PATTERNS OF COAUTHORSHIP AND

RESEARCH PRODUCTIVITY IN FINANCE ACADEMIA

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ABSTRACT

We analyze the implications of different research coauthoring strategies of early-career finance faculty members for their later-career research productivity. Specifically, we measure how frequently junior faculty members publish with colleagues who are more seasoned ("mentors"), as opposed to publishing alone or with colleagues at roughly the same career level ("peers"). We then apply cross-sectional tests to determine whether a higher frequency of papers published with mentors or with peers early in one's career results in a higher rate of publication success around and after the tenure decision date. We control for the quality of a graduate's doctoral program (which also serves as a proxy for the quality of the individual), as well as for the quality of his or her first academic affiliation.

Our results suggest that early-career coauthoring with a mentor can provide significantly increased later-career research output for a faculty member. However, this positive impact of mentoring appears to be limited to junior faculty members who coauthor with mentors who are still research-active in the field—coauthoring with research-inactive mentors, at best, shows no benefit, and, at worst, appears to put a drag on later-career research output. Finally, junior faculty who establish coauthoring arrangements with their peers (rather than sole-authoring) have significantly higher career output in the highest-quality finance journals. Our results should provide useful inputs for recent doctoral graduates who are planning their coauthoring strategies, and for academic institutions that are considering the establishment of formal mentoring programs.

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Finance research productivity, as reflected in the number and quality of articles published in academic journals, has been examined from a variety of perspectives. At the aggregate or business school level, researchers have studied the link between published research and business school rankings [e.g., see Schwert (1993), Armstrong and Sperry (1994), and Borokhovich, Bricker, Brunarski, and Simkins (1995)]. Other researchers examined the impact of the total research output by academic institutions [Klemkosky and Tuttle (1977a), Ederington (1979), and Niemi (1987)], while still others analyzed the total research output of graduates of various finance doctoral programs [Klemkosky and Tuttle (1977b), Schweser (1977), and Zivney and Bertin (1992)].

A second stream of literature has focused on research productivity at the individual researcher level. For example, the distribution of published research over the career of a finance academic was analyzed by Chung and Cox (1990) and Zivney and Bertin (1992). More recently, Swidler and Goldreyer (1998) examined the impact of publishing an academic article on the salary and promotion likelihood of a finance academic, and Fishe (1998) examined the research publications of full professors of finance in an effort to identify research standards for promotion to full professor.

Since research success is important to both the employing academic institution and the employed academic, these studies provide useful benchmarks and predictors of long-term career success. For the institution, these studies provide administrators with research benchmarks to allow an objective evaluation of the research output of an individual while making yearly salary adjustments. In addition, these benchmarks are useful for predicting the long-term output of an

individual, which is extremely useful information when making reappointment or tenure decisions. For the junior faculty member, these research benchmarks are useful information for formulating an early career research strategy, as well as for evaluating likely future productivity. For example, one may find that the strategy of publishing less frequently early in one's career, but in highest quality journals, is likely to lead to better long-term productivity, higher salaries, and greater chances of promotion than publishing more frequently in lower-ranked journals.

In general, prior studies of individual research records strongly indicate that early research success predicts later-career research success. However, little is known about why some faculty members have more successful research careers than others do, holding the early publication frequency constant. Clearly, a better understanding of the characteristics that are associated with greater long-term research productivity is of significant value to both the individual faculty member and to university administrators.

In this paper, we analyze one important characteristic of early-career publishing records that has been overlooked in prior studies. We refer to this characteristic as the "coauthoring strategy" of individuals—that is, the tendency to publish alone ("sole authoring"), to publish with peers ("peer authoring"), or to publish with more senior faculty members ("mentored authoring" or "mentoring"). In studying coauthorship patterns, our objective is to determine the extent to which the coauthoring strategy choice by an untenured faculty member affects his or her long-term research output. As such, our study should be of great interest to junior faculty members, because we predict whether sole-authoring, coauthoring with a mentor, or coauthoring with a peer lays better groundwork for a successful long-term career. Academic institutions should also find our results of interest because we help determine whether a faculty member, at reappointment or tenure time, should be rewarded or penalized (or neither) for coauthoring

frequently with senior colleagues.[1]

Specifically, we address the following questions:

- What are the coauthorship patterns of junior finance faculty (i.e., how frequently do they publish with their advisors, with other mentors, and with peers)?
- Does the tendency to publish with a mentor vary among finance academics who receive their doctoral degree, or begin their academic career, at academic institutions of varying quality?
- Do coauthorship patterns of junior faculty impact their career research success around and after the tenure decision date?

We show that junior faculty members in finance regularly publish with senior colleagues, as roughly 50 percent of those who publish frequently early in their careers publish one or more articles with a mentor. In general, our results indicate that such coauthoring arrangements can be beneficial to the new faculty member, depending on the type of mentor with whom the recent graduate coauthors. Specifically, after controlling for the quality of the new finance faculty member's doctoral program and first academic employer, our results indicate that early-career coauthoring with a mentor is associated with significantly increased later-career research output. However, this positive impact of mentoring appears to be limited to coauthoring arrangements with mentors who are still research-active in the field: coauthoring with research-inactive mentors, at best, shows no benefit, and, at worst, appears to put a drag on later-career research output. Also, junior faculty who establish coauthoring arrangements with their peers have significantly higher career output (relative to junior faculty who sole-author) in the highest-quality finance journals.

Our paper proceeds as follows: Section I discusses our data and their characteristics;

[1] In recent years, some universities have even developed initiatives and programs designed to provide "mentoring" for new faculty in the apparent belief that this will help to improve research productivity.

Section II presents our methodology for measuring mentoring; Section III provides our empirical results; and Section IV provides concluding remarks.

I. DATA AND SAMPLE CHARACTERISTICS

The first stage of our study involved identifying all individuals who received doctoral (Ph.D. or DBA) degrees in finance or in a finance-related area. To accomplish this, we first used the University Microfilms International (UMI (1995a)) *Dissertation Abstracts Ondisc* database to find all individuals who received doctoral degrees with UMI dissertation subject categories "Economics, Finance" or "Business Administration, Banking."

Because contributors to the finance literature may come from other related disciplines, and because not all doctoral degree-granting institutions report dissertation subjects in the same manner, we also searched for dissertations listed under the following subjects: "Business Administration, General," "Business Administration, Management," "Economics, Commerce-Business," "Economics, General," and "Economics, Theory." Since this second set included many dissertations that were not finance-related, we implemented additional screens to eliminate such cases. These screens involved searching the dissertation titles in these more general categories for 25 "key" words or phrases frequently used in the finance literature.[2] Authors of dissertations whose titles included one or more of these key words or phrases were retained in our database.

The initial set of finance and finance-related dissertation authors covered the period from 1950 through 1994 which was the latest date available when the database was being constructed. We started with the decade of the 1950s because finance was beginning to be viewed at that time

[2] Examples of the control words or phrases include: investments, capital structure, cost of capital, portfolio returns, portfolio analysis, etc. A complete list is available from the authors upon request.

as a discipline distinct from economics. For example, the first major academic journal specifically designed to publish finance research, *The Journal of Finance*, began publishing in 1946.[3] From each UMI dissertation record, we obtained the author's name, dissertation title, year of completion, degree-granting institution name, and dissertation advisor name (when available). UMI (1995a) dissertation information (on CD-ROM) was augmented when necessary by information from the University Microfilms International (UMI, 1995b) *Dissertation Abstracts* printed volumes.

