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

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

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Abstract

This paper provides new evidence on the importance of the breadth (as opposed to the depth) of human capital for career success (defined as top management appointments) by using Denmark's Linked Employer-Employee Data. In so doing, we support and enrich the human capital theory of corporate leadership sketched in the context of job rotation by Gibbons and Waldman (2004) and developed formally by Lazear (2005) and (2012). There are four main advantages of our study over prior work. First, the use of Danish registry data comprising all workers in Denmark (from different industries, with different education levels and different types of education) enables us to obtain more externally-valid evidence in support of the human capital theory of corporate leadership. Second, we construct the contestant pool for top management appointments with more precision, taking into consideration not only internal promotion but also external recruitment as means to achieve such appointments. Third, we conduct a variety of additional analyses to demonstrate the robustness of our findings and the relative validity of our preferred interpretation based on the human capital theory of corporate leadership to alternative interpretations. Finally we extend our baseline analysis, and provide additional evidence and insights on the human capital theory of corporate leadership: (i) the breadth of human capital is found to be less important for top managers when the firm's underlying technology is relatively new; and (ii) the internally-obtained breadth of human capital is found to be more valuable than the externally-acquired breadth of human capital, pointing to the relevance of the concept of firm-specific human capital to the breadth of human capital.

(JEL codes: M5 and J24)

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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 roles, and become a "generalist." While the literature on human capital is vast, relatively fewer studies focus on the importance of the breadth of human capital acquired through on-the-job training (as opposed to the quantity or quality of formally acquired human capital). The important exceptions are Gibbons and Waldman (2004), Lazear (2005), and Lazear (2012).

Gibbons and Waldman (2004) use their task-specific human capital theory and provide an economic explanation of the practice of job rotation. Candidates for managerial positions acquire a broad set of task-specific human capital through extensive job rotation rather than becoming an expert on one specific task, for such a broad set of task-specific human capital (breadth) proves to be more useful for managers in general (not only top management but also lower-level management) than a mastering of one specific task (depth).

Lazear (2005) develops a formal human capital theory of entrepreneurs and explained why generalists as opposed to specialists are more likely to become entrepreneurs. Later the theory is extended to the case of corporate leaders (Lazear, 2012). The essence of the theory is that leaders (corporate leaders or entrepreneurs) need to solve diverse problems which require diverse skills. Under the assumption that the probability of solving a problem successfully will rise with the level of skill but at a decreasing rate, generalists with a full set of competent skills are better suited for such leadership tasks than specialists with a limited set of extraordinarily

high skills. Hence, individuals who have experienced more roles in the labour market are more likely to become successful leaders and as such they have higher probabilities of being assigned to leadership positions – a prediction for which Lazear (2012) provides supporting evidence by analysing a sample of Stanford MBAs.[1]

The main objective of this paper is to provide more compelling and richer evidence on the importance of the breadth of human capital for career success, and thereby support and enrich the human capital theory of corporate leadership sketched in the context of job rotation by Gibbons and Waldman (2004) and developed formally by Lazear (2005) and (2012).

Our study has four major advantages. First, the empirical literature on internal labour market in general and career development and promotion tournaments in particular is often case studies (e.g., salaried workers from a large U.S. firm in Baker, Gibbs, and Holmstrom, 1994a and 1994b; and academics from a large European university in Haeck and Verboven, 2012). Lazear (2012) is also a case study on Stanford MBAs. While rich and precise, the case study approach lacks external validity. Using Danish registry data comprising all workers in Denmark (from different industries, with different education levels and different types of education) we obtain new evidence with stronger external validity in support of the human capital theory of corporate leadership.

Second, external validity is not the only advantage of our study. A major challenge for Lazear's initial test as well as most empirical studies of promotions is to construct the contestant pool in a realistic way. Consider the case of CEO. If internal labour markets with well-defined promotion ladders and a strict rule of internal promotion to top management are pervasive, we can construct the contestant pool empirically by gathering all workers who are one level below

[1] Whether one becomes a generalist or a specialist can be endogenous (her own conscious choice) or exogenous (nature's choice). Regardless of whether the source of variations in the breadth of human capital is endogenous or exogenous, the theory yields the same prediction: a positive association between the odds of becoming a corporate leader and the breadth of human capital (Lazear, 2012, p. 95).

the CEO level within the same firm. In spite of their general importance in most industrialized economies including Denmark, internal labour markets are not sufficiently pervasive to warrant the aforementioned construction of the contestant pool.[2] Lazear's initial test of his leadership theory used Stanford MBAs who work for a variety of firms. Here the challenge is even more daunting. There is no way of knowing the size of the contestant pool for each Stanford MBA and therefore even the aforementioned construction of the contestant pool is infeasible.

Our Danish registry data allow us to identify all newly appointed top managers in Denmark and discern what kind of jobs they did prior to their top management appointments. We use this information to construct a contestant pool which includes both individuals who can be promoted to top management positions internally as well as individuals who can be externally recruited to top management positions. With this construction of the contestant pool, we can determine the odds of winning the tournament (getting top management appointments) with more precision. Moreover, we can experiment with alternative definitions of the contestant pool, and check the sensitivity of our key findings to such changes in the definition of the contestant pool.

Third we recognize that there are possible alternative interpretations of our key finding---a positive association between the breadth of human capital and the odds of top management appointments. First, taking on an additional role may not be always a lateral career move, as it may be a "move up the promotion ladder". The positive association between the number of roles and the odds of top management appointments may be simply telling us that an individual who moves up the promotion ladder is more likely to reach top management. Second, it is possible that an individual who experiences more roles may be more innately capable than others. If this is true, the observed positive association between the number of roles and the odds of top

[2] For instance, Agrawal, Knoeber, and Tsoulouhas (2006) report that close to 20 percent of all CEO appointments in large U.S. corporations over period 1974-95 were recruited externally.

management appointments will be an indication of "ability bias"—an innately more able individual is naturally more likely to gain a top management appointment and at the same time he/she may be more likely to broaden the scope of her human capital. The unusual richness of our data allows us to provide additional evidence that favours our interpretation over such alternative interpretations.

Fourth, we extend our baseline analysis, and provide fresh evidence and insights on the human capital theory of corporate leadership. First, Lazear (2012) suggests that the breadth of human capital is less important for top managers when the firm's underlying technology is relatively new. Unlike his Stanford MBA data, our Danish registry data allow for an econometric test of the validity of this prediction, and we find evidence in support of its validity. Second, we extend the analysis to allow for heterogeneity in the value of the breadth of human capital, depending on whether the breadth of human capital is acquired in the current firm or elsewhere. This extended analysis yields fresh evidence on the relative value of the breadth of human capital acquired internally to the one obtained externally, suggesting the importance of firm-specific breadth of human capital.

In the next section, we describe the empirical strategy and data in detail. In Section III we offer our econometric specifications and present the key results including robustness tests. In Section IV we discuss alternative interpretations of our key finding and present additional evidence that favours our preferred human capital theory interpretation over the alternative interpretations. In section V we extend the baseline model and provide additional findings that further support and enrich the human capital theory of corporate leadership. Section IV concludes.

II. Empirical Strategy and Data

To obtain rigorous and systematic evidence on the interplay between the breadth of human capital and career success, we need detailed and reliable data on each individual worker's complete career history (human capital acquisition through informal on-the-job training) on top of demographic data (such as education, gender, age). Furthermore, when career success - defined as appointments to top management positions - can be achieved either through internal promotion or through external recruitment 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 all individuals with long employment histories who have reasonable odds of being appointed to top management positions either via internal promotion or via external recruitment.

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 (LEED), which provide detailed information on all employment matches in the private sector of the Danish Economy since 1980.[3,4] 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 that include both internal and external candidates, and check the robustness of the results to the use of alternative constructs of the contestant pool.

Second and perhaps more importantly, in addition to providing information on formally acquired human capital (schooling) the data allow for the construction of our key variable – the breath of informal human capital. Lazear (2005, 2012) argue that a person's breadth of human

[3] We focus on private-sector employees, for public-sector employment tends to be subject to a different regulatory framework and labour market conditions, in particular more non-economic influences such as political considerations (Pedersen, 1990).

[4] We further match our LEED to pension contribution dating back to 1964 and use the information to calculate each individual's tenure and general work experience.

capital is reflected by the number of roles experienced in the labour market and predict that those who have experienced more roles have greater odds of being assigned to leadership positions. Fortunately the IDA provides complete and reliable data on the number of different occupations that each individual worker has experienced throughout his/her past employment history. Based on this information, we set our key variable, *"ROLES," equal to the number of different occupations each worker has experienced in the past*, counting the same occupation experienced at two different employers as two different roles.[5]

Since IDA's occupational data play a crucial part in our analysis as they are used to construct our key variable ROLES, we provide some necessary detail on the nature, scope and reliability of this variable. The "Bekendtgørelse af lov om Danmarks Statistik" (Ministerial Order on the Statistics Denmark Act) requires every employer in Denmark to annually report 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), and it follows all the requirements set forth by the ILO.

Since there was a major change in the DISCO in 2003 (a switch from a four-digit 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. It is noteworthy that the DISCO codes have been updated regularly even prior to the 2003 revision, 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 roles (occupations). The elimination of a DISCO code results in code changes for those individuals with the eliminated code. Yet such code changes reflect no

[5] We also tried an alternative definition of ROLES in which we simply count the number of different occupations (experiencing the same occupation at two different firms counted as one role) and found no discernible difference in our key results. These as well as all other unreported results are available upon request from the corresponding author (tkato@colgate.edu).

real changes in their roles. The creation of new codes produces similar spurious changes in the DISCO codes. We believe, however, that our analysis is largely free from such spurious changes, 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 one with fewer than 1,000 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. Hence, focusing on the one-digit and two-digit levels minimizes the issue of spurious code changes and we have chosen to show results based on the two-digit level in our empirical analysis presented below.[6]

Our operational definition of career success is an appointment to a top management position in a firm with 100 or more employees. As discussed below, the use of 100 employees as the threshold is meaningful. Yet we repeated the same analysis, using alternative thresholds of 50 and 25, and reassuringly found no discernible change in our main findings. Top management positions are defined as DISCO 12 Corporate Managers and DISCO 13 General Managers.[7] Using this definition of top management is comparable to the top management team or C-class executives in large U.S. firms. In Danish firms with more than 100 employees the average number of top managers (including the CEO) is around 12. A recent study of the structure of top

[6] Despite of the aforementioned measurement issue we have analysed the data making use of both 1, 3, and 4 digit codes and those results are discussed at various points later in the paper.

