What a Difference a Ph.D. Makes: More than Three Little Letters*

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ABSTRACT

Several hundred individuals who hold a Ph.D. in economics, finance, or others fields work for institutional money management companies. The gross performance of domestic equity investment products managed by individuals with a Ph.D. (Ph.D. products) is superior to the performance of non-Ph.D. products matched by objective, size, and past performance for one-year returns, Sharpe Ratios, alphas, information ratios, and the manipulation-proof measure MPPM. Fees for Ph.D. products are lower than those for non-Ph.D. products. Investment flows to Ph.D. products substantially exceed the flows to the matched non-Ph.D. products. Ph.D.s' publications in leading economics and finance journals further enhance the performance gap.

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The capability to identify money managers who will be successful is important in both academic and practical settings. A natural question in this context is whether possession of a Ph.D. degree is a positive signal of managerial skill in the domain of institutional money management. We start from the premise that substantial effort and knowledge acquisition is necessary to complete the advanced coursework and execute unique research required to obtain a Ph.D. degree. Thus, individuals holding these degrees will have unusual characteristics relative to the baseline population. We extend this logic to the production of papers published in leading economics and finance journals, as substantial academic publications could play an additional role beyond the mere possession of a Ph.D. degree.

Completion of a Ph.D. program may serve as a screening device for individuals with innate ability as in Spence (1973). Moreover, specialized human capital developed during a Ph.D. program might be particularly useful for various tasks related to money management as in Becker (1964, 1993). On the other hand, it is also possible that Ph.D. degrees are largely useless outside an academic environment. In spite of the latter possibility, hundreds of individuals holding this advanced degree are employed by institutional money management companies. In this paper, we investigate whether this employment pattern stems merely from a random distribution of advanced degrees amongst money managers, or whether its explanation is rooted in some form of selection.

The prevalent organizational form in the institutional money management industry is for a firm to offer multiple investment products covering a range of

investment objectives. Each product encompasses a collection of one or more separately managed client accounts.[1] Typical clients who invest through these products include corporate retirement plans, government retirement plans, insurance companies, high net-worth individuals, endowments, foundations, and unions. Accounts are large (particularly in comparison with those in the mutual-fund industry); the average account size in the period from 1993 to 2007 is 29 million dollars.[2]

Institutional asset management firms are important players in the arena of financial intermediation.[3] The sheer amount of money they manage and the sophistication of their clients suggest that the 1,200 firms in this industry operate in a competitive environment. Together with the size and importance of this industry, the availability of biographical data for more than 21,000 individuals working in this industry, several hundred of whom hold Ph.D. degrees, imply that the institutional money management industry is an excellent setting for the study of the relation between performance and demonstrated academic acumen. In our tests, we focus on domestic equity products because the empirical literature has developed a set of well-established investment benchmarks (e.g., Carhart (1997)). Moreover, domestic equity products are a very large segment of the institutional money management industry, encompassing more than one-half of assets under institutional money management.

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[1] In some instances, often to accommodate smaller clients, multiple clients' assets may be commingled into portfolios to enable better diversification and to lower transaction and management costs.

[2] Authors' calculations based on the information contained in the dataset (see Section I for details).

[3] The volume of assets under management, comparable to that of the mutual fund industry, is in the range of several trillion dollars. According to Standard & Poor's (2007), at the end of 2006, more than 51,000 plan sponsors allocated more than seven trillion dollars in assets to about 1,200 institutional money managers.

We find that the gross performance[4] of domestic equity products managed by a Ph.D. (interchangeably called Ph.D. products) is better than the performance of non-Ph.D. products. In the context of this paper, a product is regarded to be managed by a Ph.D. if a key role in the firm is performed by a Ph.D.[5] To control for several product-specific differences, our analysis matches Ph.D. products to non-Ph.D. products by investment objective, product size, and previous performance, and then investigates subsequent performance differential according to several performance measures. We find statistically significant and economically meaningful differences in objective- and size-adjusted annual returns (42.7 basis points per year), one-year monthly Sharpe ratios (Sharpe (1966)) (0.847 percent), one-year monthly 4-factor alphas (Carhart (1997)) (3.31 basis points per month), one-year monthly information ratios (Treynor and Black (1973)) (4.76 percent), and one-year monthly manipulation-free Goetzmann, Ingersoll, Spiegel, and Welch (2007) measure MPPM (rho = 3) (0.516 percent per year).

It is conceivable that this superior performance in terms of gross returns could disappear (or even reverse) once fees are taken into account. To the contrary, if anything, Ph.D. products are associated with significantly lower fees compared to non-Ph.D. products. The economic magnitude of the difference in the baseline specification is approximately four basis points per year. Thus, the performance gap between Ph.D.

[4] Gross performance is investment performance reported net of transactions costs, but before the deduction of investment management fees (covering charges for managerial compensation and investment expenses).

[5] As discussed in detail in Section I, following the classification from Nelson's Directory of Investment Managers, we define key roles as those of Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research.

products and non-Ph.D. products is preserved, and even ever so slightly enhanced, after fees (that is, in terms of net returns).

