative value of firm-specific human capital has been rarely studied in the context of career success. We find that it is more beneficial to broaden the breadth of human capital within the firm than without, pointing to the significance of firm-specific human capital for career success.

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Corresponding author:

Takao Kato  
Department of Economics  
Colgate University  
13 Oak Drive  
Hamilton, NY 13346  
USA  
E-mail: [tkato@colgate.edu](mailto:tkato@colgate.edu)

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# Human Capital and Career Success: Evidence from Linked Employer-Employee Data

## I. Introduction

Individuals acquire general human capital through formal schooling. However, human capital acquisition does not stop upon graduation. Workers acquire both general and firm-specific human capital through learning by doing, or on-the-job training. On-the-job training can be rather narrow in its scope and workers remain mostly within the same field. It is, however, also possible that workers may go through rather extensive on-the-job training, experience diverse fields, and become a “generalist”.<sup>1</sup> This paper provides fresh evidence on the role of the different types of human capital in worker’s career success, defined as appointments to top management.

In so doing, we make three notable contributions to the literature. First, Lazear (2005) develops a theory of entrepreneurship, and uses unique data on career histories of Stanford MBA graduates and provides evidence that entrepreneurs are more likely to be generalists with diverse job experiences. More recently, using the same Stanford MBA graduate data, Lazear (2010) extends the analysis to corporate leaders and finds similar evidence that corporate leaders are also more likely to be generalists. In this paper, we expand his analysis to the population of workers in Denmark by taking advantage of Denmark’s registry data covering the population of Danish workers from 1992 to 2002. The importance of generalist career development for corporate leaders which Lazear (2010) found for a skewed (in terms of innate ability) sample of Stanford MBAs is also uncovered for the population of workers in Denmark.

Second, Gibbons and Waldman (2006) extend their earlier theory of wage and promotion within the firm (Gibbons and Waldman, 1999) and predict complementary interplay between

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<sup>1</sup>The human capital theory developed for example by Becker (1964) resulted in . For a discussion of the links between tenure, training and the formation of human capital see, e.g., Ryan, 2001, Lazear, 1998 ch. 6, and Koike, 2005 chs. 1-3)

initial human capital attained through formal schooling and subsequent human capital acquired on the job. We take advantage of large variations in formal schooling among the population of workers in Denmark and provide the first rigorous evidence on such a complementary relationship between formal schooling and on-the-job training.

Third, since each individual worker is linked to the employer each year in the Danish registry data, we are able to identify clearly which part of each worker's career history remains within the present firm and which part is outside of the present firm. Hence we can estimate the relative value of human capital acquired within the firm to human capital acquired outside of the firm. While there is a large body of the literature on the relationship between firm-specific human capital and wages, the relative value of firm-specific human capital in the context of career success has been rarely studied. Our paper provides novel evidence on the relative benefit of firm-specific human capital for career success, and thereby informs a long debate over the relative value of firm-specific human capital to general human capital (see, for instance, Lazear, 2009).

In the next section, we describe the empirical strategy and data in some detail. Section III presents our key results, followed by concluding remarks in section IV.

## **II. Empirical Strategy and Data**

To provide rigorous and systematic evidence on interplay between human capital (formal and informal) and career success, we will need detailed and reliable data on each individual worker's schooling (formal human capital formation) and complete career history (human capital acquisition through informal on-the-job training). Furthermore, we define career success as appointments to top management, and top managers are either promoted internally or recruited externally. It follows that the data will need to include both internal and external candidates for

top management positions. In other words, ideally the data are comprehensive enough to include any individual who has a reasonable chance of winning a top management appointment.

Such data are rare and the register-based Integrated Database for Labour Market Research (IDA) created by Statistics Denmark is unusually suited for the objective of this paper. First, the IDA database contains detailed information on *all* employers and *all* employees in the Danish economy. Using unique firm and individual identifiers we construct Linked Employer-Employee Data which provide detailed information on all employment matches in the private sector of the Danish Economy since 1980.<sup>2</sup> As such, we have data for the population of workers in the private sector in Denmark, which allows us to construct the pool of contestants for top management appointments, and perhaps more importantly check the robustness of the results to the use of alternative constructs of the contestant pool.

Second, the IDA provides data on career history for each individual worker which allow us to create a reasonable measure of the scope of informal human capital acquired through experiencing various occupations. Since IDA's occupational data play an important role in our analysis, we provide some necessary details on the nature, scope and reliability of IDA's occupational data.

The "Bekendtgørelse af lov om Danmarks Statistik" (Ministerial Order on the Statistics Denmark Act) requires every employer in Denmark to report annually an occupational classification code for each of its full-time employees, following the DISCO. The DISCO is the Danish version of the ILO's ISCO (*International Standard Classification of Occupations*). Normally the DISCO code reporting to Statistics Denmark takes place directly through the company's electronic salary systems.

Since there was a major change in the DISCO in 2003 (a switch from a four-digit

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<sup>2</sup> We focus on private sector employees, for the public sector employment tends to be subject to a different set of regulatory framework and labor market conditions, in particular more non-economic influences such as political considerations (Pedersen, et al., 1990).

classification system to a more detailed six-digit classification system) and the starting year of our occupation data is 1992, we choose 1992 – 2002 for the time period under study. However, as explained in more detail below, for data on firm tenure and general work experience, we will need data even prior to 1992. Hence we further match our Linked Employer Employee Data with pension contribution data dating back to 1964 to add data on firm-tenure and general work experience.

Even prior to the 2003 revision of the DISCO, however, the DISCO codes had been updated regularly, with some codes being eliminated and some new codes being created. Of obvious concern is therefore the possibility of spurious changes in the DISCO codes assigned to workers who experience no real change in their occupations. To demonstrate the spurious changes in the DISCO code, consider an employee to whom a DISCO code X is assigned in 2000. In 2001, DISCO code X is eliminated. The employer is now required to assign a new code to this individual in spite of the fact that the employee is doing exactly the same tasks. The creation of new codes may also produce similar spurious changes in the DISCO codes. We believe, however, that our analysis is largely free from such spurious changes in the DISCO codes, as we base our main analysis on one-digit or two-digit classifications. As shown in Table 1, over the 1992-2002 period, reassuringly at the one-digit and two-digit levels, there was only one new code added. Furthermore, as shown in the lower panel of the table, the newly added code turned out to be a rather insignificant code with fewer than 1000 employees assigned to this code each year.

The table also shows, as expected, that more code changes occurred at the three-digit and four-digit levels, although such changes often involved a relatively small number of employees. In sum, by focusing on the one-digit and two-digit levels, we are able to minimize the problem of spurious code changes.

Our operational definition of career success is an appointment to a top management position in a firm with 100 or more employees.<sup>3</sup> Top management positions are defined as DISCO 12 Corporate Managers and DISCO 13 General Managers.<sup>4</sup> In 2002, there were 601,467 individuals with proper DISCO codes who worked for firms with 100 or more employees in Denmark. Out of these 601,467 individuals, 16,168 individuals were in DISCO 12 and 2,179 individuals were in DISCO 13, together amounting to a little over 3 percent of all workers in firms with 100 or more employees. Furthermore, those individuals who are appointed to top management positions are estimated to earn 30 percent more than other employees, after controlling for age, gender, tenure, general work experience, education, and year effects.<sup>5</sup> Regarding appointments to these top management positions as career success appears to be appropriate.<sup>6</sup>

To uncover what factors contribute to career success, we first use our unusually comprehensive database to construct a contestant pool i.e., identify individuals who had some reasonable chance of becoming a top manager. The results presented below focus on a contestant pool which is constructed as follows:

1. For each individual who was appointed to a top management position in year  $t$ , we identify the occupation (2-digit DISCO code) in year  $t - 1$ .
2. We consider anyone who listed one of these occupations as their primary occupation in year  $t - 1$  as part of the contestant pool for a top management position in year  $t$ .