[7] 12 CORPORATE MANAGERS are defined as: "this group is intended to include persons who - as directors, chief executives or department managers - manage enterprises, organizations or departments, requiring a total of three or more managers." Likewise, 13 GENERAL MANAGERS are defined as: "this group is intended to include persons who manage enterprises, or in some cases organizations, on their own behalf, or on behalf of the proprietor, with some non-managerial help and the assistance of ...". Smith, Smith, & Verner (2013), in their recent study of gender pay gaps in top management positions in Denmark, use a similar method to define top management positions of the top 2000 private firms in Denmark.

management teams of large U.S. firms by Guadalupe, Li, and Wulf (2014) reports that the average size of the top management team (defined as senior executives who report directly to CEO) was about ten in the late 2000s.

In 2000, there were 618,682 individuals with proper DISCO codes who worked for firms with 100 or more employees in Denmark. Only 3.5 percent of them held top management positions as defined above (18,181 individuals working in DISCO 12 and 3,381 individuals working in DISCO 13). On average top managers earn twice as much as regular employees.[8] An appointment to a top management position is on average associated with a 30-percent pay increase, controlling for age, gender, tenure, general work experience, and education.[9] Thus, viewing appointments to these top management positions as career success appears to be appropriate empirically.

A natural alternative to our definition of career success is an appointment to CEO. However, in Lazear's human capital theory of corporate leadership, corporate leaders are those who need to solve diverse problems which require diverse skills. CEOs certainly fit the description of such corporate leaders but so do COO, CFO, or other managing directors. In fact, Lazear (2012) tests the validity of the key prediction from his theory by defining a corporate leader as a "C" level executive (CEO, COO, CFO…), a managing director, or similar. Hence, we focus on the results based on the broader definition of career success (appointments to top management positions) but we also provide results using the more narrow CEO definition.[10]

[8] This should be seen in the context that the 5%-50% earnings gap in Denmark among 30 to 50 years old is only two and the 1%-50% earnings gap is just above three. Hence, top earners make only two to three times the salary of the median earner.

[9] For a detailed discussion of the economic returns to within- and cross-firm mobility in Denmark, see Frederiksen, Halliday, & Koch (2016).

[10] The two subgroups labelled DISCO code 121 DIRECTORS AND CHIEF EXECUTIVES and DISCO code 131 MANAGERS OF SMALL ENTERPRICES can be used to identify CEOs. This definition of CEOs is subject to some measurement error. For instance, while any individuals with DISCO code 121 and 131 are likely to be CEOs, a non-trivial number of Danish firms had no individual assigned to DISCO code 121 and 131. In other words, not all CEOs of Danish firms are captured by DISCO code 121 or 131. Beside, as

Having defined career success as top management appointments, we now construct a contestant pool of people who have reasonable odds of winning such top management appointment as follows: (i) for each individual who was appointed to a top management position for the first time in year t, we identify his/her occupation (2-digit DISCO code) in year t – 1; and (ii) the contestant pool for top management appointments in year t is then comprised of all individuals who listed one of these occupations as their primary occupations in year t - 1.

This is probably the broadest and least restrictive construct of the contestant pool for top management appointments. Figure 1 shows the number of top management appointments and the size of the contestant pool by occupations (one-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). As discussed in more detail in section III, we also consider alternative definitions of the contestant pool and find that our key results are insensitive to the use of those alternative definitions.

To study the benefit of the breadth of human capital obtained through various occupational experiences for career success, naturally we have to limit our analysis to those employees for whom reasonably long and continuous career history data 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 Ministerial Order on the Statistics Denmark Act does not require reporting of DISCO codes for those individuals who are out of the labour force, unemployed, self-employed, working in the workplace with fewer 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 labour market status for a particular year has a missing DISCO code for that particular year. Second, young

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discussed above, the use of the detailed codes beyond the second digit are more susceptible to measurement errors than the two-digit codes.

employees or recently immigrated individuals do not have sufficiently long occupational histories. Finally, any Danish citizen who works 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.

For the rest of the paper, we report results based on all workers with at least eight years of complete employment histories (the robustness of our results to an alternative less stringent restriction is confirmed below). We use this employment history to construct our main explanatory variable measuring the breath of human capital (ROLES) as the number of different roles (different occupations in the context of our analysis) that each worker has experienced over the past eight years. Note that when we calculate ROLES for each individual, we count the number of past occupations that are different from his/her current occupation. As such, for a sample of workers with at least eight years of complete employment history, if the worker has never changed his/her occupation over the last eight years, ROLES will be zero. Likewise if the worker has been changing his/her occupation every year over the last eight years, ROLES will be equal to eight (her current occupation is the ninth different occupation).

In Table 2 we present descriptive statistics for individuals with complete eight-year employment histories as well as for all individuals in the private sector. First, educational attainments appear to be quite similar across the two groups. Second, as expected, individuals with complete eight-year employment histories have considerably longer tenure and labour market experience and they are older and more likely to be male.

Table 2 further divides individuals with complete employment histories into two groups: those who left the contestant pool and became top managers (those with career success) and those who remained in the contestant pool (those without career success). Individuals with career success have experienced considerably more different roles in the past than those in the

contestant pool without career success. For example, nearly one in two individuals with top management appointments had at least three different roles in the past, whereas less than 30 percent of those in the contestant pool without such appointments have had three different roles. Further, the proportion of individuals with five or more different roles is higher among those with career success than among those without career success (10 percent vs. 5 percent). In addition, 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.[11] These preliminary observations suggest that not only formal schooling but also the breadth of human capital measured by ROLES may be important for career success. 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 the interplay between human capital and career success, we begin by estimating the following baseline logit model of top management appointments:[12]

$$(1) \qquad \Pr(\mathbf{APPOITMENT_{it}=1}) = \Lambda(\alpha + \beta\mathbf{ROLES_{it}} + \gamma\mathbf{SCH_{it}} + \delta\mathbf{FEMALE_i} + \rho\mathbf{Z_{it}})$$

where $\mathbf{APPOINTMENT_{it}}$ is equal to one if worker i is appointed to a top management position in a large firm (with 100 or more employees) between year t and t+1, zero otherwise; $\mathbf{ROLES_{it}}$ is the measure of the breath of informal human capital (described in detail above) for worker i in year t; $\mathbf{SCH_{it}}$ is a column vector of dummy variables capturing the level of formal educational attainments of worker i in year t; $\mathbf{FEMALE_i}$ is a dummy variable taking a value of one if worker i is female, zero otherwise; $\mathbf{Z_{it}}$ is a column vector of other control variables for worker i in year t

[11] University education in Denmark consists of a three-year bachelor program (college) followed by a two-year master's program. PhD programs are available after a master's degree is obtained. We combine Master's and PhDs and denote them as graduates.

[12] An alternative to the discrete choice framework used here is the duration model. In his original work Lazear (2012) applied a discrete choice framework and we stay within that tradition.

(a quadratic in age, tenure, and general work experience and a vector of 34 (two-digit) occupation dummy variables reflecting the current occupation). In addition, since we are pooling two years of data (t=2000 and 2001), we include a year dummy, which takes a value of one if t=2001, zero otherwise, to control for any year-specific shocks that affect the odds of top management appointment for all workers.[13] α, β, and δ as well as the two vectors γ and ρ are the parameters to be estimated. Hereafter subscripts i and t will be omitted for simplicity of exposition.

The sign and significance of the estimated coefficient on ROLES can be used to test our key hypothesis -- the probability of being assigned to a top management position will increase with the breadth of informal human capital. For SCH, our data allows us to identify five different levels of formal educational attainments, and we code the data as follows: HIGHSCHOOL=1 if worker i's highest educational attainment is a regular high-school diploma, zero otherwise; VOCATIONAL=1 if worker i's highest educational attainment is a vocational high-school diploma, zero otherwise; COLLEGE=1 if worker i's highest educational attainment is a college degree, zero otherwise; and GRADUATE=1 if worker i's highest educational attainment is a graduate degree, zero otherwise (omitted reference group is LESS-THAN-HIGHSCHOOL=1 if worker i's highest educational attainment is less than a high school diploma). We control for such schooling variables, for an individual with greater schooling possesses a greater amount of general human capital and hence is likely to enjoy higher odds of obtaining a top management appointment. We also control for gender through FEMALE since the literature on gender gaps in top management appointments provides evidence for significant gender gaps in promotion (see, for instance, Blau & DeVaro, 2007; Bjerk, 2008; and Smith, Smith and Verner, 2013 for glass

[13] We also estimated Eq. (1) for 2000 and 2001 separately. Reassuringly, for each year we obtained similar results to what we report in the paper for the pooled data.

ceiling, and Milgrom & Oster, 1987 and Cassidy, DeVaro and Kauhanen, 2016) for the invisibility hypothesis).

Main results

The logit estimates of Eq. (1) are presented in column (i) of Table 3. The estimated coefficient on ROLES is positive and statistically significant at the 1 percent level, showing that the probability of being appointed to a top management position rises significantly with the number of roles experienced in the past, after controlling for formal educational attainments, gender, age, current occupation, tenure, and general work experience.[14] As such, the data supports the human capital theory of corporate leadership---a broader scope of human capital obtained informally on the job improves the odds of career success.