Perhaps nothing is more important from the perspective of an institutional money management company than the ability to attract money. After following the matching procedure using investment objective, product size, and past performance, it is quite remarkable that the average flow into Ph.D. products is 18.2 percent higher than the average flow into matched non-Ph.D. products (this differential is statistically significant at the one-percent level). This gap is not uniformly distributed across quintiles of past performance. It is as large as 40.4 percent for top-quintile performers, 18.6 percent for second highest performance quintile, 17 percent for the middle quintile, 10.3 percent for second lowest (all statistically significant at the 1% level), and only 4.3 percent (not statistically significant) for the bottom quintile.

We recognize that the link between the decision to hire Ph.D.s and product performance may be endogenous. For instance, better firms may choose to hire Ph.D.s as an advertising tool to attract more money. Alternatively, Ph.D.s may be better able than non-Ph.D.s to determine which firms will do well in the future and, accordingly, favor superior firms in the process of selecting an employer. In both of these scenarios, Ph.D.s might not provide any incremental contribution to product performance once hired, yet the performance differential results would follow. We address the potential for such an endogenous relation by turning to the performance analysis of firms founded by Ph.D.s. We find performance gaps between products managed by firms founded by Ph.D.s and those managed by firms without Ph.D.s in key roles (non-Ph.D.

firms) comparable in magnitude to those obtained from the full sample, thus presenting strong evidence that the baseline performance differentials calculated for the full sample do not stem (only) from Ph.D.s somehow matching to good firms; rather, Ph.D.s do contribute toward generating strong performance.

Finally, some of the Ph.D. managers in our sample have entered the money management industry early in their careers. Others have begun academic careers and switched to money management soon thereafter. Still others have had distinguished academic careers before they entered into money management. Accordingly, the Ph.D. managers in our samples have varying publication records in top outlets in economics and finance. The immediate question is whether the demonstrated success in generating and placing research in premier academic journals translates into investor acumen for institutional money management. In our final analyses, we answer this question affirmatively by showing that Ph.D. product performance is positively related to the manager's publication record in leading journals in economics and finance.

The existing literature has explored some aspects of the link between managerial talent and both ability and education in the context of money management. For instance, Chevalier and Ellison (1999) find that mutual fund performance is related to certain educational characteristics of mutual fund managers. In particular, mutual fund managers graduating from undergraduate institutions with higher average SAT scores achieve higher raw fund returns. Similarly, Chevalier and Ellison (1999) also find that raw fund returns achieved by managers with an MBA outperform those without an MBA by 63 basis points per year. However, upon adjustments for risk, only the

differential in risk-adjusted performance between the managers graduating from undergraduate institutions with higher average SAT scores and those graduating from undergraduate institutions with lower average SAT scores persists, whereas the risk-adjusted performance differential between funds managed by MBAs and non-MBAs disappears.

Our study takes matters considerably farther by exploring the information relevant for institutional money management potentially embedded in the possession of the highest degree attainable, a Ph.D. The hurdle for this degree is usually much higher than the hurdle for professional degrees in finance and other related fields. Moreover, the distribution of academic acumen present in our sample stretches far beyond an indicator variable of attaining a Ph.D. by virtue of our study of publication records, offering an insight into the extent to which a wide range of proven academic ability at the very highest percentiles of achievement translates into successful institutional money management.[6]

The remainder of the paper is organized as follows. Section I describes the data sources and presents summary statistics. Section II uses a matching procedure to analyze the performance and fees of Ph.D. products compared to non-Ph.D. products.

[6] The results presented in this paper show that, relative to their non-Ph.D. counterparts, Ph.D.s performing key roles in money management firms generate superior returns and attract more investment flows. Intimately related with these findings are matters explored by the literature analyzing the link between contributions employees make and their compensation, be it specifically in the finance industry (e.g., Phillipon and Reshev, 2012), or for executives more generally (please see Murphy, 2012, for a recent, very thorough survey of the voluminous and developed literature concerning executive compensation). Unfortunately, we are not in a position to contribute to that literature because the data set contains no information concerning compensation.

Section III explores the extent to which Ph.D. products attract more money than non-Ph.D. products do, even after controlling for observed performance. Section IV addresses various alternative explanations based on the possibility that Ph.D.s may be more readily hired to perform key roles in firms with characteristics that will eventually generate better performance (and Ph.D.s themselves need not have outstanding investment skill). In Section V, we investigate the relation between performance of products managed by Ph.D.s and their records of leading publications in economics and finance. Section VI reports results for several alternative specifications. Section VII concludes.

I. Data Sources and Sample Overview

We compile data from several sources. The key data are 59 quarterly releases of self-reported institutional money management data for the period from June 1993 to December 2007, obtained from leading data vendors: first from the Mobius Group and, from September 2006 onward, from Informa Investment Solutions (IIS) PSN Data Select.[7] By its very nature, the data set is not affected by survivorship bias. Both data sources have been, and IIS PSN continues to be,[8] used by most large pension fund sponsors and endowment funds to identify money managers, study their track records,

[7] Upon subsuming the Mobius Group and the subsequent expiration of one-year agreements with Mobius clients, Informa Investment Solutions began applying its own pricing model (data extractions charged by variable), making continued subscription to the data more challenging and prohibitively costly. Ultimately, December 2007 was the last installment IIS was willing to provide under the earlier pricing scheme.