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<sup>3</sup> Our results are robust to the use of different cut-off levels of employment, such as 50 employees. These as well as all other unreported results are available upon request from the corresponding author ([tkato@colgate.edu](mailto:tkato@colgate.edu)).

<sup>4</sup> Smith, Smith and Verner (2010) in their recent study of gender pay gaps in top management positions in Denmark use a similar method to define top management positions of top 2000 private firms in Denmark.

<sup>5</sup> For a detailed discussion of the economic returns to within- and cross-firm mobility in Denmark see Frederiksen, Halliday and Koch (2010).

<sup>6</sup> An alternative and narrower definition of career success is an appointment to CEO. Unfortunately this requires the use of the 4-digit codes, and more importantly we discovered that not all firms assigned the same 4-digit code to their CEOs.



This is probably the broadest and least restrictive construct of the top management contestant pool. Figure 1 shows the number of top management appointments and the size of the contestant pool by occupations (1-digit DISCO codes). As shown in the figure, top managers are appointed from a very broad set of occupations including clerks and machine operators, which is consistent with high social mobility in Denmark (Aaberge, et. al., 2002). We also consider alternative narrower definitions of the contestant pool and find that our key results are insensitive to the use of alternative narrower definitions.<sup>7</sup>

To study the benefit of the scope of human capital obtained through various occupational experiences for career success, naturally we have to limit our analysis to those employees for which reasonably long and continuous career history data (in particular DISCO codes and employer codes) are available. In spite of the relative completeness of the Danish registry data, there are several reasons why some individuals lack complete occupational histories. First, the “Bekendtgørelse af lov om Danmarks Statistik” (Ministerial Order on the Statistics Denmark Act) does not require reporting of DISCO codes for those individuals who are out of labor force, unemployed, self-employed, working in the workplace with less than 10 employees or working in a firm directly engaged in agriculture, fishery or forestry. As such, any Danish resident worker who falls into any one of those categories as a primary labor market status for a particular year will have a missing DISCO code for that particular year. Second, young employees or recently immigrated individuals will not have sufficiently long occupational histories. Finally, any Danish citizen who work outside of Denmark for over six months and thereby is no longer liable to Danish income tax for that year is also exempt from the annual reporting requirement.

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<sup>7</sup> Instead of using only 2-digits DISCO codes, we tried 3- and 4- digits codes and found that the coefficient on TOCC (our key measure of the breath of informal human capital used extensively below) remained positive and significant. In addition, in the subsequent section, we report our additional logit estimations of career success defined as appointments to specific functional area directorships in which the contestant pool for each functional area directorship is defined more narrowly as those competing for the specific functional area directorship.

For the rest of the paper, we report the results based on all workers with at least 8 years of complete occupational histories. However, we also repeated the analysis based on a less restrictive exclusion criteria (all workers with at least 5 years of complete occupational histories) and reassuringly found no discernable difference.

In short, we identify all employees working in the private sector in Denmark in year  $t$  who have complete occupational histories between year  $t - 8$  through year  $t - 1$ . We then consider each employee's probability of winning an appointment to a top management position between year  $t$  and  $t + 1$ , given her current occupation (occupation in year  $t$ ) and her career history (occupational experiences obtained in years  $t - 8$  to  $t - 1$ ). Ultimately we end up estimating a logit model with the annual probability of top management appointment in 2000 and 2001 as the dependent variable and the career history as the key independent variable.

In Table 2 we present descriptive statistics for individuals with a complete eight-year occupational history as well as for all individuals with less than eight years of complete occupational history. First, on the one hand, educational attainments appear to be quite similar between our sample of individuals with 8 years of complete occupational history and the total sample. On the other hand, as expected, our sample of individuals with complete occupational history have considerably longer tenure and labor market experience than the total sample, and our sample include more older and male workers than the total sample.

Table 2 further divides our sample of individuals with complete occupational history into two groups, those who won top management appointments (those with career success) and those who are in the contestant pool but not appointed (those without career success). First, only 11 percent of those without career success have a college or graduate degree. In contrast, 36 percent of those with career success have at least a college degree. Second, individuals with career success held considerably more different occupations in the past (broader breath of informal

human capital) than those in the contestant pool without career success. For example, 60 percent of individuals with top management appointments held at least two different occupations measured at the two-digit level in the past whereas only 40 percent of those in the contestant pool without such appointments have done so. Further, the proportion of individuals with four or more different occupations is higher among those with career success than among those in the contestant pool without career success (19 percent vs. 10 percent). These preliminary observations suggest that formal education may play a significant role in career success and that the breadth of human capital acquired through informal OJT may be important. In the next section we will estimate logit models to confirm these preliminary findings with rigor.

### III. Econometric Specifications and Results

To provide rigorous and systematic evidence on interplay between human capital (formal and informal) and career success, we begin with the following baseline logit model of top management appointments:

$$(1) \ln[\Pr(\mathbf{APPOINTMENT}_i)/1-\Pr(\mathbf{APPOINTMENT}_i)]=\alpha+\beta\mathbf{BHC}_i+\gamma\mathbf{SCH}_i+\delta\mathbf{FEMALE}_i+\rho\mathbf{Z}_i+u_i$$

where  $\mathbf{APPOINTMENT}_i$  is equal to 1 if worker  $i$  is appointed to a top managerial position in a large firm (with 100 or more employees), zero otherwise;  $\mathbf{BHC}_i$  is the breadth of human capital that worker  $i$  has acquired through OJT;  $\mathbf{SCH}_i$  is a column vector of dummy variables capturing the level of formal educational attainments of worker  $i$ ;  $\mathbf{FEMALE}_i$  is a dummy variable taking a value of one if worker  $i$  is female, zero otherwise;  $\mathbf{Z}_i$  is a column vector of other control variables of worker  $i$  (age, tenure, general work experience, and a vector of 34 (2-digit) occupation dummy variables to indicate his/her current occupation as well as a year dummy variable to control for year effects;  $\alpha$ ,  $\beta$ , and  $\delta$  and the two vectors  $\gamma$  and  $\rho$  contain the parameters to be estimated, and

$u_i$  is the disturbance term.

For  $SCH_i$ , our data allow us to identify five different levels of formal educational attainments;  $HIGHSCHOOL_i=1$  if worker  $i$ 's highest educational attainment is a regular high-school diploma, zero otherwise;  $VOCATIONAL_i=1$  if worker  $i$ 's highest educational attainment is a vocational high-school diploma, zero otherwise;  $COLLEGE_i=1$  if worker  $i$ 's highest educational attainment is a college degree, zero otherwise; and  $GRADUATE_i=1$  if worker  $i$ 's highest educational attainment is a graduate degree, zero otherwise (omitted reference group is  $LESS-THAN-HIGHSCHOOL_i=1$  if worker  $i$ 's highest educational attainment is less than a high school diploma).<sup>8</sup>

We consider several alternative measures for BHC (hereafter subscript  $i$  will be omitted for exposition). First, we calculate for each individual worker the number of occupations held prior to the current occupation, TOCC. The sign and significance of the estimated coefficient on TOCC can be used to test our key hypothesis that the probability of winning a top management appointment will increase with the breadth of human capital acquired through OJT, measured by the number of prior occupations (2-digit). Ideally we also like to examine the breadth of informal human capital at the 3-digit or higher level. For instance, the breadth of human capital obtained on the job within the functional area may be of considerable interest. Unfortunately, studying the breadth of informal human capital within the functional area will inevitably require us to go beyond the 2-digit level, and as discussed above, the coding inconsistency will become a potentially serious concern once we go beyond the two-digit level.