Table I shows that over 15,000 dissertations were completed in finance or on finance-related topics from 1950 to 1994. The number of finance or finance-related dissertations more than doubled between the decades of the 1950s and the 1960s, and almost doubled again between the decades of the 1960s and the 1970s. The decade of the 1980s showed only a slight increase over the 1970s. However, based on the number of finance and finance-related dissertations completed during the first-half of the 1990s, the total number for the decade of the 1990s will be much larger than the 1980s level.

[Table I here]

The second stage of our study involved gathering journal publication information on the individuals included in our completed dissertations sample. As in prior studies of faculty research output, we were interested in both quantity (breadth) and quality of publications. To measure quantity, we used the Heck (1995) *Economic Literature Database* (ELDB), which provided a listing of articles published in 280 finance and related journals through the end of 1994. The ELDB database was used to build a career publication profile (through 1994) for each doctoral graduate in our sample.

Table I shows that about 39 percent (5,845 out of 15,124) of individuals who completed

[3] The *Financial Analysts Journal* was started in 1945 but was not considered to be primarily an academic journal.

finance or related dissertations during the 1950-1994 period published at least once in an ELDB-covered journal. A lower percentage of graduates of the 1950s "published" (measured in terms of the 280 journals covered in the ELDB) relative to those graduating during the next three decades. This might reflect the fact that many finance and related journals did not come into existence until the 1960s and 1970s and/or there may have been a possible lesser emphasis on published research for doctoral graduates in the 1950s. The portion of graduates during the 1960s, 1970s, and 1980s who published remained surprisingly stable at about 46-47 percent of total graduates for each decade. If we exclude the first-half of the 1990s, nearly 46 percent of the graduates who completed finance-related dissertations published at least once in an ELDB-covered journal. The lower rate for subjects who completed dissertations in the 1990s is due to a dissertation author vintage affect because we "truncate" all careers at the end of 1994.

To measure quality of finance publications, we used the following four ("Top 4") finance journals: *The Journal of Finance* (JF), *The Journal of Financial and Quantitative Analysis* (JFQA), *The Journal of Financial Economics* (JFE), and *The Review of Financial Studies* (RFS).[4] Mabry and Sharplin (1985) found that the JF, JFE, and JFQA were the most influential journals in finance. In a follow-up citations-based study by Alexander and Mabry (1994), after the RFS was in print for several years, the four journals were ranked in terms of highest-impact finance journals as: JFE (1), JF (2), JFQA (3), and RFS (6). A study by Borokhovich, et al. (1995) ranked the impact of the four journals as JF (1), RFS (2), JFE (3), and JFQA (9) based on citation "impact factors" measured in 1993. Clearly, the exact rankings of these journals can change from year to year.[5] However, most studies of journal influence include three or more of

[4] As previously noted, the JF began publication in 1946. Initial publication years for the other three journals were: JFQA in 1966, JFE in 1974, and RFS in 1988.

[5] The Journal of Business ranks highly in most citation studies, too. Some studies (e.g., Fishe (1998)) include it instead of the JFQA as a "top finance journal."

these four journals in their set of "top finance journals."

Table I shows the number of doctoral graduates who have published in these Top 4 finance journals as of the end of 1994.[6] For the three decades from the 1960s through the 1980s, approximately 12-13 percent of graduates who completed finance or finance-related dissertations published at least once in a Top 4 finance journal. This "stability" of the percentage of dissertation authors who were able to publish in "top" finance journals, whether they completed their dissertations in the 1960s, 1970s, or 1980s, is quite interesting. This finding apparently is due, in part, to the fact that the number of "top" finance journals expanded from one to four (using our definition) during time periods when the numbers of individuals completing finance-related dissertations also were growing.[7]

This database provides the most comprehensive statistical summary of journal publishing success to date. Zivney and Bertin (1992) previously examined journal publication success and frequency by examining finance doctorates as reported in the *Journal of Business* under "doctoral Dissertations Accepted" under the area of "Business Finance and Investments." A total of 1137 finance doctoral graduates, who completed dissertations during the 1963 through 1987 period, were identified. Our database covers a longer time period, a much broader list of dissertation authors completing dissertations on finance and finance-related topics, and considers a larger list of journals.

Zivney and Bertin found that 29 percent (333/1137) of the finance doctoral graduates in their sample published at least once in a Top 3 (JF, JFE, or JFQA) finance journal. This is about three times the high quality publishing rate we found in Table I. Zivney and Bertin also found

[6] The RFS is relatively under weighted since it did not begin until 1988.
[7] The relatively low percentage of 1990-94 dissertation authors who have published in the Top 4 finance journals by the end of 1994 likely reflects a vintage effect exasperated by the typically long time it takes to publish research in Top 4 journals.

that 57 percent (650/1137) published at least once in their set of 128 journals. In contrast, in Table I we found that only about 39 percent of our sample of doctoral graduates published at least once in a 280-journal set. A variety of reasons may account for these differences. Schools self-report to the *Journal of Business* and Zivney and Bertin note that some under reporting took place. That is, some schools apparently were lax in reporting the dissertations of their doctoral graduates.[8] Also, our study included dissertation authors from the 1950s who were less likely to publish. A dissertation author vintage effect also may contribute to the differences. For example, a relatively large portion of our sample completed their dissertations during the 1990-94 period and thus had little time to publish by the end of 1994. Since, the distribution of the dissertation authors in the Zivney and Bertin are not known, it is not whether their dissertation author vintage effect was as large as ours. In addition, Zivney and Bertin considered publications one year beyond (1988) their last doctoral graduates (1987).[9]

Although not reported in Table form, we found that it was common practice to publish sole-authored articles during the 1950s and into the 1960s. A secular change occurred in patterns of coauthorship in finance and related publications during the late 1960s—from a predominance of sole-authored publications to one of multiple-authored publications [for example, see Hudson (1996)].[10] As a result, our analysis of the impact of early mentoring on future publication success begins with dissertations completed in 1970.[11]

[8] However, Zivney and Bertin argue there is no evidence that non-reported finance dissertation authors published more or less frequently than those that were reported.

[9] We have replicated the Zivney and Bertin procedure for examining life-cycle publication effects. However, we do not report our findings here. These results are available upon request.

[10] We provide supporting evidence of this change in authoring patterns in the next section when we report the frequency of publishing with a mentor over various time periods.

[11] A secondary reason for beginning our study in 1970 was a limitation on our ability to measure the quality of academic institutions and dissertation programs during earlier time periods.

II. METHODOLOGY

A. Measures of Research Mentoring

Robert Boice (1992) found that most faculty when starting their careers felt isolated and often were overwhelmed. A mentoring program, according to Boice, seemed to reduce the stress associated with trying to conduct research and teaching well. A mentoring program also seemed to reduce the feeling of being isolated.