[8] Recent extant literature on institutional money managers uses either the same data source (Informa Investment Solutions; Bussee, Goyal, and Wahal (2010)) or a comparable data source from another vendor (Mercer's Manager Performance Analytics; Goyal and Wahal (2008)).

and consider a range of other variables relevant for the investment decision-making process. Also, IIS data have been used in extant academic research concerning institutional investment management (e.g., Busse, Goyal, and Wahal, 2010). Aside from monthly product returns (reported net of trading costs, but gross of investment management fees), the data contain a range of firm and product characteristics, including quarterly reports of products' firm affiliation and investment style, firm personnel biographies, and annual reports of assets under managements.

The biographies include personnel names, titles, and degrees. Out of 21,313 distinct individuals listed overall, we focus on the 531 individuals listed in the database as holding a Ph.D. degree and being affiliated with a firm that manages a domestic equity product (the database does not map personnel to specific products within firms).[9] Individuals' titles and the related descriptions provide the role(s) they play in their firms. Titles are reported by the firms, and they are not standardized. Consequently, there is heterogeneity in the terminology the firms use to name the roles; faced with a plethora of distinct titles, we classified these titles into 30 roles (a given Ph.D. could perform multiple roles, such as principal *and* senior portfolio manager).[10]

[9] The indication of their Ph.D. degrees is sometimes accompanied by the field (finance, economics, management, accounting, physics, applied mathematics, and others) and the institution that awarded the degree, but that coverage is far from systematic and is not sufficient for more detailed analyses.

[10] The complete list of roles—condensed to thirty from a very wide range of similarly worded, yet slightly different titles—is (in alphabetical order): Advisor; Analyst/Researcher; Associate; Assistant/Associate Director; Assistant Vice President; CEO; Chairman/Chairman of the Board; Chief Economist/Senior Economist; Chief Investment Officer/Chief Investment Strategist/Senior Investment Officer; Consultant; Chief Operating Officer; Chief Portfolio Manager/Senior Portfolio Manager/Lead Portfolio Manager; Director/Head/Leader; Director of Research; Economist; Executive Vice President; Executive Director; Founder; General Partner; Information Technology Specialist/Programmer; Managing Director; Managing Partner; Partner; Portfolio Manager/Investment Manager; President; Principal; Strategist; Senior Vice President/First Vice President; Vice Chairman; Vice President.

We use these roles to define Ph.D. firms as the firms in which a key role in the firm is performed by a Ph.D. We regard as key roles in the firm precisely the roles associated with the personnel labeled as "Key Personnel" in Nelson's Directory of Investment Managers, that is, Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research. Accordingly, we often refer to products managed by Ph.D. firms as Ph.D. products.

For all Ph.D.s in our sample, we collect information regarding their publications in leading outlets in economics and finance. The list of journals is elite indeed (economics: American Economic Review, Econometrica, Journal of Political Economy, Quarterly Journal of Economics, and Review of Economic Studies; finance: Journal of Business, Journal of Finance, Journal of Financial Economics, and Review of Financial Studies). Overall, 65 Ph.D.s from the sample have had at least one publication in these top outlets. Twenty-nine of those individuals had three or more, of whom eleven have had more than ten top publications.[11]

Our analyses of product investment performance use standard investment style benchmarks (objective- and size-adjusted annual returns, one-year monthly Sharpe ratios, one-year monthly 4-factor Carhart (1997) alphas, one-year monthly information ratios, and one-year monthly manipulation-free Goetzmann, Ingersoll, Spiegel, and

[11] For a list of Ph.D.s from our sample covering domestic equity products who have had three or more publications in top outlets in finance and economics, please see Appendix Table A.I.

Welch (2007) measure MPPM (rho = 3)). The data for the domestic equity risk factors come from the data library that Kenneth French maintains and makes widely available.[12] Many of our analyses will compare products pursuing the same investment style. We use the information regarding the products' investment styles to classify them into twelve categories: equity combined, equity growth, equity value, large cap, large growth, large value, mid cap, mid cap growth, mid cap value, small cap, small cap growth, and small cap value. Moreover, the analyses focus on actively managed products; accordingly, we exclude index products.

Finally, the data set also contains some coverage of the products' fee schedules. In this industry, fees need not be disclosed, and they were not reported for slightly more than one-third of all the observations in the sample (36.7%). Also, fees are paid on a per-client basis; unlike mutual funds, institutional money management firms may charge different fees to different investors in the same product. The information provided in the data set is not sufficient to compute the fees charged for the product even when fee schedules are reported for two key reasons. First, fee schedules are listed for ranges of clients' assets under management; for a product with multiple investors, the fees the product charges cannot be computed because, except for products with one or two clients (by virtue of having the information only regarding the assets under management of the largest and, if applicable, the smallest portfolios), the information regarding clients' assets under management in the product cannot be calculated.

[12] The data for the four benchmarks may be downloaded from Kenneth French's data library, available at `http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`.

Second, anecdotally, fees may be discounted from the schedule, especially for clients with bargaining power. These *ad hoc* discounts are not observable in the data. Altogether, these considerations preclude precise analyses of the fee structure in the present setting. Nonetheless, with all these caveats in place, in light of the important role that consideration of fees plays in the present context for investor welfare implications, we perform and report the analyses of the extent to which fees vary across products managed by Ph.D. firms and non-Ph.D. firms.