Furthermore, we acknowledge that the quantity, nature and scope of human capital an individual worker obtained through formal schooling and informal on-the-job training (BHC and SCH) may not be strictly exogenous. Unfortunately the lack of reliable instruments prevents us

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<sup>8</sup> University education in Denmark consists of a 3-year Bachelor program (college) followed by a 2-year Master program. PhD programs are available after a Master degree is obtained. We combine Masters and PhDs and denote them as graduates.

from accounting for such possible endogeneity fully. As such we will interpret the estimated coefficients on BHC and SCH as upper bounds of their effects. For instance, the estimated coefficient on TOCC will imply the beneficial effect for career success of having an additional occupational experience for those who benefit the most from such an additional occupational experience.

Column (i) of Table 3 shows the logit estimates of Eq. (1) with TOCC as a measure for BHC. The estimated coefficient on TOCC is positive and statistically significant at the 1 percent level, showing that the probability of winning a top management appointment rises significantly with the number of occupations experienced in the past, after controlling for formal educational attainments, gender, age, current occupation, tenure, and general work experience.<sup>9</sup> As such, the data support our hypothesis that by acquiring the broader scope of human capital through OJT, workers can enhance the chance for career success. The economic significance of the estimated coefficient on TOCC as well as on schooling variables will be discussed in the next section.

To see if the results change when we use a more general and less parsimonious specification which allows for possible nonlinear relationships between the breadth of human capital and career success, we consider a set of dummy variables instead of TOCC (OCC1=1 if worker *i* experienced one occupation which differs from his/her current occupation, zero otherwise; OCC2=1 if an individual experienced two occupations which differ from his/her current one; likewise for OCC3 to OCC7). Reassuringly as shown in Column (ii) of Table 3, the estimated coefficients on the dummy variables are positive and statistically significant at the 1 percent level and the magnitude of the estimated coefficient rises with the level of the OCC dummy variables except for OCC7 (note that there are very few workers with OCC7=1). Overall, the observed significant positive effect on career success of the breadth of human capital is not

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<sup>9</sup> Because some individuals enter the sample in both 2000 and 2001, we cluster standard errors at the individual level in all regressions presented below.

sensitive to whether we use a parsimonious specification (TOCC) or a more general specification (a set of dummy variables).<sup>10</sup>

The estimated coefficients on the formal schooling variables are also found positive and statistically significant at the 1 percent level, suggesting that individuals with college degrees and postgraduate degrees have a significantly higher likelihood of winning top management appointments relative to less educated individuals, which is consistent with either the human capital theory emphasizing formal schooling as production of general human capital or the signaling theory stressing formal schooling as a credible labor market signal.

The estimated coefficient on FEMALE is negative and statistically significant at the 1 percent level. Thus, after controlling for education, age, current occupation, tenure, general work experience as well as TOCC, women are less likely to be appointed to top management positions. Though not inconsistent with the notion of “glass ceiling” for female managers (see, for instance, Albrecht, Björklund and Vroman, 2003, Blau and DeVaro, 2007, and Smith, Smith and Verner, 2010), our finding is subject to unobserved individual heterogeneity and hence needs to be interpreted with caution.

To further explore the gender differences in the relationships between career success and human capital, we estimate Eq. (1) separately for men and women. The results are presented in Table 4, from which we produced Figure 2. Specifically, using modal values for all dummy variables and mean values for all continuous variables in Eq. (1) estimated separately for men and women, we calculate the predicted odds of winning a top management appointment for the typical male and female contestant for different levels of educational attainment, and divide the former odds by the latter odds. The resulting relative predicted probabilities of top management appointments are plotted for different levels of educational attainment in Figure 2. The figure

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<sup>10</sup> A few workers experienced eight different occupations prior to their current ones (OCC8=1). However, nobody from this group was appointed to a top management position and hence a very small number of workers with OCC8=1 were not included in our estimation of the nonlinear version of Eq. (1).

points to a higher return to postgraduate education for women than for men in terms of its beneficial effect on career success. Our finding of the greater value of postgraduate degrees for women's career as compared to men's career is consistent with the invisibility hypothesis on discrimination in promotion (Milgrom and Oster, 1998 and DeVaro, Suman and Zoghiz, 2007). That is, when a woman is promoted to a top management position, outside firms are finally convinced of her high ability. In contrast, when a man is promoted to a top management position, it is likely that outside firms already knew of his high ability through the old boy network. Formal schooling may serve as a relatively more important signaling device for women, for formal schooling can be used to make up for the lack of network.

#### Formal schooling and informal OJT: Complements or substitutes?

As discussed earlier, Gibbons and Waldman (2006)'s extended theory of wage and promotion within the firm predicts complementary between human capital attained by formal schooling and human capital acquired on the job. We take advantage of variations in formal schooling among the population of workers in Denmark and examine if formal schooling and on-the-job training are indeed complements in the production of career success. Specifically we estimate Eq. (1) augmented by a set of interaction terms involving TOCC and educational dummy variables.

Column (iii) of Table 3 summarizes the logit estimates of the augmented version of Eq. (1). The estimated coefficients on the interaction terms involving TOCC and formal schooling variables are insignificant at lower levels of schooling but positive and significant at the 5 percent level for individuals with graduate training. The observed complementarity between formal schooling and informal OJT is consistent with Gibbons and Waldman (2006)'s key insight that formal schooling enhances each individual's general learning ability and hence makes informal OJT more effective.

To demonstrate the importance of formal schooling and informal OJT, again we use modal values for all dummy variables and mean values for all continuous variables in the above augmented model with interaction terms and calculate the probability of top management appointments for the typical worker with different values for TOCC for each formal schooling category (Less than high school; High School; Vocational; College; and Graduate). The resulting experience-career success profiles are drawn in Figure 3.

The typical college graduate with minimal breadth of human capital (TOCC=0) is predicted to have a little over 1 percent chance of winning a top management position in a large firm in Denmark, and is about twice as likely to win a top management position as the comparable high school graduate. As the breadth of human capital earned through informal OJT increases, both the typical college graduate and the typical high school graduate will enjoy higher odds of career success. For example, the typical high school graduate with considerable breadth of informal human capital, say TOCC=4, is twice as likely to win a top management position as the typical high school graduate with TOCC=0 (minimal breadth of informal human capital). Note that the typical high-school graduate's odds of winning a top management position are now comparable to the typical college graduate's odds with minimum breadth of information human capital. In other words, the typical high school graduate needs to experience four additional occupations to overcome the initial disadvantage of not having a college degree.

Perhaps more importantly, the difference in the winning odds between graduate degree holders and college graduates is rather small when the breadth of informal human capital is narrow. However, the gap in the odds of winning a top management appointment widens considerably as the breadth of informal human capital increases due to the significant complementarity between formal schooling and informal OJT for graduate degree holder. For example, the typical college graduate with TOCC=4 is about **two and a half times** as likely to



win a top management appointment as the typical college graduate with TOCC=0, while the typical graduate degree holder with TOCC=4 is about **Four times** more likely to win a top management appointment as the typical graduate degree holder with TOCC=0. This demonstrates the importance of the complementarity between formal schooling and informal OJT in the context of career success.

We repeat the same analysis for men and women separately, and the results are presented in column (iii) of Table 4. The estimated coefficients on an interaction term involving TOCC and GRADUATE are positive and large for both men and women, suggesting that complementarity between graduate degrees and informal OJT applies to both men and women (although the coefficient for women is somewhat less precisely estimated).

#### Firm-specific human capital

Occupational experiences obtained outside the worker's present firm may not be a perfect substitute for occupational experiences acquired within the worker's present firm, for there may be firm-specific human capital formed through internal work experiences in various occupations within the firm. To examine the degree of substitutability between internally-acquired experiences and externally-obtained experiences, we consider two new variables: (i) INT\_OCC = the total number of internal occupations a worker has experienced in the present firm (excluding the current occupation); and (ii) INT\_EXT\_OCC = the total number of all occupations experienced by an individual excluding the present one (note that if an individual experience the same occupation in two different firms, we consider this as experiencing two "different" occupations). Of prime focus is the estimated coefficient on INT\_OCC which captures the value of internal occupational experiences, holding total prior occupational experiences constant.