As expected, the estimated coefficients on the formal schooling variables are also found to be positive and statistically significant at the 1 percent level with higher point-estimates for higher levels of schooling, underlining the importance of schooling for career success. The observed importance of schooling for career success is consistent with the human capital theory of education emphasizing formal schooling as a means to grow general human capital as well as the signalling theory of education with asymmetric learning stressing formal schooling as a credible labour market signal (see Rubinstein & Weiss, 2006, for a recent survey of the literature on human capital and signalling).[15] The estimated coefficient on FEMALE is negative and statistically significant at the 1 percent level. Thus, after controlling for a broad set of covariates, ROLES and formal schooling, women are less likely to be appointed to top management

[14] Because some individuals enter the sample in both 2000 and 2001, we cluster standard errors at the individual level in all regressions presented below.

[15] DeVaro & Waldman (2012) report that promotions work differently for workers with master's degrees than those with PhDs. We repeated the same logit analysis, dividing those with graduate degrees into the two groups. However, due to the small number of individuals with Ph.D. degrees in Denmark, we find no statistically significant differences between those two groups of individuals with graduate degrees.

positions, which is consistent with the literature on gender gaps in promotion (see appendix A for a more detailed analysis of gender gaps in career success).

To demonstrate the economic significance of the importance of the breadth of human capital for career success as compared to the importance of formal schooling for career success, we use modal values for all dummy variables and mean values for all continuous variables and determine the predicted odds of a top management appointment for the typical worker with different values for ROLES and for each schooling category. The resulting role-career success profiles are drawn in Figure 2. The typical college graduate with minimal breadth of human capital (ROLES=0) is predicted to have a little over a 1 percent chance of winning a top management appointment in a large firm in Denmark, and is about twice as likely to be appointed to a top management position as the comparable high school graduate. As the breadth of human capital acquired through informal OJT increases, both the typical college graduate and the typical high school graduate will enjoy higher odds of career success. For instance, the odds of a top management appointment for the typical college graduate with ROLES=3 are twice as high as for the typical college graduate with ROLES=0.

Robustness

We now assess the robustness of the above baseline estimates. First, to see if the results change when we use an alternative and narrower definition of career success, CEO appointments, we re-estimate the baseline logit equation, Eq. (1), using the odds of CEO appointments instead of the odds of top management appointments as the dependent variable. Note that when doing so we also change the contestant pool (Column (ii) of Table 3). Reassuringly our key finding of a positive association between the breadth of human capital and career success is robust to the use of this alternative and narrower definition of career success.

Note that the results on schooling differ somewhat between the two specifications. In contrast to the case of top management appointments where education had an increasingly positive effect, only college and above are found to increase the odds of CEO appointments.

Second, the relationship between the breadth of human capital and career success can be nonlinear. To allow for such possible nonlinear relationships between the breadth of human capital and career success, we replace ROLES with a set of dummy variable – ROLES1=1 if worker i has experienced one role which is different from the current one, zero otherwise; ROLES2=1 if an individual experienced two roles which are different from the current one; likewise for ROLES3 to ROLES8. Reassuringly, as shown in column (i) of Table 4, the estimated coefficients on the dummy variables are positive and statistically significant at the 1 percent level, and there is a general tendency for the size of the estimated coefficients to rise with the level of the dummy variables.

Third, individuals who are appointed to top management positions originate from a broad set of occupations. Some of these occupations such as "clerks" or "plant and machine operators and assemblers" contain many employees yet very few are appointed to executive positions, while others such as "professionals" are relatively small in the overall cell size yet produce many top management appointments. To see if our results are influenced significantly by the inclusion of occupations with very low appointment probabilities we estimate separate regressions for the three occupations: "Professionals", "Technicians and associated professionals" and "Craft and related trades workers". The results are presented in columns (ii)-(iv) of Table 4, and the association between ROLES and the likelihood of being appointed to a top management position is positive and significant at the 1 percent level for all three groups.

Fourth, as discussed earlier, there are potentially significant measurement issues associated with the use of three- and four-digit DISCO codes, and hence we have presented our

results based on the two-digit DISCO codes. Nonetheless, we repeated the same analysis, using three- and four-digit DISCO codes instead of two-digit codes. Reassuringly we find that the coefficient on ROLES remain positive and significant. This is also the case when we use one-digit DISCO codes. Furthermore, when we investigate alternative definitions of our dependent variable such as appointments to CEO or to particular functional area directorships (as shown in the appendix) which requires the use of four-digit DISCO codes, the positive association between ROLES and career success is preserved.

Finally, our analysis focuses on individuals with at least 8 years of complete employment history. Naturally this restriction excludes individuals who for some reason have shorter employment histories (such as youth and immigrants). To explore if our results are sensitive to this restriction we construct a new and larger sample by imposing a less restrictive inclusion criteria—at least 5 years of complete employment history instead of 8 years. The results from our analysis of such larger and less restrictive data are found to differ little from our original results, pointing to their robustness.

IV. Alternative Interpretations

We interpret the observed positive association between an employee's breadth of human capital and career success as evidence in support of the human capital theory of corporate leadership---the worker can increase the odds of career success by experiencing more diverse roles and as such increasing the breadth of human capital. There are two major threats to this interpretation. In this section we will discuss these issues in detail and provide additional evidence pointing to the validity of our preferred interpretation.

First, our interpretation is based on the assumption that occupational changes prior to top management appointments are mostly lateral career moves rather than vertical moves

(promotions). If this assumption is invalid, a worker who has experienced a greater number of roles prior to a top management appointment may well be the one who has been climbing up the promotion ladder. In other words, there can be an alternative interpretation of the positive and significant coefficients on ROLES – those who experience a series of incremental promotions with discrete wage increases prior to top management appointments are more likely to win top management appointments.

To explore the plausibility of this alternative interpretation, we conduct two additional analyses. First, we estimate a cross-sectional Mincer wage equation, augmented by the eight ROLES dummies (ROLES1, …, ROLES8). Note that we use a regression sample comprising only non-executive employees. As such, the estimated wage effect of the breadth of human capital does not include the effect on wages of top management appointments. In other words, we test whether or not an increase in the number of roles is associated with a substantial wage gain prior to top management appointment that could suggest that individuals are moving up in the corporate hierarchy.

There is no evidence for a linear relationship between wages and the breadth of informal human capital (see Table A4 in the appendices). Instead the results suggest an inverse U-shape relationship – the worker's wage rises as the number of different roles increases, yet the wage reaches its maximum value at ROLES=5 and starts to *fall* rather rapidly as ROLES rises beyond 5. Perhaps more importantly, the magnitude of the wage effect of the breadth of human capital is rather small. Thus, even at the peak of the wage-ROLES profile (ROLES=5), the size of such a maximum wage effect is found to be only 3 percent. In other words, those in the contestant pool who have experienced five different roles earn only 3 percent more than those in the same contestant pool who have never experienced a different role.

Based on this it is probably safe to assume that many of role increases prior to top management appointments in the Danish workplace occur in the form of lateral moves rather than in the form of successive promotions with discrete wage increases.[16] Note that the lack of significant wage gains from the breadth of human capital prior to top management appointments in Denmark is not inconsistent with the human capital theory of corporate leadership. First, as shown, the breadth of human capital is positively associated with higher odds of top management appointments. Second, top management appointments are also shown to be accompanied by a discrete jump in wage (30%). It follows that an increase in the breadth of human capital implies a significant increase in *ex ante* expected earnings.[17]

That switching between roles prior to top management appointments does not increase wages much, yet that it increases the odds of reaching the C-suite with a discrete jump in wage points to a tournament at play, with only the winner taking all. The objective of the present paper is to study the potential importance of the breadth of human capital for top management appointments including both internal promotion (winning a promotion tournament within the firm) and external recruit. A detailed and full analysis of the nature and scope of a promotion tournament in Denmark is beyond the scope of this paper and will be explored in our future work.[18]

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[16] To put our wage regression results in context, we estimated models similar to Oyer, Lazear and Shaw (2008) on our data from 2000. Such regressions establish that 5.87 percent of the variation in log wages for white collar workers is explained by occupation codes. For blue collar workers occupation codes explain 4.21 percent of the variation. Hence, it appears to be the case that occupations explain a smaller proportion of log wages in Denmark than in Sweden and that the results for Denmark are more in line with those for Swedish blue collar workers where occupation codes explained between 9 and 19 percent of log wage variation.

[17] The expected *ex ante* earnings, y, can be expressed as $\alpha*(w+0.3w)+(1-\alpha)w$ where w=wage without a top management appointment and α=the odds of a top management appointment. As such, $dy/d\alpha=0.3wage>0$.

[18] We conducted a preliminary analysis of the tournament. Specifically we used a subsample of those who won their respective tournaments and estimated the size of the tournament prize (wage increase associated with winning the tournament) as a function of the size of the internal contestant pool (measured by the number of professionals within the firm) along with a set of observable covariates. We found the estimated coefficient on the size of the contestant pool to be positive and statistically significant, confirming an earlier study by

Second, admittedly the above wage regression analysis does not completely rule out the possibility that some role changes are upward career moves. Unfortunately we have no direct information on whether each role change is lateral or vertical. There is, however, a reasonably good, albeit imperfect, proxy for vertical role changes prior to top management appointments. Assuming that any role changes involving movements towards Major Group 2 (Professionals) from Major Group 3 (Technicians and associate professionals) or any higher-numbered Groups (Groups 4, 5, 6, -----) are upward career moves (promotions) rather than lateral career moves, we create a new variable, PROMOTIONS, which is the number of role changes involving upward career moves.