A. Firm-Level Summary Statistics

Table I presents basic summary statistics at the end of 2000.[13] Panel A shows total firm domestic equity assets under management. Out of 836 firms that reported the assets under management of their domestic equity products at the end of 2000, only 14 firms (1.7%) did not report biographies. These are small firms, whose combined assets under management of U.S. domestic equity products amount to around 31.7 billion dollars (around 0.7% of the U.S. domestic equity assets managed by all sample firms at the end of 2000).

Of the firms managing domestic equity that reported biographies, 688 (83.7%) did not feature Ph.D.s, whereas 134 (16.3%) did. From the total of 4.43 trillion dollars in domestic equity under management (encompassing separate accounts, commingled funds, and mutual funds reported in the database), 2.03 trillion (or 45.8%) were

[13] All statistics reported in this section are qualitatively similar for other years during the sample period from 1993 to 2007.

managed by non-Ph.D. firms, and 2.40 trillion (or 54.2.7%) were managed by Ph.D. firms. Comparing the distributions of U.S. domestic equity assets under management reported by non-Ph.D. and Ph.D. firms, displayed in Panel A of Table I, suggests that, though substantially more numerous, non-Ph.D. firms are much smaller than Ph.D. firms, a tendency observable at every percentile documented in the table. For example, both median and average firm asset sizes of non-Ph.D. firms are several times smaller than their Ph.D. counterparts (2.95 billion versus 17.91 billion dollars for means; 360 million versus 3.88 billion dollars for medians).

B. Product-Level Summary Statistics

Panel B of Table I presents the basic product-level summary statistics of U.S. domestic equity product assets under management at the end of 2000. Of the 2,607 products with available total assets under management, 17 products (0.7%) were managed by firms that did not report biographies. Of the products whose firms reported biographies, 1,773 (68.5%) were non-Ph.D. products (products managed by non-Ph.D. firms), whereas 817 (31.5%) were Ph.D. products.

Once again, this time at the product level, comparing the distributions of U.S. domestic equity assets under management reported by non-Ph.D. and Ph.D. products (second and third rows of Table I, Panel B) reveals that, though about twice as numerous, non-Ph.D. products are much smaller than Ph.D. products. For example, both median and average product asset sizes of non-Ph.D. products are nearly three times smaller than those of Ph.D. products (1.14 billion versus 2.94 billion dollars for

means; 198 million versus 572 million dollars for medians), with this ratio preserved across the documented percentiles.

With all the caveats regarding the fee data in our sample, we document their summary statistics. To maximize the number of observations, we compute "expense ratios" by dividing the fees the products state for 25-million dollar accounts by 25 million dollars.[14] Panel C of Table I provides summary statistics pertaining to the fees charged by Ph.D. products and non-Ph.D. products. It turns out that, overall, the fees stated by Ph.D. products are a few basis points lower than those stated by their non-Ph.D. counterparts.

II. Performance and Fee Analyses

A. The Empirical Setup

Panel B of Table I shows that non-Ph.D. products are much smaller—nearly three times smaller across the board. Extant literature has established quite convincingly a negative relation between performance and size of mutual funds (e.g., Berk and Green (2004), Chen, Hong, Huang, and Kubik (2004), Pollet and Wilson (2008)), suggesting that a direct comparison of product performance across these two categories is challenging even in the presence of controls for size. To address the size-related *caveat*, and thereby perform a more meaningful and precise comparison, we contrast Ph.D. and non-Ph.D. products pursuing the same investment objective, with similar total assets

[14] Results are very similar if we focus on 10-million dollar account or 50-million dollar accounts, but we lose more observations because of the increased propensity not to report in those ranges; moreover, 25 million dollars is close to 29 million dollars, the median account size in the sample.

under management, and similar past performance. We do so by developing a matching procedure that, for each observation, takes each Ph.D. product-year for which the product has all twelve monthly returns and identifies the corresponding non-Ph.D. product-year such that the non-Ph.D. product pursues the same investment objective, is in the same size quintile in terms of its total assets under management, and is the closest in terms of past one-year performance (implicitly requiring that both products had all twelve monthly returns past year).

B. Results

The dependent variables studied in this section are all computed for each of the 6,723 resulting observations on the basis of their two twelve-month time series of returns. In the first analysis, the dependent variable is the difference in annual returns between the Ph.D. product and the matching non-Ph.D. product. The second analysis features the difference between their Sharpe ratios. The dependent variable in the third analysis is the difference between their alphas, calculated from regressions of the respective 12-month return series on the four factors commonly employed in the analysis of risk-adjusted performance of U.S. equity portfolios (Carhart (1997)). The dependent variable in the fourth analysis is the difference between their information ratios from these regressions. Lastly, the fifth analysis features the difference between their manipulation-free performance measures MPPM, with rho = 3, as discussed in Goetzmann, Ingersoll, Spiegel, and Welch (2007). Regressions reported in this section also control for total assets under management for both products (in logarithmic form),

as well as their respective firm assets under management (given the close and careful matching design, their point estimates are practically zero, and we suppress them from the table for readability). Lastly, in our estimations, we adjust standard errors by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs.