Table 5 reports the logit estimates on INT\_OCC and INT\_EXT\_OCC. The estimated

coefficient on INT\_OCC is positive and statistically significant at the 1 percent level. Thus, holding constant formal educational attainments, gender, age, current occupation, tenure, general work experience as well as the total amount of prior occupational experiences, having more internal occupational experiences will result in a significantly higher probability of career success. Note since we are holding total amount of prior occupational experiences constant, the estimated coefficient on INT\_OCC reflects the value of experiencing an occupation internally as opposed to externally, and thereby shows the importance of firm-specific human capital.

As done for formal schooling and informal OJT, we demonstrate the magnitude of the effect of internal and external occupational experiences on career success in Figure 4. Using the estimated coefficients of model (ii) in Table 5, we produced experience-career success profiles for two types of college graduates: (a) internal career developers (INT\_EXT\_OCC=INT\_OCC=0, 1, 2, 3, and 6); and (b) external career developers (INT\_EXT\_OCC=0, 1, 2, 3, and 6, and INT\_OCC=0). In both cases, as the typical college graduate expands the breadth of informal human capital by experiencing more occupations, the odds of winning a top management appointment will rise. However, the magnitude of the benefit of the breadth of informal human capital differs considerably between the two cases (internal and external career development). For the case of internal career development, on the one hand, the winning odds for the typical college graduate will rise from 1 percent to 5 percent as he/she broadens the scope of his/her informal human capital by experiencing four additional occupations internally. For the case of external career development, on the other hand, the same amount of informal human capital broadening from INT\_EXT\_OCC=0 to INT\_EXT\_OCC=4 will result in an increase in the winning odds from 1 percent to only 2 percent. Considering that tenure and age are fully controlled for, the advantage of expanding the breadth of informal human capital within the firm as opposed to outside the firm appears to be considerable, pointing to the importance of firm-

specific human capital.

Until now, we have focused on whether or not an individual succeeds in obtaining a top management appointment in a large firm, and have not paid attention to how the individual wins a top management appointment (in particular, through internal promotion or external recruitment). We believe this is a reasonable abstract from the reality. For many individuals, whether to earn a top management appointment in a large firm is probably of primary concern, and how to win it is of secondary importance.

To further shed light on the value of specific human capital, however, we now consider a distinction between winning a top management appointment through internal promotion without switching the present firm and winning a top management appointment through external recruitment or moving from the present firm to another firm. Specifically we expand model (ii) in Table 5 to a multinomial logit framework with three destinations: (i) winning a top management appointment through internal promotion; (ii) winning a top management appointment through external recruitment; and (iii) not winning a top management appointment. The results are presented in Table 6. The estimated coefficients on INT\_EXT\_OCC are positive and statistically significant at the 1 percent level for both internal promotion to top management and external recruitment to top management, confirming the importance of the breadth of human capital as a determinant of career success.

It is also not too surprising that the estimated coefficient on INT\_OCC is found to be positive and statistically significant at the 1 percent level for internal promotion. Holding constant formal educational attainments, gender, age, current occupation, tenure, general work experience as well as the total amount of prior occupational experiences, having more internal occupational experiences will result in a significantly higher probability of internal promotion. Interestingly the estimated coefficient on INT\_OCC for external recruitment is also found to be

positive and statistically significant at the 10 percent level. Expanding the scope of human capital through on-the-job training in the present firm will help an individual attain a top management appointment not only in the present firm through internal promotion but also in a different firm through external recruitment.

To demonstrate the economic significance of firm-specific human capital in the multinomial logit framework with internal promotion and external recruitment as two distinct means to win a top management appointment, we produce Figure 5. The figure considers the case of internal career development with all of their occupational experiences including the current one in the same firm ( $INT\_EXT\_OCC=INT\_OCC$ ), and plots experience-career success profiles, distinguishing career success through internal promotion from the one through external recruitment. First, the steepness of the experience-career success profile for internal promotion demonstrates vividly the considerable benefit of extending the breadth of human capital internally and hence expanding the scope of firm-specific occupational experiences for winning a top management appointment through internal promotion. In contrast the relative flatness of the experience-career success profile for external recruitment shows that such internal human capital formation is of less value for winning a top management appointment through external recruitment. It is important, however, to note that the profile is positive and that extending the breadth of human capital internally still helps the typical college graduate win his/her top management appointment through external recruitment.

#### Breadth of Informal Human Capital and Functional Areas

It is plausible that the value of the breadth of informal human capital differs among functional areas, such as Finance, HR, R&D, and Sales and Marketing. To investigate possible differences in the importance of the breadth of informal human capital among functional areas, we repeat the

above analysis separately for directors of four key functional areas, Finance, HR, R&D, and Sales and Marketing. We define top management appointments in Finance as changes from DISCO Major Groups 2 through 9 and all codes in firms with less than 100 employees to DISCO 1231 FINANCE AND ADMINISTRATION DEPARTMENT MANAGERS in large firms with 100 or more employees. Likewise, top management appointments in HR, Sales and Marketing, and R&D are defined as changes from DISCO Major Groups 2 through 9 and all codes in firms with less than 100 employees to: DISCO 1232 PERSONNEL AND INDUSTRIAL RELATIONS DEPARTMENT MANAGERS in large firms with 100 or more employees; DISCO 1233 SALES AND MARKETING DEPARTMENT MANAGERS in large firms with 100 or more employees; and DISCO 1237 RESEARCH AND DEVELOPMENT DEPARTMENT MANAGERS in large firms with 100 or more employees respectively. Note that we do rely on the four-digit codes in this last exercise. However, after a careful review of those four specific codes (1231, 1232, 1233, and 1237), we are confident that insofar as those four codes are concerned, they are stable over time and there is no inconsistency.

Table 6 presents the results. The estimated coefficients on TOCC in a general specification (Model (i) in which occupational experiences within and outside the firm are treated equally) are positive and significant at the 1 percent level, pointing to the significant positive effect on the probability of winning each functional area directorship of the breadth of informal human capital. Figure 6, which is produced from the estimated coefficients of Model (i) in a similar fashion to earlier figures, demonstrates the relative importance of broadening the scope of occupational experiences for career success in R&D as compared to other functional areas, in particular HR.<sup>11</sup>

To further investigate the relative importance of firm-specific human capital in each

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<sup>11</sup> Due to the large difference in the level of predicted probabilities of directorship appointments among functional areas, we normalized each predicted probability by dividing it by the predicted probability for an individual with TOCC=0 for each functional area.

functional area, we distinguished internally-accumulated occupational experiences from externally-obtained occupational experiences as in the previous section. The results are shown in Models (ii) and (iii). While firm-specific occupational experience remains relevant in general, the estimated coefficient on INT\_OCC for HR is now insignificant, pointing to the unimportance of accumulating firm-specific occupational experiences for career success in HR.

Unfortunately we lack adequate data (qualitative and quantitative) to interpret the observed differences between R&D and other functional areas (especially HR) fully. However, our preliminary interpretations are based on both supply-side and demand-side considerations. On the supply-side, we can use our data to establish that many R&D directors are indeed engineers and scientists with professional engineering degrees (undergraduate and/or graduate degrees in engineering and science), and that directors in other functional areas have more diverse and often broader educational backgrounds. For instance, the majority of R&D directors in our data are holders of college or graduate degrees in science and engineering, whereas only ten percent of HR directors are holders of such degrees. Thus, broadening the breadth of informal human capital through experiencing diverse occupations (and hence compensating for the relatively narrow formal human capital) may be more important for potential R&D directors.

On the demand-side, we hypothesize that a R&D department tends to function more as a semi-autonomous stand-alone organizational unit as compared to other departments. As such, running a R&D department will probably have more resemblance to running the entire corporation, as contrasted to running an HR department. Hence, possessing broader occupational experiences will be more relevant to R&D directorship than to other directorships.