Clearly, mentoring can occur in many different forms. Most of these are very difficult to measure accurately. To overcome this problem, we focus on collaborative research mentoring, which we assume occurs when a junior (pre-tenure) finance academic conducts research and publishes with a senior faculty member. Therefore, we quantify potential research mentoring by examining early-career coauthorship profiles.[12] We define the "early" career of a finance academic as including years –2 to +5 relative the doctoral degree conferral date. That is, we define year "zero" for an individual as the year in which the degree was conferred to that individual. We extend back to year –2 due to pre-degree publishing: many finance academics (especially recently) publish articles, and may even assume a regular faculty position, before they are formally awarded their doctoral degree.

Public universities traditionally have initiated their tenure decisions during the early part of a faculty member's sixth year so that an unsuccessful candidate will have a seventh year of employment. Our decision to use year +5 after the doctoral degree date as a cut-off point for an individual's "early career" is consistent with this traditional pre-tenure probationary period.[13]

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[12] We count each publication (sole authored or coauthored) as being one publication in this study. We do not adjust the number of coauthored publications with *n* coauthors by dividing by *1/n* publications. This approach is consistent with Zivney and Bertin (1992) and Fishe (1998). Furthermore, Zivney and Bertin report that the distribution of "weighted" publications had the same general shape as the distribution of "unweighted" publications when examining lifetime publication patterns.

[13] Of course, most tenure decisions also include journal article "acceptances" and some even include "working papers" when making tenure decisions. Thus, our cut-off at +5 years does not necessarily reflect all research

We assume the potential for mentoring is present whenever a junior faculty member coauthors with one or more "seasoned" academics. We further assume that whether or not mentoring occurs with the publication of a given article is determined by the most "senior" coauthor on that publication. For example, if a junior faculty member coauthors an article with two colleagues, one who received his degree three years prior to the article publication date, and the other who received her degree ten years prior, then the article is classified using only the seniority level of the latter (more senior) coauthor. In addition, we discretize seniority rankings for individual coauthors into the following mutually exclusive categories: (1) dissertation chairperson or "advisor"; (2) "active mentor"; (3) "inactive mentor"; (4) "peer"; and (5) "unidentified coauthor".

Figure 1 illustrates our algorithm or diagram for classifying coauthors. Each coauthor of a given publication is classified as one of the five types listed above as follows. We first ask whether or not the coauthor is the dissertation chair of the junior academic. If so, he or she is designated as such.[14] If not, then we identify whether or not the coauthor is eligible for "mentor" status. If we have a documented dissertation date for the coauthor,[15] then that coauthor is designated as a mentor if her doctoral degree date is at least six years prior to the year of journal article publication. If no degree date is available, then the coauthor is eligible for mentor status if she has a publication at least six years earlier than this publication (indicating that the coauthor is at least moderately seasoned). Coauthors who are not designated as mentors are categorized as

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productivity considered in tenure decisions. Also, we are aware that many public universities now make the tenure decision during an individual's seventh year of employment and some private universities allow faculty ten years before their tenure decisions.

[14] In several of our empirical tests we collapse different categories of mentors into single measures. In these regressions we consider advisors to be "active mentors" regardless of their recent publication frequency.

[15] Since our constructed dissertation database contains only finance-related dissertations, coauthors who do not have doctoral degrees, or who have dissertations in, e.g., mathematics, will not have documented degree dates. However, we do believe that mentoring is still possible in these cases. Therefore, we use the number of years since the coauthor's earliest publication as a proxy for his or her seasoning.

"peers" if we have a documented dissertation date. If not, then they are categorized as "unidentified".

[Figure 1 here]

Coauthors who are designated as mentors are further classified as "active mentors" or "inactive mentors". This distinction is based on the coauthor's recent publication frequency. "Active mentors" are those coauthors who have at least 5 other publications in all 280 ELDB journals in the 7 years prior to the publication date of this journal article. "Inactive mentors" have 4 or fewer other publications. The purpose of partitioning non-advisor mentors into active and inactive categories is to attempt to determine whether publishing with research-active mentors is more beneficial than publishing with research-inactive mentors.

Each publication by a junior faculty member is categorized according to the most "senior" coauthor, as ranked by the algorithm described above. In other words, first every coauthor of a given publication is given one of the classifications listed above, and then that publication is given the designation of the most senior coauthor. For example, suppose that a junior academic publishes an article with an advisor, a peer, and an unidentified coauthor. This article would count only as one publication with an advisor (and not another publication with a peer) to avoid double-counting a single publication.

We characterize the coauthoring tendency of an individual by measuring the percentage of early-career publications (years –2 through +5) that fall into each type of coauthoring arrangement. We limit our set of individuals to those who published at least three articles in ELDB journals during those years. With this restriction, the percentage measures provide a reasonable estimate of the coauthoring tendency of each graduate.

B. Trends in Mentoring

How frequently do finance academics publish with a "mentor"? In the prior section, we noted that coauthorship patterns changed significantly during the late 1960s, so that sole-authored publications became less common. Panel A of Table II shows how frequently graduates of different decades published with a mentor. Here, "publishing with a mentor" includes publications for which the most senior coauthor is an advisor, an active mentor, or an inactive mentor. Panel A presents counts of the number of graduates who published 0, 1, or 2 or more ELDB-covered publications with a mentor during years –2 to +5 (and bounded by the end of 1994 when applicable) of their careers. For example, the panel shows that none of the graduates in the 1950s published with a mentor during the early-part of their careers. Only about 7.9 percent of graduates of the 1960s ever published with a coauthor that we would consider a mentor. By the 1970s, about 26 percent of graduates published with a mentor—this percentage increases to about 32 percent during the 1980s. Furthermore, even about 29 percent of the graduates during the first-half of the 1990s who were able to publish by the end of 1994 did so with a mentor.

[Table II here]

Panel B presents the same information as Panel A, except the sample is restricted to graduates who published "frequently" (at least three ELDB-covered articles) during the early-part of their careers (years –2 to +5).[16] Of the total graduates during the 1950-94 period who published frequently during the early-part of their careers, nearly 42 percent published at least one article during the early-part of their career. This same statistic for the graduates of the 1970s and 1980s approached nearly 50 percent. Thus, a substantial portion of doctoral graduates since the end of the 1960s have published with mentors.

C. Control Variables

Before proceeding, we note that there are many factors that likely contribute to the career publishing success of an individual. Among these factors are the innate talents of the individual, as well as the skills obtained through the individual's doctoral program (including any mentoring relationship that might have developed) and through the academic institution that first employs the individual. Since the tendency to publish with a mentor may be correlated with any or all of these factors, it is important to control for institutional effects when measuring the impact of mentoring. Thus, we control for both the quality of the individual's doctoral program and the quality of the individual's first academic affiliation.