The results of all these analyses are reported in Panel A or Table II. In short, we find statistically significant and economically meaningful differences according to objective- and size-adjusted annual returns (42.7 basis points per year), one-year monthly Sharpe ratios (0.847 percent), one-year monthly Carhart alphas (3.31 basis points per month), one-year monthly information ratios (4.76 percent), and one-year monthly manipulation-free Goetzmann, Ingersoll, Spiegel, and Welch (2007) measure MPPM (rho = 3) (0.516 percent per year). Thus, there is strong evidence that the gross performance realized by Ph.D. products exceeds the performance realized by their matched non-Ph.D. products.

These gross performance results show convincingly that Ph.D. products outperform their matched non-Ph.D. counterparts along a range of performance measures. It is conceivable, however, that this performance differential in gross returns could disappear (or even reverse) once fees are taken into account. To the contrary, Panel C of Table I suggests that, if anything, Ph.D. products are associated with lower fees compared to non-Ph.D. products. Moreover, Panel B of Table II features the results of a regression analysis in which we estimate the differential fees (the difference between the fees stated by the Ph.D. products and the fees stated by their matched non-

Ph.D. products), in the presence of a rich set of covariates, to be around four basis points. Thus, the performance gap between Ph.D. products and non-Ph.D. products is preserved, and, if anything, even slightly enhanced after fees (that is, in terms of net returns).

III. Flows

Our next inquiry is whether investor flows have a differential response to performance posted by Ph.D. products and non-Ph.D. products. The dependent variable in these analyses is the difference between annual flows to Ph.D. products and the matched, non-Ph.D. products, expressed in percentages.[15] Similar to other analyses, for each product managed by a Ph.D. firm for the year, the matching process identifies the product managed by a non-Ph.D. firm that belongs to the same style and is the closest in terms of product assets under management and past one-year performance.

Controls, once again, are total assets under management for both products and for both firms (in logarithmic form). Given the close and careful matching design, their point estimates are practically zero, and we suppress them from the table for readability. We adjust standard errors by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs.

Panel A of Table III reports results of an estimation carried out across all observations. The extent to which the flow into Ph.D. products exceeds the flow into

[15] The distribution of flows in this industry is highly leptokurtic (especially compared to the mutual fund industry). To minimize the influence of outliers, we have undertaken several standard steps. Specifically, we exclude products managing fewer than five million dollars in total assets, and we winsorize flows at the 2.5th and 97.5th percentiles.

matched non-Ph.D. products is very large, estimated at 18.2 percent per year (and statistically significant at one-percent level). Panel B reports results estimated on five subsamples of the overall sample, defined by the objective- and size-adjusted quintiles of past one-year product performance. It shows that the gap from Panel A of 18.2 percent per year is not uniformly distributed across past performance. Rather, the gap among the top-quintile Ph.D. and non-Ph.D. products is as large as 40.4% percent per year. As the past performance drops, so does the magnitude of the gap, from 18.6 percent for second highest performance quintile, 17 percent for the middle quintile, 10.3 percent for second lowest (all statistically significant at the 1% level), and only 4.3 percent (not statistically significant) for the bottom quintile.

In their seminal work on managerial ability in the related, mutual-fund industry, Berk and Green (2004) assume that observable fund manager ability to generate risk-adjusted returns erodes as money flows from products without skill to products with skill. Chen, Hong, Huang, and Kubik (2004) and Pollet and Wilson (2008) find a strong negative relation between mutual fund size and performance. In the present context, this finding implies that the performance gap between Ph.D. products and non-Ph.D. products, presented in Table II in the previous section, might be even wider in the absence of the strong relation between differential flows and the presence of a Ph.D. from Table III. Accordingly, this evidence suggests that, by virtue of their disproportionate investment into Ph.D. products at practically every level of past performance, investors appear to harbor particularly strong beliefs that Ph.D. products provide better performance (such disproportionate investment enhances the size of

those products, thus making it more difficult, in light of the well-known and robust negative relation between performance and size, to attain strong risk-adjusted performance in the future).

IV. Addressing Alternative Explanations: Founders' Analysis

It is evident that the decision to hire (or fire) a Ph.D. could be endogenous. Firms that eventually have better performance could be more likely to have Ph.D.s perform key roles for a variety of reasons. One such reason is that better firms might hire Ph.D.s as an advertising tool for attracting future flows. Another alternative explanation is that Ph.D.s may be better able than non-Ph.D.s to determine which firms will do well in the future based on the performance history and other firm characteristics. It is possible, then, that Ph.D.s would choose employers accordingly, favoring superior firms in the process of selecting an employer. Ultimately, under these scenarios, Ph.D.s might not provide any incremental contribution to product performance once hired, yet the results from the previous section would follow.

To address the possibility that our results are driven by such a pattern, we turn to the performance analysis of firms founded by Ph.D.s, thus eliminating the mechanisms outlined in the previous paragraph. Indeed, firms founded by Ph.D.s have had a Ph.D. perform a key role since inception (all of the sample firms founded by a Ph.D. have continued to have a Ph.D. perform a key role thenceforth). Finding a performance gap between products managed by Ph.D.s and those managed by non-Ph.D.s in this subsample would constitute strong evidence that the performance

differentials reported in the previous section do not stem (only) from Ph.D.s somehow matching to firms with "good" characteristics. Indeed a Ph.D. firm founded by a Ph.D. did not find itself in this subsample because of a Ph.D.'s subsequent decision to accept employment in a "good" firm. Rather, at the moment of founding, the firm has not had any history, and a Ph.D. in a key role is an integral part of subsequent performance from the very start.