#### **IV. Concluding Remarks**

Denmark's registry data provide accurate and complete career history data along with detailed personal characteristics (e.g., education, gender, work experience, tenure and others) for the population of Danish workers. That our data include all workers in Denmark as opposed to a small subset of the labor force in Denmark has given us unusual flexibility in terms of our ability to construct diverse contestant pools for top management appointments. Our preferred construct is the least restrictive one, i.e., a group of all individuals in Denmark who during last year worked in the same occupations as anyone who is appointed to a top management position this year.

By using such data from 1992 to 2002, we have provided fresh evidence on the effects of the nature and scope of human capital on career success (measured by appointments to top management). First, we have confirmed the beneficial effect of acquiring general human capital formally through schooling for subsequent career success, as well as the gender gap in career success rates (female workers are less likely to be appointed to top management, after controlling for a variety of personal characteristics). Second, broadening the scope of human capital by experiencing various occupations (becoming a generalist) is found to be advantageous for career success, controlling for education; gender; current occupation; age; general work experience; and tenure. Our finding has lent external validity to a recent case study (Lazear, 2010) which reports a similar finding for a skewed (in terms of innate ability) sample of Stanford MBAs.

Third, we have found evidence for complementarity between initial human capital earned through formal schooling and subsequent human capital obtained informally on the job. Though a number of theorists predicted such synergic interplay between schooling and on-the-job training, we believe our study is the first to provide rigorous evidence on the interplay in the context of career success (top management appointments).

Fourth, though there is a large body of the literature on the relationship between firm-specific human capital and wages, the relative value of firm-specific human capital has been rarely studied in the context of career success (top management appointments). We have found the first evidence that it is more beneficial to broaden the breadth of human capital within the firm than without, pointing to the significance of firm-specific human capital for career success.

Finally, the breadth of human capital obtained on the job has been found to be more beneficial for R&D directorship than for other functional area directorships, in particular HR, pointing to heterogeneity of the importance of the breadth of human capital among different functional areas.



## References

- Aaberge, Rolf and et al.** "Income Inequality and Income Mobility in the Scandinavian Countries Compared to the United States." *Review of Income and Wealth*, 2002, 48(4), pp. 443-69.
- Albrecht, James; Bjorklund, Anders and Vroman, Susan.** "Is There a Glass Ceiling in Sweden?" *Journal of Labor Economics*, 2003, 21(1), pp. 145-77.
- Becker, Gary S.** *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. Chicago: University of Chicago Press, 1964.
- Blau, Francine D. and Devaro, Jed.** "New Evidence on Gender Differences in Promotion Rates: An Empirical Analysis of a Sample of New Hires." *Industrial Relations*, 2007, 46(3), pp. 511-50.
- DeVaro, Jed; Ghoshy, Suman and Zoghiz, Cindy.** "Job Characteristics and Labor Market Discrimination in Promotions: New Theory and Empirical Evidence," Cornell University ILR School Working Paper, 2007.
- Frederiksen, Anders; Halliday, Timothy and Koch, Alexander K.** "Within- and Cross-Firm Mobility and Earnings Growth," IZA Discussion Paper No. 5163, 2010.
- Gibbons, Robert and Waldman, Michael.** "Enriching a Theory of Wage and Promotion Dynamics inside Firms." *Journal of Labor Economics*, 2006, 24(1), pp. 59-107.
- \_\_\_\_\_. "A Theory of Wage and Promotion Dynamics inside Firms." *Quarterly Journal of Economics*, 1999, 114(4), pp. 1321-58.
- Koike, Kazuo.** *Shigoto No Keizaigaku (Economics of Work)*. Tokyo: Toyo Keizai, 2005.
- Lazear, Edward P.** "Entrepreneurship." *Journal of Labor Economics*, 2005, 23(4), pp. 649-80.
- \_\_\_\_\_. "Firm-Specific Human Capital: A Skill-Weights Approach." *Journal of Political Economy*, 2009, 117(5), pp. 914-40.
- \_\_\_\_\_. "Leadership: A Personnel Economics Approach," National Bureau of Economic Research, Inc, NBER Working Papers: 15918, 2010.
- \_\_\_\_\_. *Personnel Economics for Managers*. New York; Chichester and Toronto: Wiley, 1998.
- Milgrom, Paul and Oster, Sharon.** "Job Discrimination, Market Forces, and the Invisibility Hypothesis." *Quarterly Journal of Economics*, 1987, 102(3), pp. 453-76.
- Mincer, Jacob.** "Investment in Human Capital and Personal Income Distribution." *Journal of Political Economy*, 1958, 66(4), pp. 281-302.
- Pedersen, P. J. and et al.** "Wage Differentials between the Public and Private Sectors." *Journal of Public Economics*, 1990, 41(1), pp. 125-45.
- Ryan, Paul.** "The School-to-Work Transition: A Cross-National Perspective." *Journal of Economic Literature*, 2001, 39(1), pp. 34-92.
- Smith, Nina; Smith, Valdemar and Verner, Mette.** "The Gender Pay Gap in Top Corporate Jobs in Denmark: Glass Ceilings, Sticky Floors or Both?," IZA Discussion Paper No. 4848, 2010.
- Wagner, Joachim.** "Are Nascent Entrepreneurs 'Jacks-of-All-Trades'? A Test of Lazear's Theory of Entrepreneurship with German Data." *Applied Economics*, 2006, 38(20), pp. 2415-19.

Table 1 Changes in DISCO codes between 1992 and 2002

	# of codes	# of new codes added	# of discontinued codes
<b>All</b>			
1-digit DISCO code	9	0	0
2-digit DISCO code	34	1	0
3-digit DISCO code	144	14	2
4-digit DISCO code	494	81	14
<b>DISCO code with cell size &gt; 100</b>			
1-digit DISCO code	9	0	0
2-digit DISCO code	33	1	0
3-digit DISCO code	100	2	0
4-digit DISCO code	232	8	2
<b>DISCO code with cell size &gt; 1000</b>			
1-digit DISCO code	9	0	0
2-digit DISCO code	28	0	0
3-digit DISCO code	65	0	0
4-digit DISCO code	97	3	0

Table 2 Descriptive statistics

	Eight years of complete occupational history				No restrictions on occupational history
	Appointed to top management in a firm with 100 or more employees	Contestant pool excluding those appointed to top management	Contestant pool	All private sector employees	All private sector employees
<i>Prior occupations (pct):</i>					
0	15.05	31.48	31.40	30.83	
1	24.26	28.43	28.40	28.50	
2	22.61	16.40	16.44	16.58	
3	18.96	14.03	14.05	14.23	
4	11.43	5.74	5.76	5.88	
5	5.38	2.98	3.00	3.02	
6	1.97	0.77	0.77	0.79	
7	0.34	0.16	0.16	0.16	
8	0.00	0.02	0.02	0.02	
<i>Education (pct):</i>					
LESS-THAN-HIGH- SCHOOL	12.54	24.28	24.22	23.90	32.49
HIGH-SCHOOL	45.16	60.03	59.96	59.49	51.63
VOCATIONAL	5.59	5.01	5.01	5.03	4.68
COLLEGE	24.81	7.44	7.52	8.00	7.10
GRADUATE	11.91	3.24	3.29	3.57	4.11
FEMALE	0.13	0.28	0.28	0.27	0.36
AGE	44.45 (8.42)	45.90 (9.00)	45.90 (8.99)	45.94 (8.99)	37.29 (12.68)
TENURE	6.72 (6.95)	8.22 (7.56)	8.21 (7.56)	8.23 (7.58)	4.73 (5.63)
EXPERIENCE	22.45 (7.85)	23.49 (7.90)	23.48 (7.89)	23.52 (7.91)	14.42 (10.85)
# observations	3,813	769,281	773,094	799,854	2,913,253

Note: Prior occupations, education and gender are percentages. All other variables are means with standard deviations in parenthesis.