Column (i) of Table 5 shows the logit estimates of Eq. (1) augmented by the new control variable, PROMOTIONS. The table shows that even if we control for role changes involving such upward career moves, the estimated coefficient on ROLES is still positive and statistically significant at the 1 percent level. The breadth of human capital appears to matter for career success independently of how many upward career moves an individual has experienced in the past. Note that the size of the coefficient on ROLES falls substantially when we control for PROMOTIONS. The falling size of the coefficient on ROLES is in part due to the fact that PROMOTIONS captures not only vertical career moves but also the broadening in human capital that follows from vertical career moves. For instance, a move from a position in the R&D department to a higher position in the Marketing department is moving up the promotion ladder yet at the same time it does increase the breadth of human capital. As such, PROMOTIONS may well be taking away some of the human capital effect of ROLES.

The second alternative interpretation focuses on possible linkages of unobserved innate ability/aptitude to ROLES and top management appointments---individuals with higher innate

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Eriksson (1999) who obtained a similar finding from his firm-level analysis and supported the relevance of a tournament to Danish firms.

ability experience more roles, AND such individuals are more likely to be appointed to top management positions. To the extent to which our set of control variables do not fully account for such innate ability/aptitude, the observed association between ROLES and top management appointments may be capturing in part a possible association between unobserved innate ability/aptitude and top management appointments.

Unfortunately conventional means to account for such ability bias are not available to us. First, our data do not include any direct measures of innate ability/aptitude such as IQ scores. Second, the use of an individual fixed effect model to account for ability bias is not a viable empirical strategy for our analysis. We are studying what helps an individual worker achieve ultimate career success (reaching the C-suite in a large corporation) with particular focus on the importance of becoming "Jack of all trades" through experiencing a variety of roles. For an individual fixed-effects model to yield a meaningful result, we will need multiple observations for the same individual with sufficient within-individual variation. Reaching the C-suite by accumulating diverse experiences and broadening human capital is a one-time event for most individuals, and there is little meaningful within-individual variation. As such, an individual fixed-effects model is not a suitable empirical strategy.[19]

There is, however, an indirect way to discern the severity of such ability bias. The IDA provides panel data on wages over 1992–2002 for all workers in Denmark which allow us to estimate a Mincer wage equation with individual fixed effects. We then extract the estimated individual fixed effects from the wage regression and use them as proxy variables for innate

[19] In fact, for this reason, prior empirical studies (Lazear, 2005 and 2012) which our paper extends also do not use an individual fixed-effects model. A random effects model is an alternative to a fixed effects model. However, the use of a random effect model is not a viable option, either. On the one hand, the random effect model as applied to our data assumes that innate ability is uncorrelated with ROLES. On the other hand, a positive correlation between innate ability and ROLES (in tandem with a positive correlation between innate ability and the odds of top management appointments) is a source of ability bias which threatens our causal interpretation of the positive and significant coefficients on ROLES. In this section we are trying to assess how serious such ability bias is. In short, the random effect model assumes away such ability bias at the onset, and hence cannot be used to assess its severity.

ability of individual workers. [20] If such individual fixed effects are highly correlated with our measure of the breadth of informal human capital (ROLES), the aforementioned ability bias can be quite serious, and it will be difficult to interpret the estimated coefficients on ROLES as a clear indication of the importance of the breadth of informal human capital for career success.

Fortunately, we find evidence suggesting that ability bias may not be too serious. First, we find that the correlation coefficient between the estimated individual fixed effects and ROLES is only 0.087. Second and perhaps more important, we augment our baseline model with the estimated individual fixed effects from the wage regression as controls for innate ability. A comparison between the original baseline model estimates as shown in column (i) of Table 3 and the augmented model estimates as shown in column (ii) of Table 5 demonstrates that the estimated coefficient on ROLES changes little even when we account for unobserved ability. It follows that the aforementioned ability bias may not be too consequential, and hence that our results are unlikely to be driven by ability bias.

Finally, column (iii) of Table 5 shows the results when we account for ability as well as vertical career moves (PROMOTIONS). Comparing the estimated coefficient on ROLES between column (i) and column (iii) of Table 5 establishes that the relative validity of our interpretation to the ability-bias interpretation is insensitive to whether we account for the additional threat of possible vertical career moves (PROMOTIONS). Thus, our preferred

[20] We believe that the estimated individual fixed effects extracted from the Mincer wage regression are reasonable proxy variables for innate ability of individuals. First, we estimated the Mincer wage equation with and without individual fixed effects and obtained R^2 of 0.30 without individual fixed effects and R^2 of 0.74 with individual fixed effects. Individual fixed effects account for much of the variation in wages in Denmark, suggesting that individual fixed effects (time-invariant unobserved characteristics of individuals) are indeed very important determinants of wages in Denmark even after controlling for a detailed set of observable determinants such as education, age, experience, and tenure. It is most probable that individual fixed effects are capturing the effect on wages of unobserved innate ability of individuals. It is hard to imagine any other unobserved time-invariant characteristics of individuals that are as important as innate ability as a determinant of wages. Second, if the proxy simply represented noise, it would not move the coefficient on ROLES but increase the standard error. We find that the coefficient on ROLES is reduced somewhat, and fortunately the standard errors do not explode, which can be seen when comparing model (i) and (iii) in Table 5. In fact, the R^2 in (iii) exceeds that of (i) in estimating the Mincer wage equation.

interpretation of the estimated coefficients on ROLES appear robust and in support of the human capital theory of corporate leadership.[21]

V. Extensions

We extend our baseline model and provide additional insight on the human capital theory of corporate leadership. First and most imporant, Lazear (2012) suggests that the breadth of human capital is less important for top managers when the firm's underlying technology is relatively new. In such new technical fields, the primary issues that top management needs to solve are often about the new technology *per se* while in other more established fields, the issues that top management is required to solve can come from anywhere. In short, the human capital theory of corporate leadership *a la* Lazear (2012) predicts a positive correlation between the imporatnce of the breadth of human capital and the age of the underlying technology of the firm. To test the validity of this prediction, we augment Eq. (1) with the age of the firm, FIRMAGE and an interaction term involving FIRMAGE and ROLES. Assuming that FIRMAGE and the age of the underlying technology of the firm are positively correlated with each other, if the aforementioned prediction of the human capital thoery of leadership is valid, the estimated coefficient on the interaction term, FIRMAGE*ROLES, will be positive and significant.

Column (i) of Table 6 presents the logit estimates of Eq. (1) augmented by FIRMAGE and FIRMAGE*ROLES. The estimated coefficient on FIRMAGE*ROLES is positive and

[21] There is an intriguing related literature that stresses the importance of initial frictions in the assignment of individuals to tasks, as early described by Jovanovic (1979) and as tested by Astebro, Chen, and Thompson (2011). The literature's key insight appears to be that people who are mismatched with their initial jobs and hence experience diverse jobs are more likely to quit being workers and become self-employed which makes good sense. However, our paper focuses on who gets promoted to top management rather than who becomes self-employed, and the theory when applied to corporate leadership does not make as much sense as when applied to self-employed entrepreneur. For instance, as shown in section V, workers with more roles (or mismatched with their initial jobs in the firm in the context of this theory) are more likely to get promoted to top management within, suggesting that the frictions in job assignment model may be more suited for an explanation of career switch from employment to self-employment than an explanation of career advancement of employed workers.

statistically significant at the 1 percent level, and thereby providing yet another piece of evidence in support of the human capital theory of corporate leadership. To assess the economic significance of the interplay between firmage and the value of the breadth of human capital, as we did to produce Figure 2, we use modal values for all dummy variables and mean values for all continuous variables and determine the predicted odds of a top management appointment for the typical worker with different values for ROLES for the young firm and the old firm respectively (the young firm with FIRMAGE=one standard deviation from the mean toward zero; and the old firm with FIRMAGE=one standard deviation from the mean away from zero). We find that for the old firm the typical contestant's predicted odds of earning a top management appointment will rise from around 0.5 to nearly 2 percent as the number of roles rises from one to six, while for the young firm the odds will rise from around 0.5 to only a little over 1 percent.

Second, roles experienced outside the worker's present firm may not be a perfect substitute for roles experienced within the worker's present firm, for there may be firm-specific human capital formed through internal work experiences. A natural extension of the human capital theory of corporate leadership is to distinguish between the breadth of human capital acquired within the current firm and elsewhere. It is plausible that a set of knowledge and skill obtained through experiencing a variety of roles are not completely general, and some are firm-specific. In other words, the breadth of human capital obtained internally in the current firm may be more valuable than the same breadth of human capital acquired elsewhere. First, as suggested by their discussion on job rotation, Gibbons and Waldman (2004) argue that the ability of top managers to supervise various lower level managers will be enhanced by their own experience with performing a variety of such lower-level managerial jobs in the past. Furthermore, such prior lower managerial job experience will be more effective if they are obtained within the firm rather than elsewhere.

Second, the advantage of obtaining the breadth of human capital within the firm as opposed to outside the firm can go beyond the scope of the supervisory function of top management. For instance, consider the breadth of human capital acquired through experiencing R&D and Marketing. Knowing when and how the R&D department should share information on its new product and process with the marketing department may prove to be useful for problem solving as a top manager. It is plausible, however, that when and how the R&D department should share information on its new product and process with the marketing department may differ between firms even if they sell the same product in the same market. Furthermore, it may prove to be instrumental in problem solving as a top manager to know what sort of information and according to what timeline the marketing department will need to get such information in order to develop a winning marketing strategy, which can again vary between firms. Finally, the breadth of human capital obtained by working in R&D and marketing departments includes a deep knowledge of key personnel in both R&D and Marketing departments, which may prove to be valuable for top manager's problem solving. Such a deep knowledge of key personnel is clearly firm-specific.

To examine the degree of substitutability between internally acquired and externally obtained breadth of human capital, we introduce a new variable: INT_ROLES, which equals the total number of roles the employee has experienced internally (not counting the current role). Specifically we estimate Eq. (1) augmented by INT_ROLES. The estimated coefficients on ROLES and INT_ROLES are reported in column (ii) of Table 6. The estimated coefficient on INT_ROLES is positive and statistically significant at the 1 percent level. Thus, holding constant formal educational attainments, gender, age, current occupation, tenure, and general work experience as well as the total number of ROLES, having experienced more roles internally results in a significantly higher probability of career success. Note since we are holding the total

number of roles constant, the estimated coefficient on INT_ROLES reflects the value of experiencing a role internally as opposed to externally, and thereby shows the importance of firm-specific human capital acquired informally on the job.