School quality is measured using a moving average of publication productivity by each institution's faculty. Specifically, for each year, from 1960 through 1994, we calculated each institution's publications (indicated by each author's affiliation listed in the article) in the Top 4 finance journals as a proportion of the total number of articles published that year by the Top 4. Then, for example, to compute an institutional quality measure for a specific university for 1970, we average that institution's annual measures over 1960 through 1969. We then use this measure as a proxy for the quality of the doctoral degree-granting institution of each graduate in our dissertations database, and also as a proxy for the quality of the institution of first employment of each graduate.[17] To accommodate the possibility that institutional quality might have a nonlinear effect on later-career research output, we include quadratic institutional quality terms in the regressions as well as linear terms.[18]

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[16] As we explain later, we restrict our regression analyses to a subset of these "frequent" publishers.

[17] Since the first affiliation (employer) of a graduate is difficult to obtain, we use the affiliation of the graduate that is listed in the graduate's first ELDB-covered publication as a proxy for this information. Such data were hand-collected and entered into our database.

[18] Dissertation school quality also serves as a proxy for individual quality under the assumption that, on average, higher quality dissertation schools attract higher quality individuals to their doctoral programs.

D. Measures of Career Research Productivity

In this paper our goal is to determine the impact of mentoring on the career research output of finance academics. However, focusing on full-career output would result in truncation bias due to the fact that our observations of currently active careers are truncated in 1994 at varying career points (e.g., through the end of 1994, 1982 graduates will have 10 fewer years of observable career than will 1972 graduates). We therefore choose to focus on a limited "window" of each academic's career.

Prior research on the life-cycle output of the average academic (Levin and Stephan, 1991), along with research on the output of the average finance academic (Zivney and Bertin, 1992), indicates that the greatest publication output occurs around the tenure decision date, with productivity declining significantly during later years. As previously noted, faculty members traditionally have been evaluated for tenure during their sixth year at most public universities—although some private universities wait until the tenth year for making tenure decisions. In cases were tenure is granted, it also is common practice to promote assistant professors to the associate rank.[19] Furthermore, Fishe (1998) suggests that the normal gestation period for promotion to full professor is approximately 11 to 12 years. Thus, research productivity over approximately the first 10 years of a faculty member's academic career typically provides much of the basis for both the tenure and full professor decisions.

We focus on publication success during the "window" designated as years +6 through +10 after the doctoral degree conferral date as an important proxy for career research success.[20]

[19] When the tenure decision is stretched to ten years, promotion to associate professor usually occurs during the probationary period. If tenure is granted in the tenth year, promotion to full professor also may occur.

[20] We also try to explain the importance of mentoring on research output during years +8 through +14. While we lose some sample observations, this second test provides a check of the robustness of prior tests, allows us to examine a longer portion of research careers, and avoids possible serial correlation problems by employing a two-year time period gap between the dependent variable and the independent variables. Results of this alternative period will be presented at the end of the regression results section.

Using this range, we construct two measures of productivity. First, for each graduate, we count the number of articles published in all 280 ELDB-covered journals during years +6 to +10. Second, to capture the value of research quality (and not just quantity), we construct the same measure using only the "Top 4" finance journal publications (JF, JFQA, JFE, and RFS). Since our career window extends through year +10 relative to the degree date, we include only doctoral graduates through 1984. This cutoff allows a full 10-year post-doctorate window for every graduate in our sample.

Table III shows the number of graduates with finance-related dissertations that were completed during the 1970-1984 period with the numbers grouped by five-year intervals. For example, the number of graduates during the 1970-74 and 1975-79 periods corresponds with the total number of graduates during the decade of the 1970s previously reported in Table I. The number of graduates for 1980-84 represents a subset of the total number of graduates listed for the decade of the 1980s in Table I. The next column in Table III reports the number of graduates during the 1970-84 period who published at least once in the 280-journal ELDB during their careers (with a 1994 limit on publishing). This sample of 2,779 graduates was reduced to 1,911 graduates because some first affiliations based on their first publications were non-U.S. academic institutions, industry or government affiliations, or could not be identified. Thus, only graduates of the 1970-84 period who had a U.S. academic institution first affiliation were retained. The last column in Table III further restricts the sample to graduates who were "frequent publishers" (more than two articles in ELDB-covered journals) during the early-part of their careers (years –2 through +5). This sample of 799 graduates provided the basis for our regression analyses.

[Table III here]

E. Serial Correlation of Journal Publications Over Academic Careers

A familiar result documented by earlier research and present in our data is that publication success is serially correlated. For example, Chung and Cox (1990) concluded that "success breeds success" and this publication phenomenon was more common in higher quality finance journals. We used the sample of 1,911 graduates in Table III who published at least once to examine for serial correlation in publishing both in terms of quantity and quality publication measures. Based on publication frequencies in the 280 ELDB-covered journals, a simple regression of publications in years +6 to +10 (relative to the dissertation year) on publications in years –2 to +5 resulted in a regression coefficient of .58. Rerunning the simple regression using Top 4 finance journal publications resulted in a coefficient of .09. By way of interpretation, other things being equal, an additional early-career publication in one of the 280 journals relates to an increase of about one-half a publication six to ten years after dissertation, of which about one-tenth of a publication is expected to appear in a Top 4 journal. Both coefficients are statistically significant at the .0001 level.

F. Regression Model Specifications

We consider a statistical environment in which early career publications (and other variables) correlate to an unobservable variable, researcher quality, which, in turn, correlates to later career publication frequency and quality. Since the number of publications during a given sub-period of a career (e.g., years +6 through +10) is a discrete, but ordered, variable, we estimate our regressions using an ordered-probit model. Such models are discussed in Maddala (1983) and Campbell, Lo, and MacKinlay (1997) and are used (for example) in Hausman, Lo, and MacKinlay (1992).

Ordered probit requires specification of the boundary values for the partition of the dependent variable into groups of discrete values. The dependent variable is either the number

of ELDB publications during years +6 to +10, or the number of Top 4 publications during those years. Following Campbell, Lo, and MacKinlay (1997), we use the empirical frequency distribution of our database of career publications to choose boundary values. We chose the following values for the "cells" that comprised the state-space of the dependent variable: 0, 1, 2, 3-4, 5-6, 7-9, and 10 or more. These values were chosen to maximize the dispersion of the dependent variable, while also avoiding very small numbers of individuals in any given cell. For our tests using only career Top 4 finance journal publications, our cells are: 0, 1, 2, 3, 4, and 5 or more.

III. REGRESSION RESULTS

A. Baseline Regressions to Explain Publication Productivity in Years +6 Through +10

Our baseline regressions are presented in Table IV. Our first cross-sectional test (A1) regresses the number of publications during years +6 through +10 of an individual's career on the percent of early career publications (years –2 through +5, inclusive) coauthored with any type of mentor (an advisor, an inactive mentor, or an active mentor), *PCMALL*; with a peer coauthor, *PCPEER*; and with a coauthor that could not be identified as belonging to either the mentor or peer category (due to missing data), *PCUNID*. The only coauthor category not explicitly represented by an explanatory variable is the percent of sole-authored publications during the early career years; thus, one should interpret the coefficients of the other coauthoring categories relative to a sole-authoring strategy. Also included as explanatory variables are the quality measure of the doctoral program attended by an individual, *DISQUAL*, and the quality measure of the first employer of the individual, *FAFFQUAL*, along with the square of these variables, *DISQSQ* and *FAFFQSQ*, respectively. Below each coefficient estimate is the estimated p-value.