Table 3. The logit estimates on the effect on career success of the scope of occupational experiences and the level of educational attainment

	Logit		
	(i)	(ii)	(iii)
<i>(Prior occupations)</i>	0.226***		0.191***
TOCC	(0.010)		(0.028)
OCC1		0.379***	
		(0.060)	
OCC2		0.817***	
		(0.059)	
OCC3		0.855***	
		(0.063)	
OCC4		1.095***	
		(0.071)	
OCC5		1.129***	
		(0.088)	
OCC6		1.333***	
		(0.130)	
OCC7		1.318***	
		(0.293)	
HIGH-SCHOOL	0.210***	0.209***	0.106
	(0.055)	(0.055)	(0.090)
VOCATIONAL	0.227***	0.226***	0.245
	(0.088)	(0.087)	(0.150)
COLLEGE	1.070***	1.081***	1.028***
	(0.064)	(0.064)	(0.100)
GRADUATE	1.255***	1.265***	1.052***
	(0.080)	(0.080)	(0.120)
FEMALE	-0.705***	-0.706***	-0.707***
	(0.055)	(0.055)	(0.055)
TOCC*HIGH-SCHOOL			0.046
			(0.031)
TOCC*VOCATIONAL			-0.008
			(0.053)
TOCC*COLLEGE			0.014
			(0.034)
TOCC*GRADUATE			0.097**
			(0.040)
Pseudo R-square	0.127	0.128	0.127
Observations	773,094	772,964	773,094

Note: All regressions control for tenure, general work experience, a quadratic in age and year dummies besides occupation dummies at the 2-digit level. Significance levels: \*\*\* 1 percent, \*\* 5 percent, \* 10 percent. The drop in sample size in model (ii) is due to the fact that no individuals with OCC8 = 1 are promoted. Standard errors are clustered.

Table 4. The logit estimates on the effect on career success of the scope of occupational experiences and the level of educational attainment: gender differences

	Logit					
	(i)		(ii)		(iii)	
	men	women	men	women	Men	women
<i>(Prior occupations)</i>						
TOCC	0.231*** (0.011)	0.162*** (0.033)			0.185*** (0.030)	0.201** (0.072)
OCC1			0.411*** (0.066)	0.181 (0.157)		
OCC2			0.866*** (0.064)	0.448*** (0.156)		
OCC3			0.896*** (0.068)	0.521*** (0.169)		
OCC4			1.159*** (0.076)	0.506** (0.217)		
OCC5			1.151*** (0.095)	0.917*** (0.249)		
OCC6			1.355*** (0.138)	1.107*** (0.374)		
OCC7			1.347*** (0.305)	1.135 (1.029)		
HIGH-SCHOOL	0.205*** (0.060)	0.110 (0.149)	0.204*** (0.060)	0.108 (0.149)	0.058 (0.099)	0.245 (0.221)
VOCATIONAL	0.202** (0.096)	0.316 (0.216)	0.200** (0.096)	0.314 (0.215)	0.191 (0.165)	0.470 (0.355)
COLLEGE	1.039*** (0.068)	1.011*** (0.193)	1.051*** (0.068)	1.017*** (0.194)	0.957*** (0.109)	1.324*** (0.281)
GRADUATE	1.156*** (0.086)	1.662*** (0.223)	1.169*** (0.085)	1.665*** (0.223)	0.971*** (0.130)	1.270*** (0.339)
TOCC* HIGH-SCHOOL					0.062* (0.034)	-0.072 (0.085)
TOCC* VOCATIONAL					0.005 (0.056)	-0.081 (0.151)
TOCC* COLLEGE					0.032 (0.037)	-0.170 (0.107)
TOCC* GRADUATE					0.085** (0.044)	0.173 (0.110)
Pseudo R-square	0.120	0.123	0.122	0.124	0.120	0.125
Observations	559,643	206,397	559,535	206,378	559,643	206,397

Note: All regressions control for tenure, general work experience, a quadratic in age and year dummies besides occupation dummies at the 2-digit level. Significance levels: \*\*\* 1 percent, \*\* 5 percent, \* 10 percent. The drop in sample size is due to the lag of promotions in small cells when splitting the sample by gender. Standard errors are clustered.

Table 5. The logit estimates on the effects on career success of the scope of internal and external occupational experiences

	Logit	
	(i)	(ii)
<i>(Total prior occupations)</i>		
INT_EXT_OCC	0.212*** (0.013)	0.169*** (0.014)
<i>(Prior occupations in current company)</i>		
INT_OCC		0.249*** (0.026)
R-squared	0.123	0.125
Observations	773,094	773,094

Note: The regressions have the same specification as Model (i) in Table 3 but with TOCC replaced by INT\_EXT\_OCC and INT\_OCC. Significance levels: \*\*\* 1 percent, \*\* 5 percent, \* 10 percent. Standard errors are clustered.

Table 6 The multinomial logit estimates on the effects on career success of the scope of internal and external occupational experiences

Reference destination: Not winning a top management appointment	Internal promotion	External promotion
<i>(Total prior occupations)</i>	0.140***	0.195***
INT_EXT_OCC	(0.017)	(0.023)
<i>(Prior occupations in present firm)</i>	0.347***	0.077*
INT_OCC	(0.031)	(0.046)
HIGH-SCHOOL	0.219***	0.148
	(0.065)	(0.097)
VOCATIONAL	0.308***	0.062
	(0.103)	(0.153)
COLLEGE	1.140***	0.893***
	(0.077)	(0.110)
GRADUATE	1.351***	1.033***
	(0.095)	(0.131)
FEMALE	-0.727***	-0.666***
	(0.066)	(0.088)

Note: The regressions have the same specification as in Table 5 except that the model is expanded to consider three destinations: (i) winning a top management appointment through internal promotion; (ii) winning a top management appointment through external recruitment; and (iii) not winning a top management appointment. Significance levels: \*\*\* 1 percent, \*\* 5 percent, \* 10 percent. Standard errors are clustered.

Table 7. The logit estimates on the effects on career success of the scope of occupational experiences for directors of four different functional areas

	Logit											
	(i)				(ii)				(iii)			
	Finance	HR	R&D	Sales and Marketing	Finance	HR	R&D	Sales and Marketing	Finance	HR	R&D	Sales and Marketing
<i>(Prior occupations)</i> TOCC	0.172*** (0.036)	0.156*** (0.075)	0.308*** (0.060)	0.187*** (0.047)								
<i>(Total prior occupations)</i> INT_EXT_OCC					0.196*** (0.043)	0.220*** (0.080)	0.413*** (0.078)	0.145** (0.058)	0.167*** (0.045)	0.181** (0.088)	0.343*** (0.085)	0.107* (0.062)
<i>(Prior occupations with current company)</i> INT_OCC									0.189** (0.086)	0.225 (0.174)	0.412** (0.165)	0.223** (0.100)
R-squared	0.128	0.076	0.138	0.86	0.128	0.077	0.141	0.083	0.129	0.078	0.145	0.084
Observations	398,549	415,830	332,810	461,065	398,549	415,830	332,810	461,065	398,549	415,830	332,810	461,065

Note: All specifications are similar to those presented in Table 5 but with the sample size determined by the contestant pool for each of the functional areas. The number of top management appointments is: Finance 288, HR 90, R&D 86 and Sales 204. Standard errors are clustered.