To demonstrate the economic significance of the value of the breadth of human capital accumulated within the firm vis a vis outside the firm, we followed the same methodology as we used to produce Figure 2, and produced a figure depicting the role-career success profiles for those with their breadth of human capital obtained entirely within the firm (internal career builders) and those with their breadth of human capital obtained entirely outside the firm (external career builders). For the typical internal career builder, his/her odds of earning a top management appointment will increase from around 0.5 to 5 percent as the number of roles rises from 1 to 6, while for the typical external career builder, his/her odds will rise from approximately 0.5 to only a little over 1 percent.

Since we build on Lazear (2012)'s human capital theory of corporate leadership, naturally we interpret the estimated coefficient on INT_ROLES as an indication of firm-specific human capital. Nonetheless the finding can be consistent with the theory of information asymmetry (see, for instance, Greenwald, 1986 and Chang and Wang, 1996). Specifically the amount of informal human capital acquired through on-the-job training may be known to the firm but not to its competitors. Hence, even if such human capital is perfectly general, outside firms cannot be sure about the exact amount of such human capital. The positive coefficient on INT_ROLES can in this case be interpreted as an indication of such information asymmetry between the current firm and its competitors (or the external labour market).

In our context we consider mobility between two-digit occupational codes which is a rather distinct move, e.g. a move from sales to accounting. Such mobility would most likely end up on the employee's resume and it is easily verifiable by outsiders. However, information

asymmetry cannot be ruled out fully, for how much human capital is accumulated when a worker is assigned to a particular occupation may be stochastic and only the current employer observes the realization of how much is accumulated. Unfortunately our data do not allow for a more rigorous test of the two interpretations.

In addition, as discussed in Greenwald (1986), it is possible that on average workers who move are low ability due to adverse selection. Such adverse selection will lead to higher odds of top management appointments for workers for whom prior roles were at the current employer than for other workers for whom prior roles were at different employers simply due to the fact that the former workers have higher ability than the latter. To see if this adverse selection interpretation is more valid than our interpretation derived from the human capital theory of corporate leadership, as we did in the last section, we re-estimate column (ii) of Table 6 with an additional set of controls consisting of individual fixed effects from the wage regression as proxy variables for innate ability. Reassuringly we find little change in the estimated coefficient on INT_ROLES (0.289 and statistically significant at the 1 percent level).[22]

Lastly, though not directly related to the human capital theory of corporate leadership (the focus of this paper), we further extended our logit model of career success and explored the following three issues: (i) gender gaps in career success with particular focus on the breadth of human capital and schooling; (ii) possible complementarity between the breadth of human capital as an example of informal human capital accumulation and schooling as an example of formal human capital formation; and (iii) the importance of the breadth of human capital for

[22] A promising future extension of our analysis of firm-specific breadth of human capital vs. general breadth of human capital is to test a new theory of firm-specific human capital developed by Lazear (2009) who re-conceptualizes firm-specific versus general human capital as a choice of the skill-weight of various mixes of general human capital that a variety of firms employ. Potentially our framework can be extended to an empirical test of the interplay between the thickness of the market and human capital investment choices as postulated by his theory, as well as providing new insight and evidence on why firms are willing to pay for employees investments in general human capital.

appointments to directors of functional areas. We summarize the key results briefly here and refer to appendices for details.

On the issue of gender gaps, we find that the breadth of human capital obtained informally on the job is important for both men and women, and that women benefit relatively more from formal schooling (in particular graduate education) than men. The latter finding can be explained by using the Bernhardt (1995), DeVaro and Waldman (2012) argument that formal schooling reduces the promotion signalling distortion. Information concerning worker ability is less public for women than for men, which in turn suggests that formal schooling reduces the promotion signalling distortion and hence education is raising the odds of promotion more for women than for men.[23]

Regarding complementarity between the breadth of human capital and schooling, we find that those with greater general human capital acquired through formal schooling accumulate human capital on the job more effectively, resulting in greater odds of top management appointments. Such complementarity between formal human capital acquired at school and informal human capital obtained at work in career advancement has been predicted by Gibbons and Waldman (2006). Concerning directorship of functional areas, the breadth of human capital obtained on the job is found to be more beneficial for R&D directorship than for other functional area directorships, pointing to possible heterogeneity of the value of the breadth of human capital among different functional areas.

VII. Concluding Remarks

In this paper we have provided clear and robust evidence that there is a significant and positive relationship between the number of roles an individual has experienced in the labour

[23] Cassidy, DeVaro and Kauhanen (2016) provide similar evidence that schooling is more important for women than men in promotion decisions.

market and his/her odds of career success measured as an appointment to a top management position. As such our results support the human capital theory of corporate leadership sketched in the context of job rotation by Gibbons and Waldman (2004) and developed formally by Lazear (2005) and (2012).

The use of Danish register based employer-employee data has enabled us to complement and expand upon prior research on the human capital theory of corporate leadership. First, our evidence from country-wide employer-employee data adds external validity to prior evidence from case studies. Second and perhaps most importantly, our ability to construct a proper contestant pool for top management appointments that comprises both internal and external candidates makes our study more compelling. Furthermore our data have allowed us to experiment with alternative definitions of the contestant pool, and confirm the robustness of our key findings to such changes in the definition of the contestant pool.

Third, our ability to follow individuals across time and companies has made it possible to distinguish the relative value of roles experienced with the current employer as opposed to elsewhere. This has enables us to establish that internally experienced roles are more important than external roles, which points towards the importance of specific human capital in this new context of corporate leadership.

While our empirical results clearly show that experiencing a variety of roles in the labour market is positively associated with the odds of career success, there are competing interpretations of the association. Our interpretation, which is inspired by the human capital theory of corporate leadership, is that an individual, by broadening his/her human capital, gains a human capital advantage over others in career advancement, and thereby is more likely to earn a top executive appointment. Alternative interpretations are that ability differences among individuals are driving the correlation; or that what we interpret as the breath of human capital is

merely a collection of steps on the promotion ladder that eventually lead to a final promotion to the C-suite. Using the panel structure of our data in various ways we have been able to demonstrate that our human capital interpretation is more plausible than such alternative interpretations. As such, our analysis has lent credence to the human capital theory of corporate leadership.

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Table 1. Changes in DISCO Codes between 1992 and 2002

	# of Codes	# of New Codes Added	# of Discontinued Codes
All			
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
DISCO Code with Cell Size > 100			
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
DISCO Code with Cell Size > 1000			
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

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark

Table 2. Descriptive Statistics

	Eight Years of Complete Employment History				No Restrictions on the Employment History
	Appointed to top management position in firms with 100 or more employees	**Contestant pool excluding those appointed to top management positions**	**Contestant pool**	**All private sector employees**	**All private sector employees**
ROLES (pct.):					
0	5.56	15.32	15.27	15.04	
1	20.98	30.22	30.17	30.15	
2	27.43	24.55	24.56	24.67	
3	21.09	15.87	15.90	15.99	
4	14.35	8.36	8.39	8.43	
5	7.13	3.78	3.80	3.81	
6	2.41	1.39	1.40	1.40	
7	0.89	0.43	0.43	0.43	
8	0.16	0.08	0.08	0.08	
Education (pct.):					
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	45.90	45.90	45.94	37.29
	(8.42)	(9.00)	(8.99)	(8.99)	(12.68)
TENURE	6.72	8.22	8.21	8.23	4.73
	(6.95)	(7.56)	(7.56)	(7.58)	(5.63)
EXPERIENCE	22.45	23.49	23.48	23.52	14.42
	(7.85)	(7.90)	(7.89)	(7.91)	(10.85)
# Observations	3,813	769,281	773,094	799,854	2,913,253

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark

Table 3. Logit Estimates of the Relationship between the Breadth of Human Capital and Career Success: Top management vs. CEO

	Top Management Number of appointments: 3813	CEOs Number of appointments: 418
	(i)	(ii)
ROLES	0.212***	0.089**
	(0.013)	(0.043)
HIGH-SCHOOL	0.193***	-0.014
	(0.055)	(0.184)
VOCATIONAL	0.221***	0.187
	(0.088)	(0.280)
COLLEGE	1.032***	1.225***
	(0.064)	(0.190)
GRADUATE	1.219***	1.510***
	(0.080)	(0.227)
FEMALE	-0.711***	-1.744***
	(0.056)	(0.260)
Pseudo R-square	0.123	0.160
Observations[1]	773,094	585,705

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes: All models include as controls tenure, general work experience, a quadratic in age, and year dummies as well as occupation dummies at the two-digit level. Standard errors are clustered at the individual level.
Significance levels: *** 1 percent, ** 5 percent, * 10 percent.

Table 4. Logit Estimates of the Relationship between the Breadth of Human Capital and Career Success: Nonlinear Effect and Occupation-specific Effects

	Logit			
	(i)	(ii) PROFESSIONALS	(iii) TECHNICIANS AND ASSOCIATE PROFESSIONALS	(iv) CRAFT AND RELATED TRADES WORKERS
ROLES		0.287***	0.137***	0.274***
		(0.026)	(0.029)	(0.025)
ROLES1	0.531***			
	(0.082)			
ROLES2	1.003***			
	(0.086)			
ROLES3	1.167***			
	(0.092)			
ROLES4	1.379***			
	(0.097)			
ROLES5	1.440***			
	(0.108)			
ROLES6	1.360***			
	(0.139)			
ROLES7	1.608***			
	(0.199)			
ROLES8	1.735***			
	(0.434)			
Pseudo R-square	0.125	0.059	0.063	0.153
Observations	773,094	77,025	148,802	185,985

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes: All models include as controls tenure, general work experience, a quadratic in age, and year dummies as well as occupation dummies at the two-digit level. Standard errors are clustered at the individual level.
Significance levels: *** 1 percent, ** 5 percent, * 10 percent.