[Table IV here]

Regression A1 indicates no significant effect of mentoring on later careers, as shown by the insignificant coefficient for *PCMALL*. Indeed, only the quality of the first employer (FAFFQUAL and FAFFQSQ) explains later career publishing success, in a somewhat non-linear fashion. We could interpret this result as meaning that high-quality schools either hire graduates with the best innate talents or that these schools provide the environment and/or motivation for junior faculty to succeed, and that nothing else seems to matter. Interestingly, the doctoral program quality (DISQUAL and DISQSQ) also does not seem to matter. This likely means that the variable that measures the quality of the first employer (FAFFQUAL) provides an adequate proxy for any quality factors (either innate or gained during doctoral training) that otherwise might be captured by the doctoral program quality variable.

Regression A2 adds squared terms to the percentage measures of mentoring. *PCMALLSQ*, *PCUNIDSQ*, and *PCPEERSQ*, respectively, are the squares of *PCMALL*, *PCUNID*, and *PCPEER*. A comparison of regressions A1 and A2 of Table IV indicates that the insignificant coefficient on a linear-only mentoring effect (*PCMALL*) really masks significant linear and quadratic components (*PCMALL* and *PCMALLSQ*). Here we see our first evidence that mentoring has an impact on later-career research success: the positive and significant coefficient on *PCMALL* indicates that coauthoring with a mentor appears to significantly increase later-career publishing output. However, the return to such a coauthoring strategy is decreasing, as indicated by the negative and significant coefficient on *PCMALLSQ*. Adding squared terms for other variables, in general, does not change their explanatory power; however, coauthoring with peers (*PCPEER*) provides a marginally significant benefit over sole-authoring articles.

In order to provide sharper tests of the type of mentoring that has an impact, Model B1 separates the percentage of early career articles published with any type of mentor (*PCMALL*) into two categories: (1) the percent published with an advisor or with an active mentor (*PCMADVR*), and (2) the percent published with an inactive mentor (*PCMIA*). This regression indicates that coauthoring with an advisor or active mentor provides a later-career benefit (with a decreasing return), but that coauthoring with an inactive mentor has no significant effect on later-career productivity.

Regressions C1 and C2 explore this issue further by separating articles published during years –2 through +5 into those published with an advisor (*PCADVR*), with an active mentor (*PCMA*), and with an inactive mentor (*PCMIA*). Regression C1 uses the number of publications in all ELDB-covered journals during years +6 through +10 as the dependent variable, while regression C2 instead uses the number of Top 4 finance journal publications during the same time period (the independent variables are identical for the two regressions). The results (in both C1 and C2) indicate that coauthoring with an advisor or an inactive mentor provides no benefit (and no penalty) for the future careers of junior faculty members. Only coauthoring with an active mentor provides significant benefits, although these benefits are decreasing as the level of coauthoring with an active mentor increases (see *PCMASQ*). Also, regression C2, while exhibiting other results similar to those of regression C1, also indicates that early coauthoring with a peer (*PCPEER*) provides substantial benefits for later-career output of top finance journal publications. One interpretation is that, as the profession has become more technical in nature, the establishment of research collaborations has become important for publishing in the best journals. In addition, given the difficulty of publishing in top finance journals, junior faculty might be best off in leveraging their talents by coauthoring with others (at the same level) to

increase their publication counts.

Another piece of evidence worthy of note is that the impact of early career publishing with a mentor increases as we separate out types of mentoring arrangements that do not seem to matter. That is, the active-mentoring coefficient in regression C1 (*PCMA*, which equals 1.66), is more than twice the "all mentors" coefficient in regression A2 (*PCMALL*, which is 0.67).

In summary, the regressions of Table IV indicate that mentoring does have a significant and positive effect (relative to sole-authoring) on the later-career success of finance academics. However, this positive impact is limited to certain types of mentoring arrangements—junior faculty should, it appears, seek out a mentoring relationship only with senior coauthors still active in the field. In addition, our results indicate that establishing successful peer-authoring relationships early in one's career improves the odds of publishing articles in the Top 4 finance journals later in one's career.

B. Interaction Effects

One might reasonably wonder whether coauthoring with a mentor has the same effect for scholars beginning their careers at institutions of differing quality. For example, since schools sort graduates on quality at the time they enter the market, we might believe that high-quality graduates (generally at high-quality institutions) are well-trained and capable of building a research record without the help of a more-seasoned coauthor. Along the same lines, perhaps lower quality graduates do benefit from mentoring relationships during their early years. An alternative possibility is that high-quality graduates are more likely to attract high-quality mentors (and more likely to have high-quality mentors available), which would show up as a significant impact of mentoring only for graduates beginning their careers at high-quality schools.

Table V explores these issues by separating the dependent variable into three partitions:

graduates beginning their careers at a top 20 school (regression D1), at a school ranked between 21 and 50 (regression D2), and at a school ranked worse than 50 (regression D3). As mentioned previously, schools are ranked, each year, based on their output of Top 4 finance journal publications during the prior ten years. The results indicate a more complex influence of mentoring than we expected: coauthoring with an active mentor provides a significant benefit for new faculty at top-tier and at third-tier schools, while coauthoring with a peer provides the only observable benefit for new faculty at second-tier schools. Interestingly, new faculty at top-tier schools actually suffer a penalty for coauthoring with inactive mentors (*PCMIA*), as shown by the negative coefficient in regression D1—apparently, such arrangements are costly in terms of a new faculty member's time. All three regressions (D1-D3) indicate that coauthoring with one's advisor or with an inactive mentor, by itself, provides no benefit to published research productivity during the +6 through +10 years of a graduate's published research productivity.

[Table V here]

Regressions D4 through D6 repeat the regressions of D1 through D3, but substitute the later-career output of Top 4 finance journal publications for the dependent variable (only). Here, the results show a bigger role for coauthoring with a peer—in all three quality tiers, the establishment of coauthoring relationships with peers proves important for later-career Top 4 output. In addition, there is some evidence that the quality of the first employer matters in Top 4 output, even within the quality subcategories. This is evident from the positive and significant coefficients for *FAFFQUAL* in regressions D4 and D6. Thus, it appears that whatever the first employer quality ranking proxies for is very important for top finance journal output—even small differences in rankings within the quality tiers appear to matter.

C. Regressions to Explain Research Productivity in Years +8 Through +14

Thus far, our dependent variable, research output during years +6 through +10 relative to

the graduation date, may be interpreted as the output around the tenure decision of an individual. But, is mentoring beneficial to even longer-term career research output? Our next tests address this issue by using the published research output of each individual during years +8 through +14 relative to the individual's graduation date as the dependent variable. In part, we use this alternative specification to check the robustness of our prior tests, which use a window of years +6 through +10: a longer window allows a more accurate gauge of the career productivity of an individual. Of course, by lengthening the portion of the academic careers that we are examining, we lose sample size due to the 1994 truncation date. For example, by extending the portion of careers being analyzed from +10 years to +14 years, we lose graduates from 1981 through 1984 which results in a sample reduction from 799 to 573 graduates.