Figure 1. Top management appointments and the size of the contestant pool by (1-digit) occupations

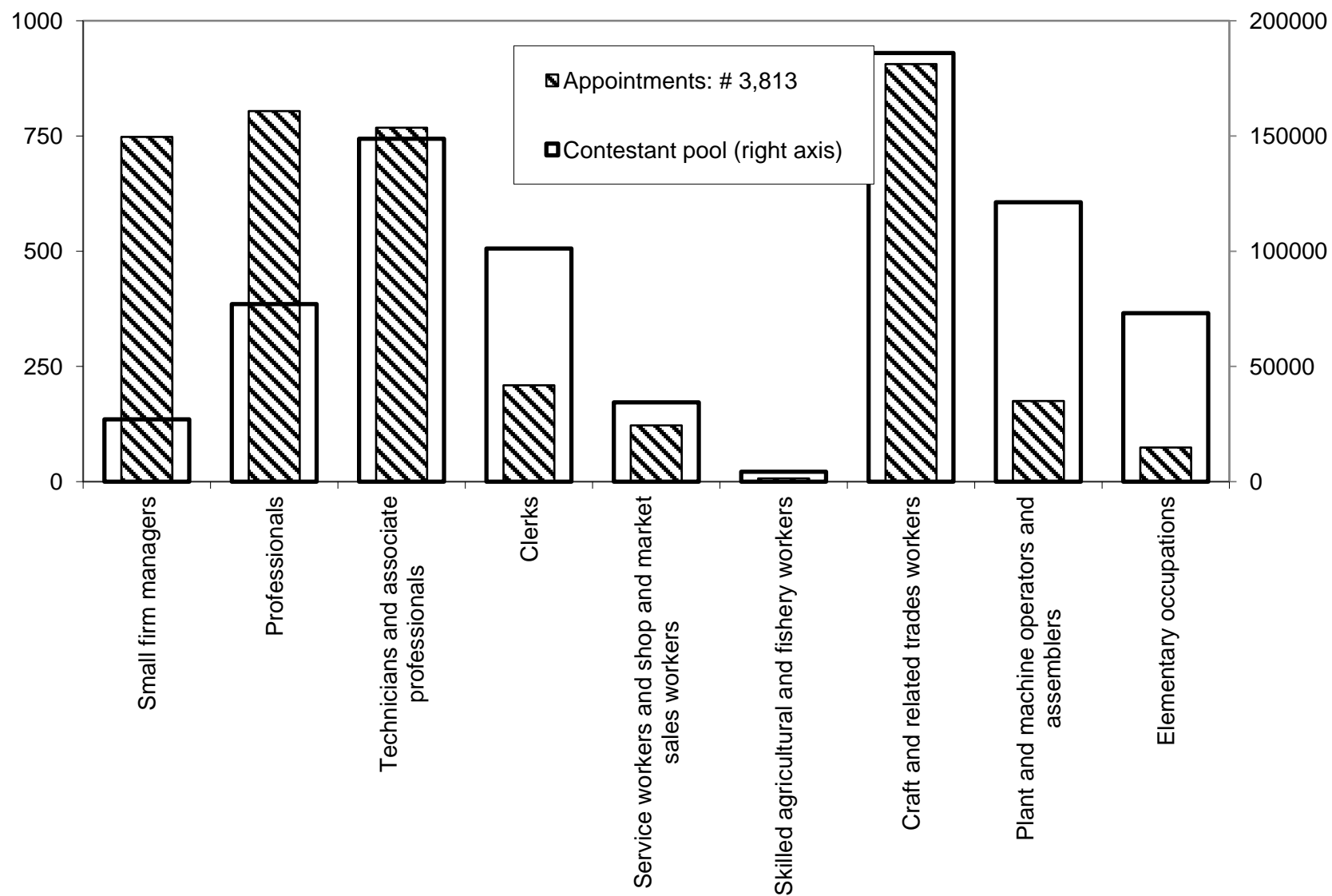


Figure 2 Career Success and Formal Schooling: Gender Differences

Predicted Pr(appointment) for women divided by Predicted Pr(appointment) for men for different levels of educational attainment

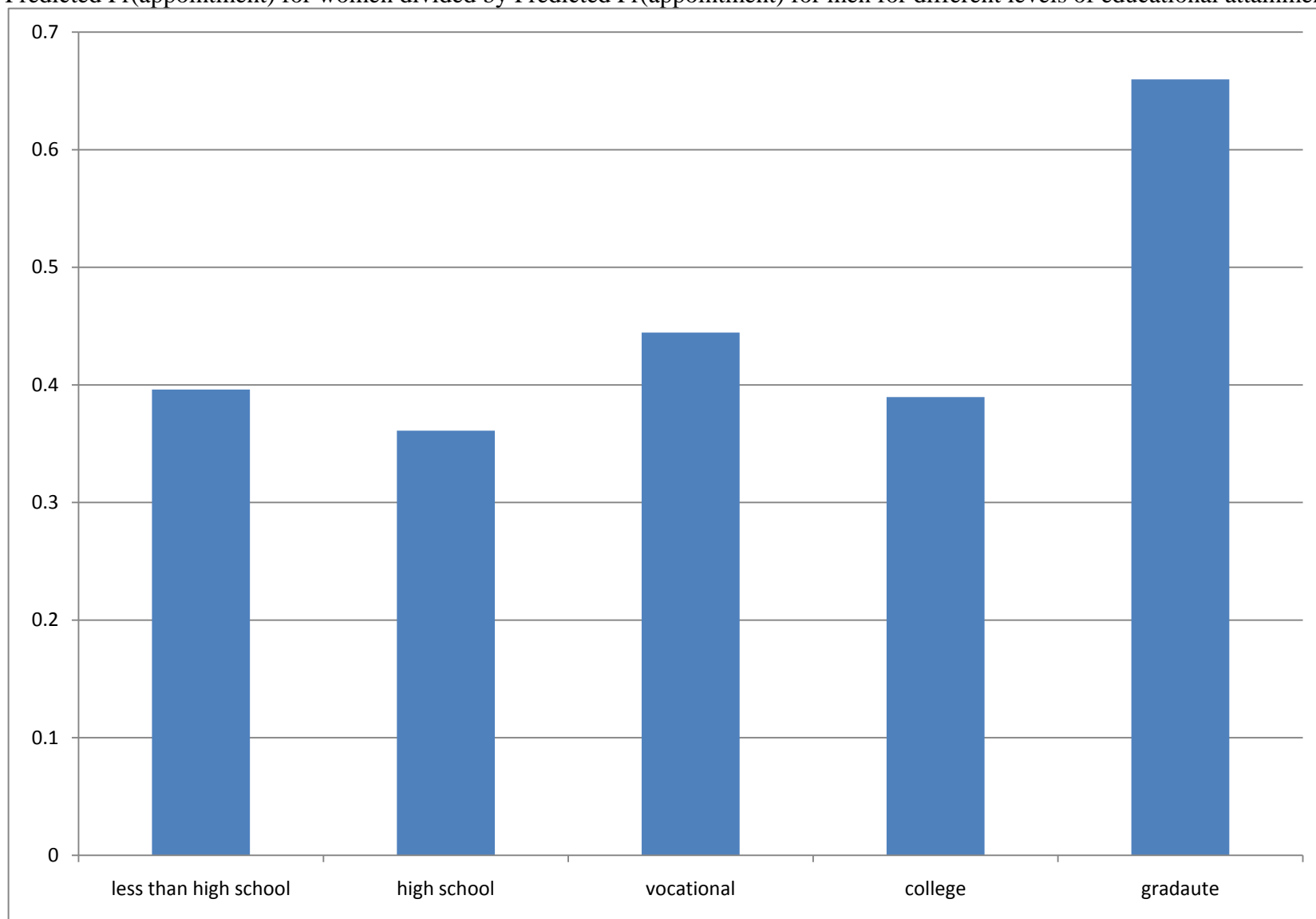


Figure 3 Experience-career success profiles for workers with different levels of educational attainment