Table 5. Logit Estimates of the Relationship between the Breadth of Human Capital and Career Success: Controlling for upward career moves prior to top management appointments and ability

	logit		
	(i)	(ii)	(iii)
ROLES	0.112***	0.208***	0.108***
	(0.015)	(0.013)	(0.015)
HIGH-SCHOOL	0.203***	0.077	0.084
	(0.055)	(0.055)	(0.055)
VOCATIONAL	0.238***	0.055	0.066
	(0.088)	(0.088)	(0.088)
COLLEGE	1.082***	0.516***	0.553***
	(0.064)	(0.065)	(0.065)
GRADUATE	1.289***	0.363***	0.419***
	(0.080)	(0.082)	(0.082)
FEMALE	-0.710***	-0.277***	-0.276***
	(0.055)	(0.056)	(0.056)
Controlling for:			
Upward career moves prior to top management appointments, PROMOTIONS	yes	no	yes
Ability (proxy fixed effects)	no	yes	yes
Pseudo R-square	0.127	0.152	0.156
Observations[1]	773,094	773,094	773,094

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes: All models include as controls tenure, general work experience, a quadratic in age, and year dummies as well as occupation dummies at the two-digit level. Standard errors are clustered at the individual level.
Significance levels: *** 1 percent, ** 5 percent, * 10 percent.

Table 6. Logit Estimates of the Relationship between the Breadth of Human Capital and Career Success: Extensions

	Logit	
	(i)	(ii)
ROLES	0.074***	0.169***
	(0.024)	(0.014)
FIRMAGE	-0.027***	
	(0.005)	
ROLES*FIRMAGE	0.011***	
	(0.001)	
INT_ROLES		0.249***
		(0.026)
HIGH-SCHOOL	0.194***	0.196***
	(0.055)	(0.055)
VOCATIONAL	0.218***	0.229***
	(0.087)	(0.087)
COLLEGE	1.036***	1.060***
	(0.064)	(0.064)
GRADUATE	1.228***	1.251***
	(0.080)	(0.080)
FEMALE	-0.707***	-0.705***
	(0.056)	(0.055)
Pseudo R-square	0.124	0.125
Observations	773,094	773,094

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes: All models include as controls tenure, general work experience, a quadratic in age, and year dummies as well as occupation dummies at the two-digit level. Standard errors are clustered at the individual level. For the multinomial logit model the reference category is no appointment to an executive position.
Significance levels: *** 1 percent, ** 5 percent, * 10 percent

Figure 1. Top management Appointments and the Size of the Contestant Pool by (one-digit) Occupations

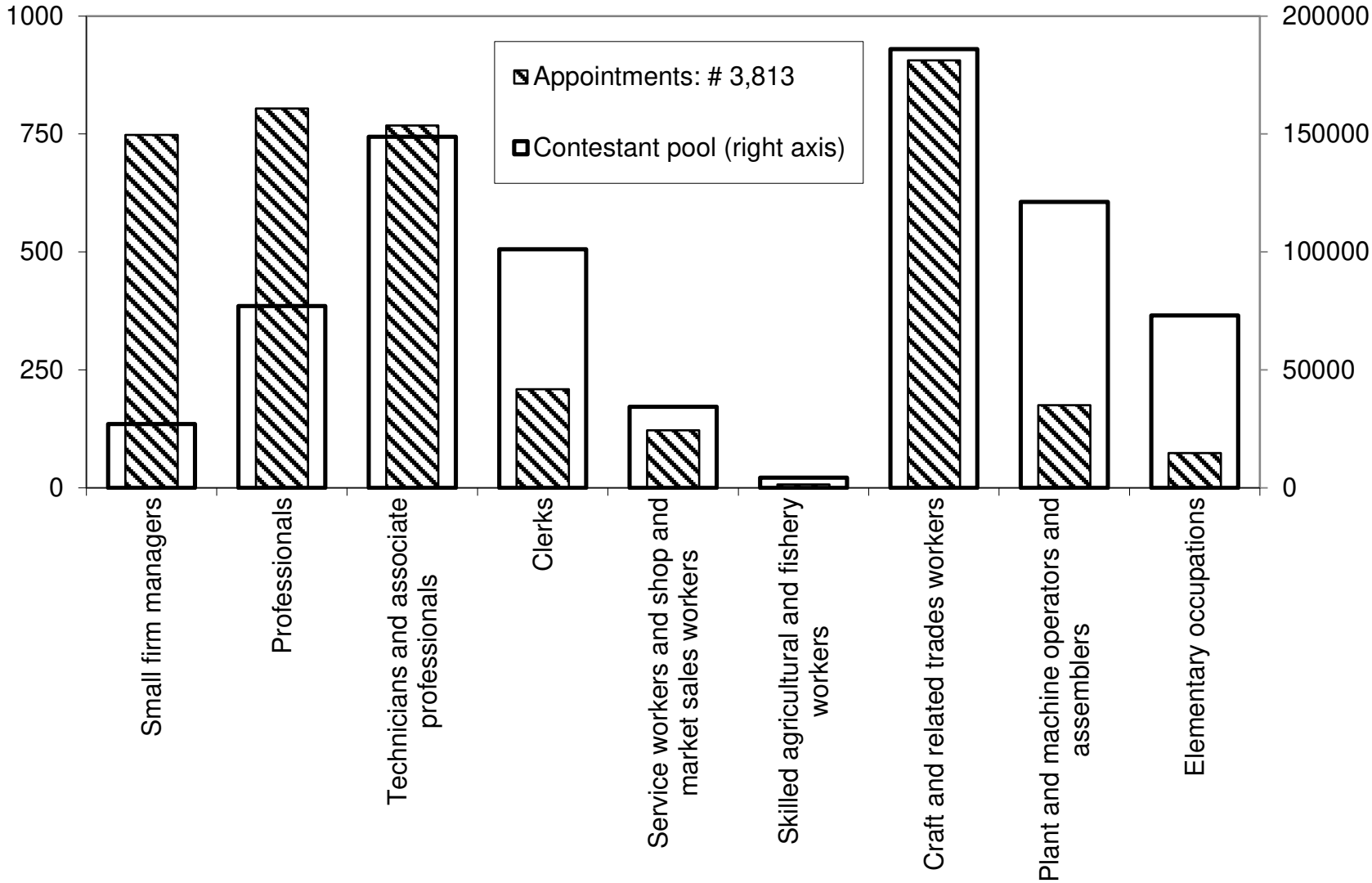
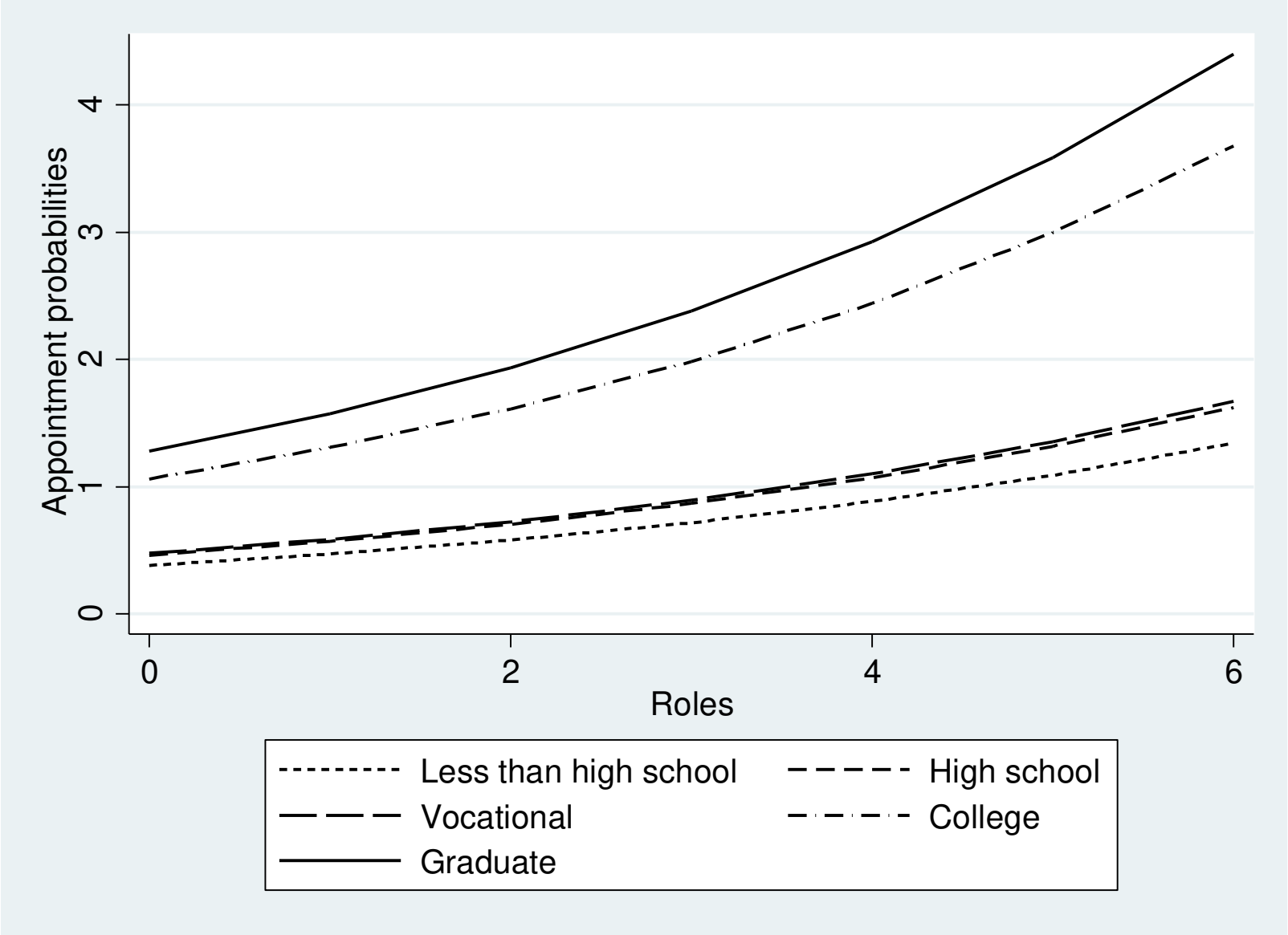