The results of performance analyses, analogous to those reported for the baseline analyses (Panel A of Table II), are presented in Table IV. The table features coefficients of similar magnitude to those from Panel A of Table II. If anything, coefficients for the first three performance measures are modestly larger. Statistical significance, though, is generally weakened (this is a much smaller sample, containing only 1,329 observations); nonetheless, it is present for all performance measures (it is even stronger for Alpha), with the exception of MPPM (rho = 3), for which it narrowly escapes statistical significance (p = 0.13). Overall, the evidence presented in Table IV suggests strongly that the performance differential between products managed by Ph.D.s and products managed by non-Ph.D.s does not stem (only) from the possibility that Ph.D.s might somehow be matched to firms with "good" characteristics; rather, Ph.D.s' contribution is also present in the domain of generating strong returns.

V. The Role of Publication Records

As discussed earlier, not all Ph.D. managers in our sample are equal. Some have entered the money management industry early in their careers. Others have begun

academic careers, and switched to money management soon thereafter. Still others have had distinguished academic careers before they entered into money management. Accordingly, the Ph.D. managers in our samples have varying publication records in top outlets in economics and finance. The immediate question is whether the demonstrated success in generating and placing research in premier academic journals translates into investor acumen in the domain of institutional money management.

As described in Section I, we compiled publication records for the Ph.D.s in our sample by searching through elite journals (economics: American Economic Review, Econometrica, Journal of Political Economy, Quarterly Journal of Economics, and Review of Economics and Statistics; finance: Journal of Business, Journal of Finance, Journal of Financial Economics, Review of Financial Studies). Overall, 65 Ph.D.s from the sample have had at least one publication in these top outlets. Twenty-nine of those individuals had three or more, of whom eleven have had more than ten top publications.

Table V offers further insight into the prevalence and depth of publication records across institutional money management firms. About 20% of the firm-year observations feature at least one publication, with the average of 3.11, and the average longest publication record across all firm-year observations is 2.04 papers. These statistics, displayed in the first column of the table, do not convey the fact that publication records are skewed across firms. For example, as reported in the last column of Table V, at the 95th percentile of the publication distribution, firm-year observations feature 9 publications, and the longest publication record is 7 papers.

We next tease out whether Ph.D. product performance is positively related to the manager's publication record in leading journals in economics and finance by relating the same five performance measures we utilized in Section II with three publication record measures. As before, all performance measures are adjusted by year, style, and size quintiles. The independent variables, each associated with its respective column in the table, are measures of the firm's publication output. *Publications*? is set to one if any of the Ph.D.s from the firm had published a paper in a top outlet in economics (American Economic Review, Econometrica, Journal of Political Economy, Quarterly Journal of Economics, Review of Economics Studies) or finance (Journal of Business, Journal of Finance, Journal of Financial Economics, Review of Financial Studies), and to zero otherwise. The variable No.Pub. is equal to the sum of the firms' Ph.D.s' number of publications in top outlets in economics and finance. The variable Max.Pub. is equal to the largest among the firms' Ph.D.s' number of publications in top outlets in economics and finance. Controls include product assets and firm assets. All specifications contain style and year effects. Standard errors are adjusted by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs.

The key coefficients associated with publication records are displayed in Table VI.[16] The first column features a simple measure of publication output, the indicator variable *Publications*? For each of the five performance metrics, the presence of a

[16] The number of observations in each specification presented in the table is 6,723, and values of R-squared range from 0.001 to 0.004.

publication record is associated with a statistically significant and economically large performance differential: objective- and size- adjusted returns are larger by 1.14 percent per year, the Sharpe ratio is larger by 1.59%, alpha is larger by 3.5 basis points per month, information ratio is larger by 5 percent, and the MPPM measure is larger by 0.68 percent per year.

The second and third columns feature the remaining two measures of publication output, capturing overall publication output for the firm and the output of its most prolific Ph.D. A one-standard deviation move for the variable *ln* (1+No. Pub.) (*ln* (1+Max. Pub.)), equal to 0.834 (0.744), translates loosely into doubling the publication output. Focusing, for example, on objective- and size- adjusted annual returns, roughly doubling these publication output measures translates into an increase in performance of 0.834 * 0.385 = 32 basis points per year (0.744 * 0.447 = 33 basis points per year). Other performance measures yield similar conclusions.

There is an absence of statistical significance for alpha in the last two columns (and for Sharpe ratio in the second column). The point estimates are in the correct direction, and are of plausible magnitudes, but the standard errors are high. The latter findings are not surprising because the estimations are based on only twelve data points and, more generally, alphas are notoriously difficult to estimate with precision. To discern whether the lack of significance related to alpha comes from a lack of power (the annual estimates of alpha may be noisy), we perform a portfolio analysis and report the results in Table VII.

Table VII presents results of zero-cost portfolio performance evaluation, with zero-cost portfolios formed on the basis of the publication records associated with products managed by Ph.D.s.[17] Each of the three zero-cost portfolios corresponds to a measure of publication output, and is presented in the respective column. All three columns feature statistically significant Carhart (1997) alphas. Resorting to back-of-the-envelope calculations, its annualized magnitude is 44 basis points per year (=3.688*12), 92 basis points per year (=7.635*12), and 104 basis points per year (=8.665*12), respectively. Moreover, coefficient estimates associated with the SMB factor and, especially, the HML factor also suggest that those with publication records loaded more heavily on those factors (this is especially true of the most discerning classification of publication records from the last column of Table VII).