The two-year gap between the dependent variable (research output in years +8 to +14) and the independent variables (coauthoring tendencies during years –2 through +5) addresses another potential issue. The gap reduces any potential for a spurious correlation between the dependent and independent variables—for example, perhaps individuals that coauthor with mentors early in their careers have high publication counts until they break the mentoring relationship later on. Such high publication counts would likely take some time to completely show up in published articles, given the long lags between the beginning and culmination (i.e., publication) of a project.[21]

Table VI repeats the tests of tables IV and V using this new dependent variable. The results, in general, are consistent with our prior results. First, the quality of the first employer of a new graduate (*FAFFQUAL*) wields significant explanatory influence on future research output,

[21] We note, however, that there is a survivorship issue with this longer dependent variable window, as those individuals who have very unsuccessful careers generally would terminate publishing sometime around years eight through ten. Thus, we might believe that our regression coefficients would overstate the impact of mentoring on later-career productivity, if there is a positive impact.

while the quality of the dissertation program (*DISQUAL*) does not (see, for example, regressions A1', A2', and B1'). This indicates that the first-employer quality variable captures quality that is either innate or is due to training at the doctoral program. In addition, coauthoring with an active mentor (*PCMA*) provides a benefit for later-career output, while other types of mentoring arrangements (e.g., coauthoring with an inactive mentor, *PCMIA*) do not. Coauthoring with an inactive mentor provides a substantial penalty for later-career output in top-quality journals among faculty starting their careers at top-quality institutions (see regressions C2' and D4'), while coauthoring with peers provides a significant later-career benefit especially for publishing in top-quality journals (see regressions C1' and C2'). Finally, we find some evidence that coauthoring with one's advisor might be beneficial, for graduates starting their careers at all but the top-quality institutions (see regressions D5' and D6').

[Table VI here]

IV. CONCLUSIONS

This paper investigates patterns of coauthorship during the early years (i.e., years –2 through +5 relative to the dissertation completion date) of graduates who completed finance-related dissertation and who received their degrees between 1970 and 1984 (inclusive). We examined the 799 graduates of this time period that had at least three publications in ELDB-covered journals during years –2 through +5 portion of their careers to determine whether certain coauthorship arrangements during those years lead to higher research output during later years (i.e., years +6 through +10 and years +8 through +14).

We first show that junior faculty members in finance regularly publish with senior colleagues, as roughly 50 percent of those who published frequently early in their careers published one or more articles with a mentor. Our empirical tests indicate that such coauthoring

arrangements can be beneficial to the new faculty member, depending on the type of mentor with whom the new graduate coauthors. Specifically, after controlling for the quality of the new finance faculty member, as well as for the quality of his or her doctoral program and first employer, our results indicate that early career coauthoring with a mentor who is still "research active" provides significantly increased later-career research output for a faculty member. In contrast, coauthoring with "research-inactive" mentors, at best, provides no benefit, and, at worst, might even inhibit later-career research output. Finally, junior faculty who establish coauthoring arrangements with their peers have significantly higher career output (relative to sole-authors) in the highest-quality finance journals.

Our results, while providing guidance for finance academics and their hiring institutions, indicate that coauthorship patterns (and their impact on later-career success) are often complex and provide different benefits to different individuals. A further area for study would be to determine whether different early career coauthoring experiences might lead to a higher career research *impact*, rather than simply a higher career *output*.

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Table I

Number of Graduates with Finance-Related Dissertations and the Extent to which They have Published—1950-1994

The number of graduates with finance-related dissertations are indicated by decade. "Number Published in ELDB" is the number of graduates who published at least once during their careers in the Heck *Economic Literature Database* (1995 edition covering 280 journals). "Number Published in Top 4" is the number of graduates who published at least once during their careers in at least one of four top finance journals [*Journal of Finance (JF)*, *Journal of financial and Quantitative Analysis (JFQA)*, *Journal of Financial Economics (JFE)*, and *Review of Financial Studies (RFS*)].

Decade	Number of Graduates	Number Published in ELDB	Percent Published in ELDB	Number Published in Top 4	Percent Published In Top 4
1950s	687	248	36.1	68	9.9
1960s	1,961	903	46.0	263	13.4
1970s	4,011	1,877	46.8	500	12.5
1980s	4,437	2,032	45.8	515	11.6
1990-1994	4,028	785	19.5	112	2.8
1950s-80s	11,096	5,060	45.6	1,346	12.1
Total:	**15,124**	**5,845**	**38.6**	**1,458**	**9.6**

Table II

Frequency of Graduates with Finance-Related Dissertations who Published with a Mentor during the Early-Part (Years –2 through +5) of Their Careers

This table presents statistics on the frequency with which graduates with finance-related dissertations published articles in the 280 ELDB-covered journals during years –2 to +5 (relative to their degree completion year) with a person deemed to be a "mentor." The procedures used to identify mentors are described in Figure 1. The final three columns in each panel show the fraction of the graduates during that decade who published (through the end of 1994) the number of articles indicated with mentors. Each graduate is represented in only one of these three cells.

Panel A: Distribution of publication frequency with a mentor among graduates who published at least once in their careers

Decade	Number of Graduates	Distribution of Publication Frequency 0	1	2+
1950s	248	100.0%	0.0%	0.0%
1960s	903	92.1	6.0	1.9
1970s	1,877	73.7	16.6	9.7
1980s	2,032	67.8	17.9	14.3
1990-1994	785	71.2	22.2	6.6
Total:	**5,845**	**75.3**	**15.4**	**9.3**

Panel B: Distribution of publication frequency with a mentor among graduates who published at least 3 ELDB articles during years –2 to +5 of their careers

Decade	Number of Graduates	Distribution of Publication Frequency 0	1	2+
1950s	62	100.0%	0.0%	0.0%
1960s	260	83.9	10.6	5.5
1970s	337	52.4	23.5	24.1
1980s	402	49.5	19.8	30.7
1990-1994	91	59.9	19.1	21.0
Total:	**1,152**	**58.2**	**18.9**	**22.9**

Table III

Number of Graduates with Finance-Related Dissertations Completed during the 1970-1984 Period and Grouped by Five-Year Intervals

"Number of Graduates" corresponds with the data in Table I but are reported for three five-year intervals for graduates completing dissertations during the 1970-84 period. "Number Published in ELDB" reports the number of graduates who published at least once during their careers in the 280-journals covered in the ELDB. "Graduates with U.S. Academic First Affiliation" reports the number of graduates who published at least once in the list of ELDB-covered journals and who were affiliated with a U.S. academic institution at the time of their first ELDB-covered journal publication. The last column reports the number of graduates with a U.S. academic institution affiliation on their first ELDB-covered journal publication who also published more than two journal articles in ELDB-covered journals during years –2 through +5 (relative to their dissertation date) of their careers.