Figure 2. Role-Career Success Profiles for Workers with Different Levels of Educational Attainment



Appendices to:

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

(forthcoming in the Economic Journal)

Anders Frederiksen and Takao Kato*

November 2016 (revised)

Abstract

This paper provides new evidence on the importance of the breadth (as opposed to the depth) of human capital for career success (defined as top management appointments) by using Denmark's Linked Employer-Employee Data. In so doing, we support and enrich the human capital theory of corporate leadership sketched in the context of job rotation by Gibbons and Waldman (2004) and developed formally by Lazear (2005) and (2012). There are four main advantages of our study over prior work. First, the use of Danish registry data comprising all workers in Denmark (from different industries, with different education levels and different types of education) enables us to obtain more externally-valid evidence in support of the human capital theory of corporate leadership. Second, we construct the contestant pool for top management appointments with more precision, taking into consideration not only internal promotion but also external recruitment as means to achieve such appointments. Third, we conduct a variety of additional analyses to demonstrate the robustness of our findings and the relative validity of our preferred interpretation based on the human capital theory of corporate leadership to alternative interpretations. Finally we extend our baseline analysis, and provide additional evidence and insights on the human capital theory of corporate leadership: (i) the breadth of human capital is found to be less important for top managers when the firm's underlying technology is relatively new; and (ii) the internally-obtained breadth of human capital is found to be more valuable than the externally-acquired breadth of human capital, pointing to the relevance of the concept of firm-specific human capital to the breadth of human capital.

(JEL codes: M5 and J24)

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Appendix A: Gender Gaps in Career Success

Blau and DeVaro (2007) survey the literature on gender differences in promotion rates. They find clear evidence that glass ceilings are at work. In their survey they find that women in general have lower promotion probabilities than men, but there are exceptions (such as Hersch and Viscusi, 1996). Recent research on the gender gap in promotions using Danish data confirms this picture. For example, Smith, Smith and Verner (2013) find that the probability of attaining executive and CEO positions is much higher for men than women even after controlling for a large set of explanatory variables. Frederiksen and Halliday (2015) also confirm that there are few women promoted. They argue that this is because of gender differences in, for example, human capital and that there simply are very few women in lower-level jobs who can be promoted. Hence, our results of a gender gap in promotion rates echo earlier results on the glass ceiling for Denmark and elsewhere.

The observed gender difference can also be understood well in the framework of the invisibility hypothesis. The firm learns about each employee's ability by observing him or her at work. Such knowledge of the worker's ability is private information and is not known to the firm's competitors. When a firm promotes a worker, his or her ability is revealed to the firm's competitors, making the employee a poaching target. Such an added competitive pressure implies that the firm will need to pay a wage premium when promoting. To avoid such a wage premium, the firm has an incentive not to promote high-ability workers. Hence, as a result of information asymmetry regarding the worker's ability between the current and prospective firms, fewer promotions will result. This mechanism is hypothesised to be less applicable to male workers, whose ability is more visible to other firms in the first place due to an effective informal

signalling device such as an ‘old-boy network’. Hence, more men are promoted relative to their equally able female peers.

To explore gender differences in the relationships between career success and human capital, we estimate Eq. (1) for men and women separately. The results are presented in Table A1 (along with the logit estimates for all individuals including both men and women for reference). First, the breadth of human capital obtained informally on the job is important for both men and women as it increases the likelihood of being appointed to a top management position. Second, women benefit relatively more from formal schooling than men (see also Figure A1). That is, using modal values for all dummy variables and mean values for all continuous variables, we calculate the predicted probability of winning a top management appointment for the typical female and male contestant, given different levels of educational attainment. To demonstrate the relative magnitude of gender gaps in top management appointments for different levels of educational attainment, we divide the predicted odds of winning a top management appointment for the typical female worker by the predicted odds of winning a top management appointment for the typical male worker. The resulting female/male ratios in the top management appointment rates are depicted in Figure A1. The figure demonstrates that in the competition for top management positions, women with graduate education are less disadvantaged over their male counterparts than women with lower levels of education.

The above finding on women with graduate education being less disadvantaged in the competition for high-level positions than women with lower education levels is consistent with Bernhardt (1995), DeVaro and Waldman (2012), and Cassidy, DeVaro, and Kauhanen (2016). Bernhardt (1995) and DeVaro and Waldman (2012) demonstrate that formal schooling (especially graduate education at the master’s level) mediates the well-known promotion

signalling distortion. DeVaro *et al.* (2012) extend the theory to the case of racially diverse workforces. Using the same logic as applied to gender diversity in the workplace, we can argue that promotion serves as a signal for women but not for men (because for men information about ability is closer to being public due to the old-boy network). In other words, for men, the odds of promotion is close to being optimal, whereas for women, the odds of promotion is lower than optimal due to the signalling role of promotion and hence the firm's incentive to conceal her high-ability by not promoting her. As predicted by Bernhardt (1995) and DeVaro and Waldman (2012), however, she can obtain a graduate degree (a formal signal) and reduce the signalling role of promotion and hence the firm's incentive to conceal her high ability by not promoting her, resulting in an increase in her odds of promotion towards the optimal level (or the level for men) and narrowing gender gaps in promotion.

Appendix B: Formal Schooling and Informal OJT: Complements or Substitutes?

Gibbons and Waldman's (2006) extended theory of wage and promotion within the firm predicts complementarity 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 whether 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 ROLES and educational dummy variables.

Column (i) of Table A2 summarises the logit estimates of the augmented version of Eq. (1) for all, including both men and women. The estimated coefficients on the interaction terms involving ROLES and formal schooling variables are insignificant at lower levels of schooling yet positive and significant at the 5% level for individuals with graduate training. The observed

complementarity between formal schooling and informal OJT is consistent with Gibbons and Waldman's (2006) 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 ROLES and for each formal schooling category (Less than High School; High School; Vocational; College; and Graduate). The resulting role-career success profiles are drawn in Figure 2.

The typical college graduate with minimal breadth of human capital (ROLES=0) is predicted to have a little over a 1% chance of winning a top management appointment in a large firm in Denmark, and is about twice as likely to be appointed to 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 ROLES=4, is twice as likely to be appointed to a top management position as the typical high school graduate with ROLES=0 (minimal breadth of informal human capital). Note that the typical high school graduate's odds of being appointed to a top management position are now comparable to the probability of a typical college graduate with minimum breadth of human capital obtained informally on the job.

Perhaps more importantly, the difference in the top management appointment probabilities between graduate degree holders and college graduates is rather small when the breadth of informal human capital is narrow. However, the gap widens considerably as the

breadth of informal human capital increases due to the significant complementarity between formal schooling and informal OJT for graduate degree holders. For example, the typical college graduate with ROLES=4 is about *twice* as likely to be appointed to a top management position as the typical college graduate with ROLES=0, while the typical graduate degree holder with ROLES=4 is about *three times* more likely to be appointed to a top management position as the typical graduate degree holder with ROLES=0. This demonstrates the importance of 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 columns (ii) and (iii) of Table A2. The estimated coefficients on an interaction term involving ROLES and GRADUATE are positive and significant at the 5% level for men, yet not at all significant for women, suggesting that complementarity between graduate degrees and informal OJT applies to men only. In fact, there is some evidence suggesting that for women formal schooling and informal OJT may be substitutes.

Appendix C: Is the Breadth of Human Capital Equally Important Across Functional Areas?

It is plausible that the value of the breadth of informal human capital differs between functional areas. To identify possible differences, we repeat the above analysis separately for four key functional areas: Finance, HR, R&D and Sales/Marketing. We define top management appointments in Finance as changes from DISCO Major Groups 2 through 9 to DISCO 1231 FINANCE AND ADMINISTRATION DEPARTMENT MANAGERS in large firms with 100 or more employees. Top management appointments in HR, Sales/Marketing and R&D are defined similarly, with target DISCO codes being 1232, 1233 and 1237. Note that we do rely on the four-

digit codes to identify appointments to the various directorships in this analysis. However, after a careful review of the relevant 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 A3 presents the results. The estimated coefficients on ROLES are positive and significant at the 1% level in all four cases, emphasizing the importance of the breadth of human capital for appointments to directorships in the four functional areas. Figure A2, which is produced from the estimated coefficients of specification (i) in a similar fashion to earlier figures, demonstrates that broadening the scope of informal human capital is particularly helpful for career success in R&D as compared to other functional areas.

To further investigate the relative importance of firm-specific human capital in each functional area, we distinguished internal roles from external roles as in previous analysis. The results are shown in specification (ii) in Table A3. Firm-specific experiences appear to be beneficial for career success in Finance and in Sales and Marketing, and it appears to be particularly important in R&D.

Why is the breadth of human capital especially beneficial for career success in R&D? First, we hypothesise that the R&D department director's ability to effectively engage in cross-functional knowledge sharing and coordination is particularly important for corporate competiveness. For instance, an R&D director with marketing experience is more likely to know when and how the R&D department should share information on its new product and process with the marketing department director. He or she is also more apt to know what sort of information and in what timeline the marketing department will need to get such information in order to develop a winning marketing strategy. In addition, the R&D department director with an

internal marketing experience tends to know key personnel in the marketing department personally, and therefore information sharing and coordination between the R&D department and the marketing department are more likely to proceed smoothly (Murakami (2009) presents a somewhat similar idea on why the breadth of human capital is beneficial for R&D directors). In contrast, interdepartmental knowledge sharing and coordination by other functional area directors are also useful yet may be less vital for corporate competitiveness than those by the R&D department director.