VI. Alternative Estimation Approaches

In this section, we report the baseline results estimated by means of three alternative estimation approaches. The first alternative approach involves a different method of product matching. Instead of the matching utilized thus far, this estimation based on propensity matching. As before, for each product managed by a Ph.D. for the year, the matching process identifies the product managed by a non-Ph.D. that belongs to the same style and is in the same size and performance quintiles; the difference is that the procedure now looks for a non-Ph.D. product that is the closest in terms of its

[17] For each zero-cost portfolio, the long side represents monthly returns to the value-weighted portfolio of products managed by Ph.D.s with the publication record meeting the standard specified for the respective column, and the short side represents monthly returns to the value-weighted portfolios of products managed by Ph.D.s without publications in top outlets in economics and finance.

propensity score. Propensity scores for a firm with a Ph.D. in a key role are calculated by estimating a Logit model with the independent variables log(firm assets), log(number of products), log(number of unique objectives offered), and year indicator variables. The results of these analyses, reported in Table VIII, are highly consistent with those reported in the main section.

The second alternative approach performs the estimation using panel regressions (rather than using a matching methodology). The key dependent variable in panel specifications, used for estimation pertaining to all five performance measures, is the indicator variable *Ph.D. Key*? This variable is set to one if a Ph.D. performs a key role in the firm (Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research) that year, and to zero otherwise. Other controls include product and firm sizes, year, and objective indicator variables. Once again, the results (Table IX) are highly consistent with the baseline results.

Finally, the third alternative approach, also conducted using panel regressions (and involving the set of independent variables very similar to that from the panel analyses reported in Table IX), defines Ph.D. presence differently.[18] Instead of the *Ph.D. Key*? indicator variable, it utilizes the *High Ph.D. Intensity*? indicator variable. We begin by defining Ph.D. Intensity as the ratio of the number of Ph.D.s in the firm performing a

[18] We thank John Y. Campbell for this suggestion.

key role in the firm and the number of domestic equity products the firm manages that year. The indicator variable *High Ph.D. Intensity*?, then, is set to one if the value of Ph.D. Intensity is equal to, or greater than, the top quintile of its distribution (0.12), and to zero otherwise. In an already established pattern, the results (presented in Table X) are highly consistent with the baseline results.

VII. Conclusion

In this paper, we analyze the relation between investment performance of domestic equity products managed by institutional money manager and a broad spectrum of managers' demonstrated academic ability. We focus on possession of a Ph.D. degree, as well as managers' publication records in top outlets in economics and finance). Using gross returns (returns measured gross of fees, but net of transaction costs), we find that the performance of investment products managed by Ph.D.s is superior to the performance of non-Ph.D. products along several metrics widely employed to measure risk-adjusted product performance (objective-adjusted returns, Sharpe ratio, four-factor alpha, information ratio, and manipulation-proof performance measure). The performance differential in gross returns is preserved, even slightly enhanced, once fees are taken into account (fees for Ph.D. products tend to be slightly lower than fees for non-Ph.D. products).

Hiring employees to maximize assets under management is of first-order importance for money management companies. We find that net flows to Ph.D. products substantially exceed net flows to the non-Ph.D. products matched by style,

assets under management, and recent performance. This difference is particularly accentuated in the top quintile of past performance. While the underlying cause of the relation between flows and educational attainment may ultimately stem from ability, knowledge, or soft skills, this finding provides a clear economic justification for the aggressive recruitment individuals holding a Ph.D. to serve in key positions in money management companies.

Finally, our analysis reveals that, among Ph.D. firms, a product's performance is strongly positively related to the firm's key personnel publication record in the top outlets in economics and finance. This finding indicates the extent to which proven academic ability at the highest percentiles of achievement translates into successful institutional money management.

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Table I
Sample Summary Statistics

This table provides summary statistics of the institutional money management data set, compiled from 59 quarterly releases of data from the Mobius Group and, from September 2006 onward, Informa Investment Solutions (IIS) PSN Data Select for the period from June 1993 to December 2007. The table reports the 2000 year-end summary. Panel A provides summary statistics of domestic equity assets under management at the money management firm level. Panels B and C provide summary statistics of domestic equity assets under management and fees of the domestic equity products. The fees tabulated in Panel C, expressed in basis points, are the "expense ratios" obtained by dividing the fees the products state for 25-million dollar accounts by 25 million dollars.