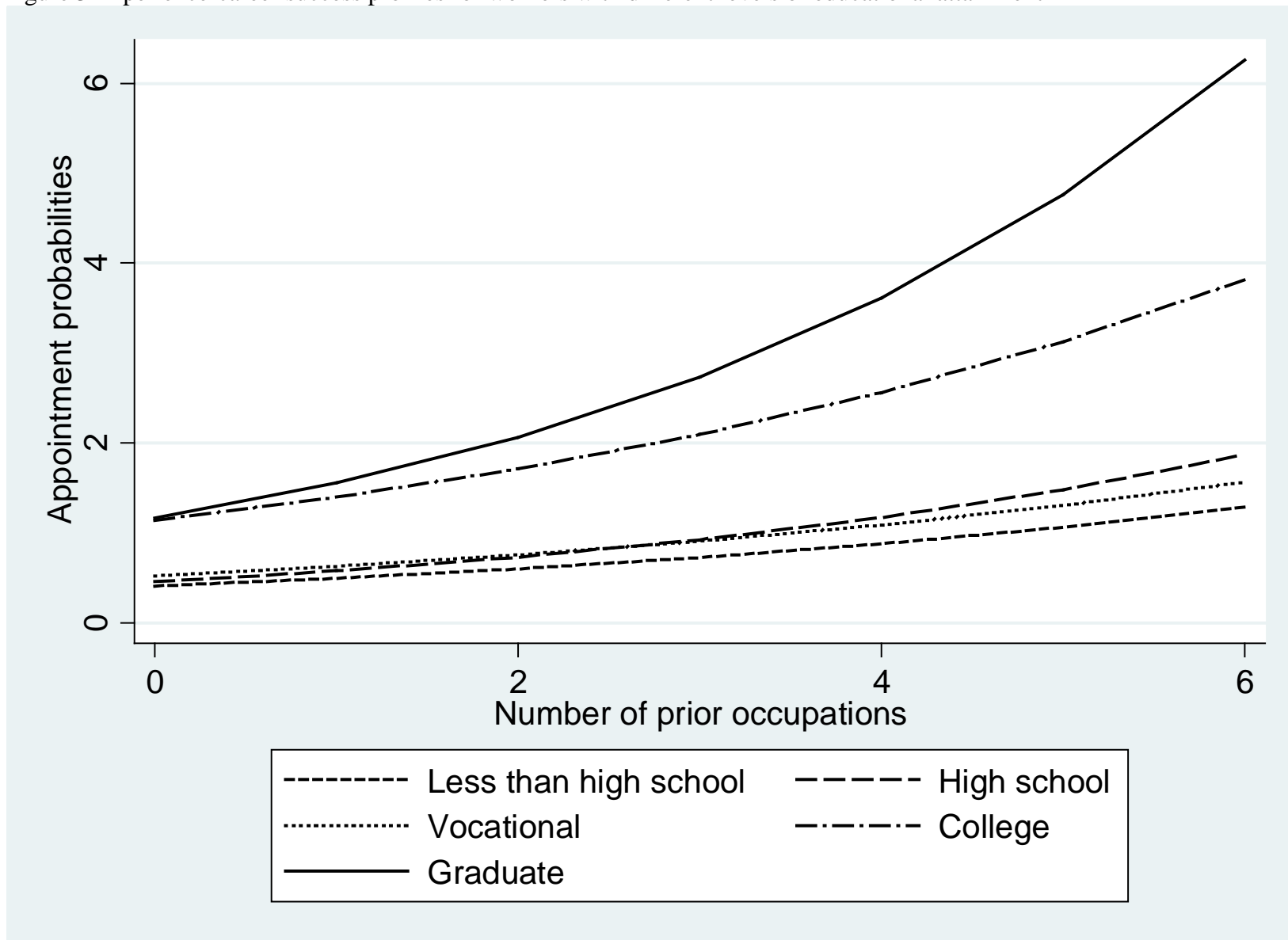


Figure 4 Experience-career success profiles for college graduates: Internal career vs. external career

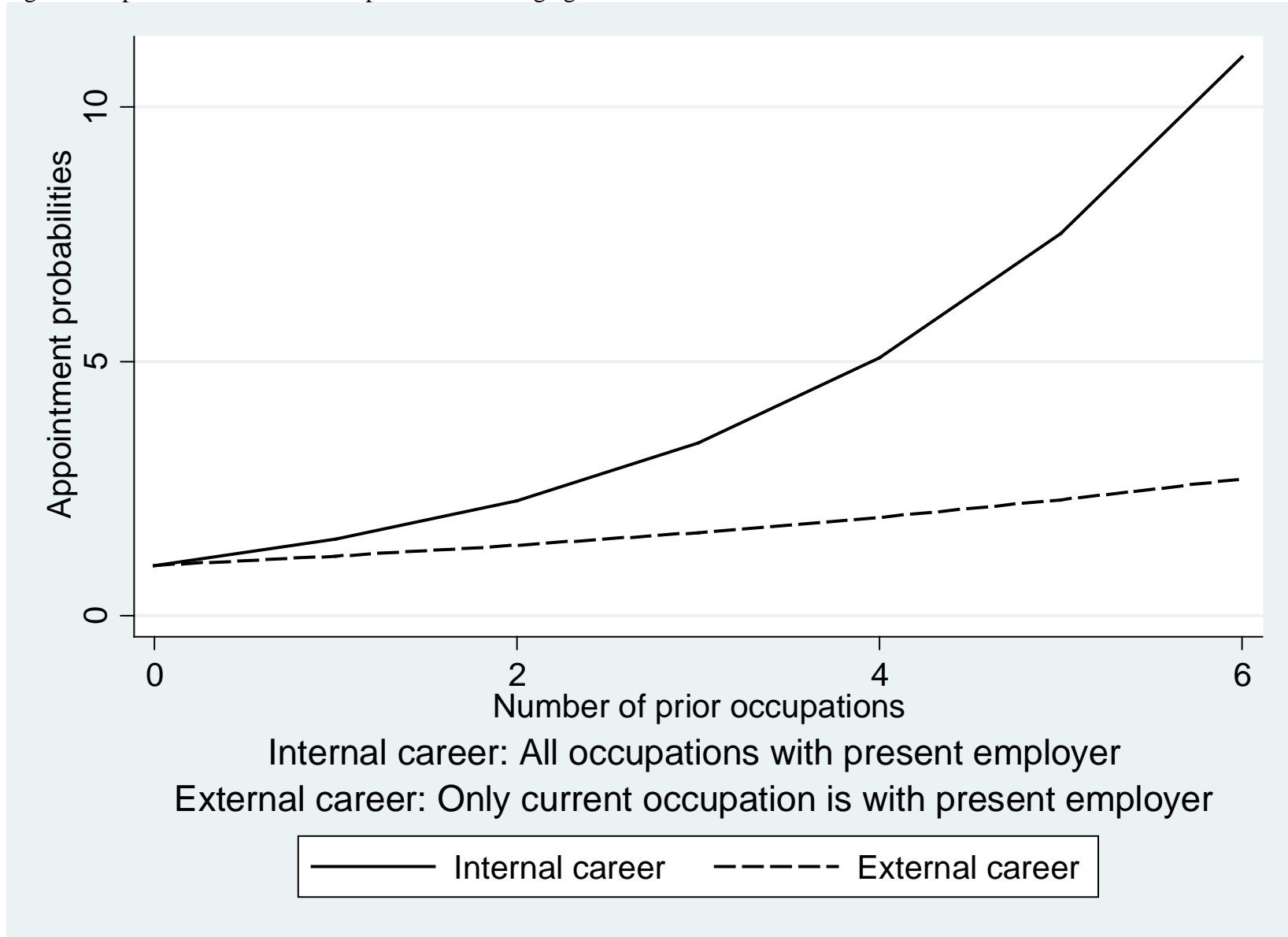


Figure 5 Experience-career success profiles for college graduates: External recruitment vs. internal promotion



Figure 6 Experience-career success profiles for college graduates: Different functional areas