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Table A1. Logit Estimates of the Relationship between the Breadth of Human Capital and Career Success: Gender differences

	Logit					
	(i)			(ii)		
	All	Men	Women	All	Men	Women
ROLES	0.212***	0.210***	0.194***			
	(0.013)	(0.013)	(0.038)			
ROLES1				0.531***	0.522***	0.547**
				(0.082)	(0.089)	(0.215)
ROLES2				1.003***	1.001***	0.933***
				(0.086)	(0.093)	(0.229)
ROLES3				1.167***	1.150***	1.168***
				(0.092)	(0.099)	(0.245)
ROLES4				1.379***	1.393***	1.118***
				(0.097)	(0.105)	(0.268)
ROLES5				1.440***	1.442***	1.238***
				(0.108)	(0.116)	(0.302)
ROLES6				1.360***	1.359***	1.168***
				(0.139)	(0.148)	(0.420)
ROLES7				1.608***	1.467***	2.307***
				(0.199)	(0.220)	(0.466)
ROLES8				1.735***	1.816***	--
				(0.434)	(0.437)	
HIGH-SCHOOL	0.193***	0.185***	0.110	0.196***	0.188***	0.113
	(0.055)	(0.060)	(0.149)	(0.055)	(0.060)	(0.149)
VOCATIONAL	0.221***	0.199**	0.304	0.229***	0.205**	0.328
	(0.088)	(0.096)	(0.216)	(0.087)	(0.096)	(0.216)
COLLEGE	1.032***	0.996***	0.999***	1.050***	1.012***	1.034***
	(0.064)	(0.068)	(0.194)	(0.064)	(0.068)	(0.193)
GRADUATE	1.219***	1.115***	1.652***	1.235***	1.130***	1.684***
	(0.080)	(0.086)	(0.223)	(0.080)	(0.086)	(0.223)
FEMALE	-0.711***			-0.714***		
	(0.056)			(0.055)		
Pseudo R-square	0.123	0.116	0.124	0.125	0.118	0.126
Observations	773,094	559,643	206,397	773,094	559,643	206,326

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes:
1. All models include as controls tenure, general work experience, a quadratic in age, year dummies and occupation dummies at the two-digit level. Standard errors are clustered at the individual level.
2. The sample size for all exceeds the sum of the sample size for men and women, for when we split the sample into men and women, a few small occupation categories have no top management appointments, and hence observations in such categories were dropped.
Significance levels: *** 1%, ** 5%, * 10%.

Table A2. Logit Estimates of the Complementarity between the Breadth of Human Capital and Schooling

	Logit		
	(i)	(ii)	(iii)
	All	Men	Women
ROLES	0.184***	0.157***	0.327***
	(0.029)	(0.031)	(0.081)
HIGH-SCHOOL	0.127	0.034	0.531**
	(0.094)	(0.102)	(0.254)
VOCATIONAL	0.253*	0.203	0.519
	(0.151)	(0.166)	(0.374)
COLLEGE	0.989***	0.875***	1.478***
	(0.108)	(0.115)	(0.321)
GRADUATE	0.986***	0.842***	1.608***
	(0.130)	(0.138)	(0.387)
FEMALE	-0.715***		
	(0.056)		
ROLES * HIGH-SCHOOL	0.027	0.060*	-0.190**
	(0.031)	(0.033)	(0.086)
ROLES * VOCATIONAL	-0.009	0.003	-0.100
	(0.047)	(0.051)	(0.122)
ROLES * COLLEGE	0.016	0.047	-0.207**
	(0.034)	(0.036)	(0.103)
ROLES * GRADUATE	0.090**	0.106**	-0.012
	(0.039)	(0.042)	(0.112)
Pseudo R-square	0.123	0.116	0.125
Observations	773,094	559,643	206,397

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes: All models include as controls tenure, general work experience, a quadratic in age, year dummies and occupation dummies at the two-digit level. Standard errors are clustered at the individual level. Significance levels: *** 1%, ** 5%, * 10%.

Table A3. Logit Estimates of the Relationship between the Breadth of Human Capital and Directorship Appointments in One of Four Functional Areas

	Logit							
	(i)				(ii)			
	Finance	HR	R&D	Sales and Marketing	Finance	HR	R&D	Sales and Marketing
ROLES	0.196***	0.220***	0.413***	0.145**	0.167***	0.181**	0.343***	0.107*
	(0.043)	(0.080)	(0.078)	(0.058)	(0.045)	(0.088)	(0.085)	(0.062)
INT_ROLES					0.189**	0.225	0.412**	0.223**
					(0.086)	(0.174)	(0.165)	(0.100)
Pseudo R-squared	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

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes: All models include as controls tenure, general work experience, a quadratic in age, year dummies and occupation dummies at the two-digit level. Standard errors are clustered at the individual level.
Significance levels: *** 1%, ** 5%, * 10%.

Table A4. Log-wage Regression Controlling for ROLES

	(i)
ROLES1	0.007***
	(0.001)
ROLES2	0.019***
	(0.002)
ROLES3	0.027***
	(0.002)
ROLES4	0.033***
	(0.002)
ROLES5	0.033***
	(0.003)
ROLES6	0.025***
	(0.004)
ROLES7	-0.012**
	(0.006)
ROLES8	-0.037***
	(0.013)
Gender	-0.218***
	(0.001)
Age	0.027***
	(0.001)
Age squared/100	-0.040***
	(0.000)
Experience	0.015***
	(0.000)
Experience squared/100	-0.007***
	(0.001)
Tenure	0.002
	(0.000)
Tenure squared/100	-0.002
	(0.001)
Year dummies	YES
Occupation dummies	YES
Adj. R-square	0.348
Number of observations	773,094

Source: The Integrated Database for Labour Market Research (IDA) created by Statistics Denmark
Notes: Standard errors are clustered at the individual level.
Significance levels: *** 1%, ** 5%, * 10%.

Figure A1. Career Success and Formal Schooling: Gender Differences

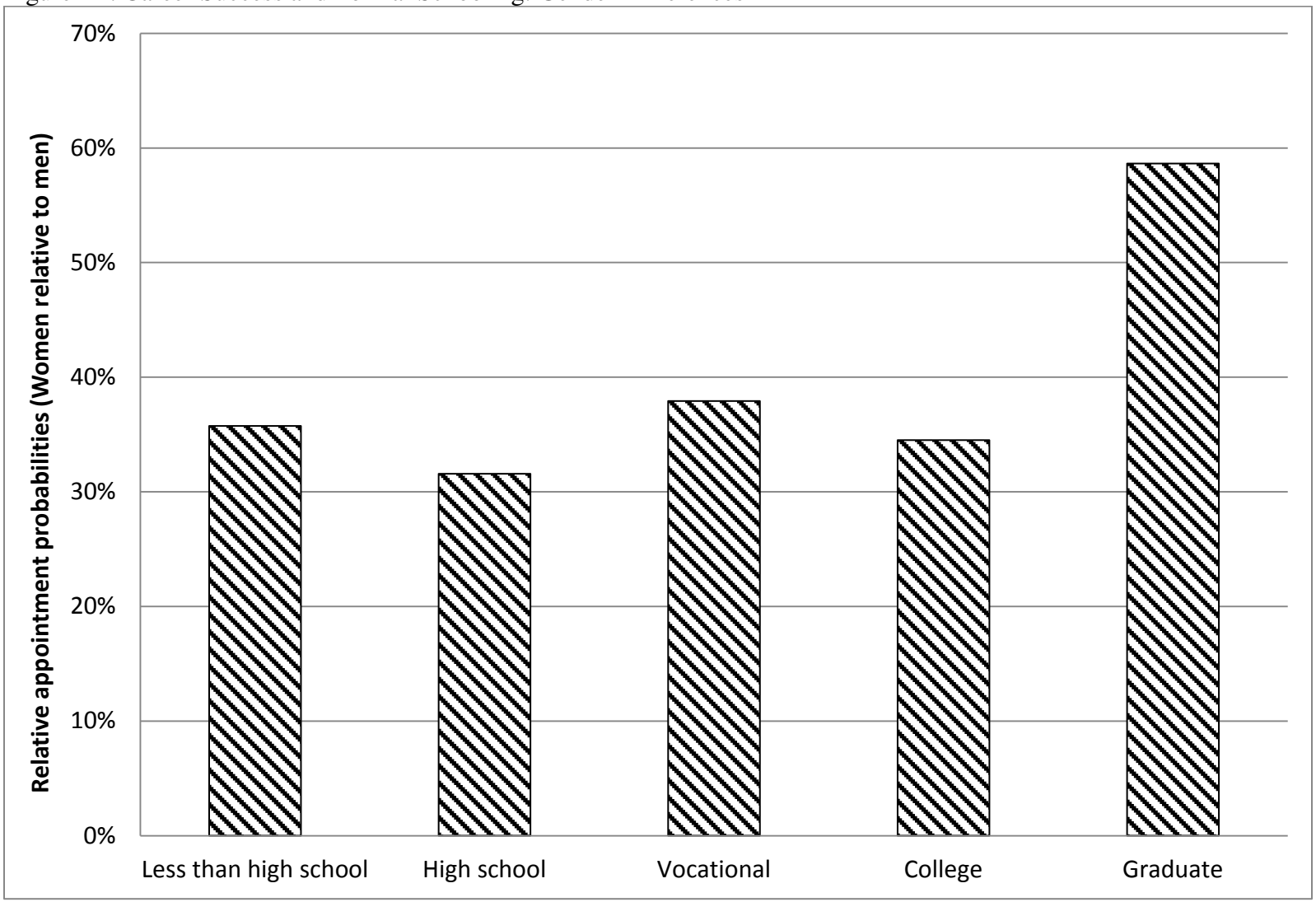

Figure A2. Role-Career Success Profiles for College Graduates: Different Directorships