Degree Period	**Number of Graduates**	**Number Published In ELDB**	**Graduates with U.S. Academic First Affiliation**	**> 2 Publications in Years –2 to+5 in ELDB**
1970-1974	2,098	960	665	259
1975-1979	1,913	917	609	249
1980-1984	1,914	902	637	291
Total:	**5,925**	**2,779**	**1,911**	**799**

Table IV

Regressions of Determinants of Later-Career (Years + 6 Through +10) Published Research Productivity

This table presents ordered-probit regressions where the dependent variable is the number of journal articles published in years +6 through +10 of a graduate's career. We attempt to explain this later-career productivity using the degree (percentage) of early-career (years –2 through +5) publications attributable to various types of coauthoring: PCMALL (mentor coauthor); PCPEER (peer coauthor); and PCUNID (unidentified coauthor). The percent of sole-authored publications is the omitted variable. The mentors classification also is subdivided into advisor (PCADVR), active mentor (PCMA), and inactive mentor (PCMIA). Control variables include: quality of the graduate's doctoral program (DISQUAL) and quality of the graduate's first academic affiliation as proxied by the affiliation listed on a graduate's first publication (FAFFQUAL).

Regr #	Observations	Dep. Var.	Intercept	PCADVR	PCMA	PCMIA	PCADVRSQ	PCMASQ	PCMALL	PCMALLSQ	PCUNID	PCUNIDSQ	PCPEER	PCPEERSQ	DISQUAL	DISQSQ	FAFFQUAL
A1	799	Pubs 6-10	1.0131 (0.00)						0.0376 (0.79)		-0.0523 (0.75)		0.1561 (0.42)		0.0290 (0.71)	-0.0114 (0.43)	0.3397 (0.00)
A2	799	Pubs 6-10	0.9813 (0.00)						0.6713 (0.08)	-0.8686 (0.07)	0.3514 (0.39)	-0.6434 (0.23)	0.7778 (0.10)	-0.9934 (0.13)	0.0184 (0.81)	-0.0103 (0.48)	0.3149 (0.00)
B1	799	Pubs 6-10	0.9956 (0.00)		1.1024 (0.01)	-0.1901 (0.45)		-1.4498 (0.01)			0.3848 (0.34)	-0.6641 (0.21)	0.6935 (0.14)	-0.9016 (0.17)	0.0176 (0.82)	-0.0095 (0.51)	0.2984 (0.00)
C1	799	Pubs 6-10	1.0064 (0.00)	0.0756 (0.92)	1.6589 (0.00)	-0.2046 (0.41)	-0.0873 (0.93)	-2.3746 (0.00)			0.0375 (0.35)	-0.6512 (0.22)	0.6266 (0.19)	-0.8211 (0.21)	0.0123 (0.87)	-0.0087 (0.55)	0.2939 (0.00)
C2	799	Top 4 6-10	-1.44568 (0.00)	1.1616 (0.17)	2.0711 (0.00)	-0.3359 (0.33)	-0.6191 (0.61)	-1.8967 (0.02)			0.2055 (0.70)	-0.2640 (0.72)	2.4903 (0.00)	-2.2432 (0.00)	0.0489 (0.62)	-0.0003 (0.99)	0.6480 (0.00)

Table V

Regressions of Determinants of Research Productivity During Years +6 Through +10 Segregated by Quality of Academic Institution of First Affiliation of Graduates

This table presents ordered-probit regressions where the dependent variable is the number of journal articles published in years +6 through +10 of a graduate's career segregated by quality of the graduate's first academic employer as proxied by the graduate's affiliation listed on his/her first publication in an ELDB-covered journal. Academic institutions are classified and ranked in terms of quality as described in the text. Academic institutions are then segregated by category: the top 20 institutions; institutions ranked 21 through 50; and 51 and below.

Regr #	Observations (School Rank)	Dep. Var.	Intercept	PCADVR	PCMA	PCMIA	PCADVRSQ	PCMASQ	PCUNID	PCUNIDSQ	PCPEER	PCPEERSQ	DISQUAL	DISQSQ
D1	260	Pubs	1.7525	0.4090	2.0261	-0.9134	-0.4693	-3.1691	0.4633	-1.7679	0.5189	-0.4741	0.0546	-0.0252
	(Top 20)	6-10	(0.00)	(0.82)	(0.01)	(0.08)	(0.87)	(0.00)	(0.57)	(0.16)	(0.59)	(0.77)	(0.73)	(0.37)
D2	187	Pubs	0.5114	-1.5202	-0.2235	-0.8835	2.9700	0.6575	1.8263	-2.3877	1.6110	-2.2211	0.2726	0.0622
	(21-50)	6-10	(0.60)	(0.37)	(0.84)	(0.17)	(0.34)	(0.74)	(0.03)	(0.02)	(0.09)	(0.09)	(0.14)	(0.09)
D3	352	Pubs	0.8547	0.9902	2.1309	0.2392	-1.2743	-2.6278	-0.0580	0.2761	-0.0692	0.2507	-0.1064	0.0198
	(51+)	6-10	(0.00)	(0.32)	(0.01)	(0.46)	(0.34)	(0.01)	(0.92)	(0.72)	(0.92)	(0.79)	(0.34)	(0.35)
D4	260	Top 4	-1.5560	0.9189	3.1245	0.2622	0.3332	-2.9554	0.2980	-0.8638	2.8957	-2.5724	-0.0198	0.0012
	(Top 20)	6-10	(0.01)	(0.65)	(0.00)	(0.66)	(0.91)	(0.01)	(0.75)	(0.57)	(0.01)	(0.14)	(0.91)	(0.97)
D5	187	Top 4	-0.6890	5.2150	0.8056	-1.7865	-8.8775	-0.4396	0.4513	-0.3685	1.9825	-1.2680	0.2550	-0.0414
	(21-50)	6-10	(0.54)	(0.01)	(0.54)	(0.08)	(0.03)	(0.84)	(0.66)	(0.78)	(0.07)	(0.37)	(0.25)	(0.33)
D6	352	Top 4	-1.7321	-0.0594	1.1294	0.0717	0.7364	-0.8100	0.4571	-0.3768	1.9091	-1.9574	0.0774	0.0053
	(51+)	6-10	(0.00)	(0.97)	(0.27)	(0.88)	(0.67)	(0.47)	(0.61)	(0.75)	(0.07)	(0.17)	(0.62)	(0.85)

Table VI

Regressions of Determinants of Published Research Productivity During Years +8 Through +14

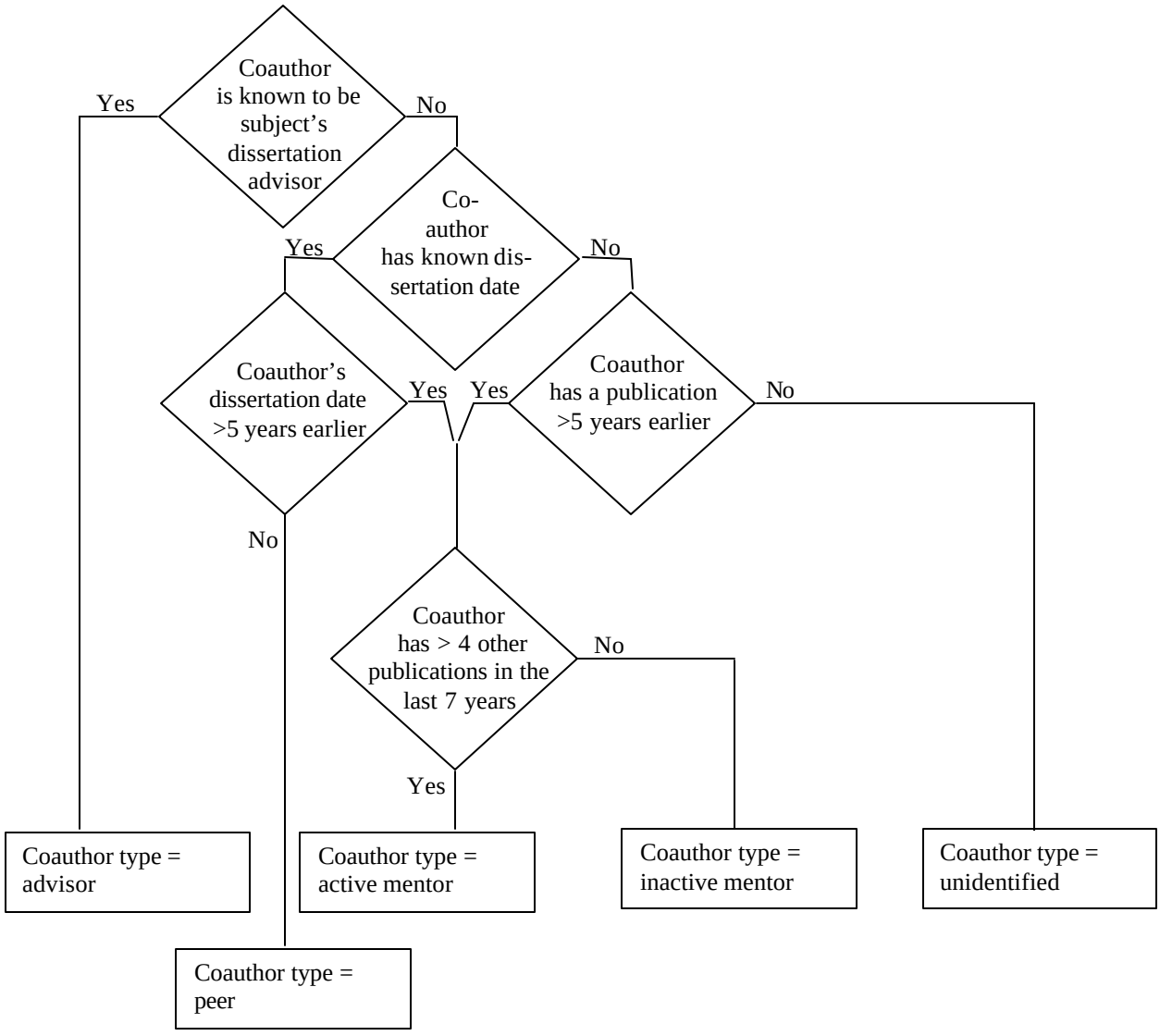
This table presents ordered-probit regressions where the dependent variable is the number of journal articles published in years +8 through +14 of a graduate's career. We attempt to explain this later-career productivity using the degree (percentage) of early-career (years –2 through +5) publications attributable to various types of coauthoring. See Table IV for descriptions of the explanatory variables.

Regr #	Observations (School Rank)	Dep. Var.	Intercept	PCADVR	PCMA	PCMALL	PCMIA	PCADVRSQ	PCMASQ	PCMALLSQ	PCUNID	PCUNIDSQ	PCPEER	PCPEERSQ
A1'	573	Pubs 8-14	0.8396 (0.00)			-0.1701 (0.34)					-0.2592 (0.19)		0.2364 (0.27)	
A2'	573	Pubs 8-14	0.7968 (0.00)			1.2113 (0.01)				-1.9157 (0.00)	-0.2898 (0.55)	-0.0536 (0.93)	1.4444 (0.01)	-1.8427 (0.01)
B1'	573	Pubs 8-14	-0.8093 (0.00)		1.6638 (0.00)		-0.1963 (0.54)			-2.6624 (0.00)	-0.2080 (0.67)	-0.1034 (0.87)	1.3551 (0.01)	-1.7414 (0.02)
C1'	573	Pubs 8-14	0.8365 (0.00)	-1.0344 (0.24)	2.5011 (0.00)		-0.2044 (0.53)	0.9321 (0.44)	-4.0250 (0.00)		-0.2100 (0.67)	-0.1182 (0.85)	1.3217 (0.02)	-1.7220 (0.02)
C2'	573	Top 4 8-14	-1.4709 (0.00)	2.3290 (0.03)	3.5505 (0.00)		-1.2535 (0.03)	-1.6471 (0.28)	-3.7245 (0.00)		0.0286 (0.97)	0.1566 (0.86)	2.3942 (0.00)	-2.0283 (0.03)
D1'	191 (Top 20)	Pubs 8-14	1.8115 (0.01)	-1.3714 (0.60)	3.5346 (0.00)		-0.7231 (0.25)	2.3190 (0.53)	-6.1308 (0.00)		-0.9756 (0.29)	0.3809 (0.77)	0.4522 (0.69)	0.1452 (0.94)
D2'	138 (21-50)	Pubs 8-14	0.2215 (0.84)	-0.1500 (0.96)	1.4290 (0.36)		-0.8520 (0.23)	-0.0309 (1.00)	-2.5510 (0.39)		1.9076 (0.06)	-2.3701 (0.05)	1.9228 (0.09)	-2.6517 (0.08)
D3'	244 (50+)	Pubs 8-14	0.7215 (0.00)	-0.7886 (0.53)	2.7565 (0.00)		0.3823 (0.40)	0.2722 (0.86)	-3.5962 (0.00)		-0.6986 (0.35)	0.6673 (0.48)	0.8595 (0.31)	-1.0663 (0.31)
D4'	191 (Top 20)	Top 4 8-14	-1.2493 (0.12)	1.0005 (0.73)	5.2768 (0.00)		-4.0415 (0.01)	1.1739 (0.77)	-6.3143 (0.00)		0.3715 (0.74)	-0.3486 (0.84)	1.8469 (0.16)	-0.5323 (0.79)
D5'	138 (21-50)	Top 4 8-14	-1.7371 (0.18)	5.6881 (0.09)	2.7296 (0.15)		-1.7241 (0.12)	-9.6404 (0.23)	-4.5318 (0.23)		1.0597 (0.41)	-1.0948 (0.50)	3.1443 (0.02)	-3.4146 (0.06)
D6'	244 (50+)	Top 4 8-14	-1.6478 (0.00)	3.0286 (0.07)	3.4696 (0.01)		-0.1288 (0.87)	-2.7950 (0.20)	-2.7521 (0.07)		-1.2051 (0.30)	1.5934 (0.28)	1.8192 (0.14)	-1.3054 (0.40)

Figure 1

Coauthorship Classification Process Diagram

Step 1: Classify each coauthor using the following algorithm.



Step 2: Publication is classified by most "senior" type from the senior to junior ordering of {advisor, active mentor, inactive mentor, peer, unidentified} .