			Panel A: Assets by Firm ($ Million)					
	No. of Firms	Average Firm Assets	St. Dev. of Firm Assets	5th	25th	Median (50th)	75th	95th
Non-Ph.D. Firms	688	2,948	13,743	5	86	360	1,574	10,212
Ph.D. Firms	134	17,908	44,533	22	414	3,877	15,285	65,785
			Panel B: Assets by Product ($Million)					
	No. of Products	Average Product Assets	St. Dev. of Product Assets	5th	25th	Median (50th)	75th	95th
Non-Ph.D. Products	1,773	1,144	5,381	3	45	198	710	4,310
Ph.D. Products	817	2,937	9,605	8	110	572	2,047	12,991
			Panel C: Fees by Product (bp/year)					
		Average Fees	St. Dev. of Fees	5th	25th	Median (50th)	75th	95th
Ph.D. Product Fees		70.18	22.92	35	55	66	85	100
Non-Ph.D. Product Fees		73.82	21.22	41	60	72	90	100

Table II
Performance and Fee Differentials Between Ph.D.-Managed and Non-Ph.D. Managed Products

The dependent variables in Panel A of this table are differences between performance measures of products managed by Ph.D.s and their respective matched products managed by non-Ph.D.s. A product is regarded to be managed by a Ph.D. if a key role in the firm (Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research) is performed by a Ph.D. The first performance measure is the difference between objective- and size-adjusted annual returns of products managed by Ph.D.s and their respective matched products managed by non-Ph.D.s, expressed in percentages per year. The second performance measure is the difference between one-year monthly Sharpe ratios of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s (expressed in percentages). The third performance measure is the difference between one-year monthly Carhart alphas of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s (expressed in basis points per month). The fourth performance measure is the difference between one-year monthly information ratios (based on Carhart alphas and idiosyncratic standard deviation) of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s. The fifth performance measure is the difference between one-year monthly manipulation-free measures MPPM (rho = 3) of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s (expressed in percentages per year). The dependent variable in Panel B of this table is the difference between fees charged by products managed by Ph.D.s and their respective matched products managed by non-Ph.D.s. These fees, expressed in basis points, are the "expense ratios" obtained by dividing the fees the products state for 25-million dollar accounts by 25 million dollars. For each product managed by a Ph.D. for the year, the matching process identifies the product managed by a non-Ph.D. that belongs to the same style, is in the same size quintile, and is the closest in terms of past one-year performance. Controls include product and matched product assets and their corresponding firm assets. Standard errors are adjusted by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table II (Continued)
Performance and Fee Differentials Between Ph.D.-Managed and Non-Ph.D. Managed Products

	Differential (Intercept)	Controls	R-Squared	Number of Obs.
Panel A: Performance				
Objective- and Size- Adjusted Annual Return (percent/year)	0.427** (0.209)	Yes	0.001	6,723
Objective- and Size- Adjusted Sharpe Ratio	0.847** (0.434)	Yes	0.001	6,723
Objective- and Size- Adjusted Alpha (bp/month)	3.306* (1.810)	Yes	0.001	6,723
Objective- and Size- Adjusted Information Ratio	4.755*** (1.082)	Yes	0.002	6,723
Objective- and Size- Adjusted MPPM (rho = 3) (percent/month)	0.516** (0.211)	Yes	0.002	6,723
Panel B: Fees				
Product Fees (bp/year)	-4.352*** (1.654)	Yes	0.002	3,541

Table III

Net Flow Differentials Between Ph.D.-Managed and Non-Ph.D. Managed Products

The dependent variable is the difference between annual flows to products managed by Ph.D.s and their respective matched products managed by non-Ph.D.s in year *t*+1, expressed in percentages. A product is regarded to be managed by a Ph.D. if a key role in the firm (Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research) is performed by a Ph.D. For each product managed by a Ph.D. for the year, the matching process identifies the product managed by a non-Ph.D. that belongs to the same style, is in the same size quintile, and is the closest in terms of past one-year performance. Controls include product and matched product assets and their corresponding firm assets in year *t*. Panel A reports results estimated over all product-year observations in the sample. Panel B reports results estimated on five subsamples of the overall sample determined by the objective- and size-adjusted quintile product annual return in year *t*. Standard errors are adjusted by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

	Differential (Intercept) (percent/year)	Controls	R-Squared	Number of Obs.
Panel A: All Products				
All Products	18.231***	Yes	0.01	6,723
	(1.784)			
Panel B: Products by Objective- and Size- Adjusted Performance Quintile in year t				
Performance in Top Quintile	40.380***	Yes	0.01	1,312
	(5.266)			
Performance in Quintile 4	18.658***	Yes	0.01	1,374
	(4.067)			
Performance in Quintile 3	16.971***	Yes	0.01	1,384
	(3.848)			
Performance in Quintile 2	10.346***	Yes	0.01	1,369
	(3.491)			
Performance in Bottom Quintile	4.340	Yes	0.01	1,284
	(2.961)			

Table IV

Subsample Analysis: Products from Firms Founded by a Ph.D.

The dependent variables in this table are differences between performance measures of products managed by Ph.D.s from the sample of firms founded by Ph.D.s and their respective matched products managed by non-Ph.D.s. A firm is regarded to be founded by a Ph.D. if the list of the firm's key personnel at the time of founding contained a Ph.D. A product is regarded to be managed by a Ph.D. if a key role in the firm (Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research) is performed by a Ph.D. The first performance measure is the difference between objective- and size-adjusted annual returns of products managed by Ph.D.s and their respective matched products managed by non-Ph.D.s, expressed in percentages per year. The second performance measure is the difference between one-year monthly Sharpe ratios of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s (expressed in percentages). The third performance measure is the difference between one-year monthly Carhart alphas of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s (expressed in basis points per month). The fourth performance measure is the difference between one-year monthly information ratios (based on Carhart alphas and idiosyncratic standard deviation) of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s. The fifth performance measure is the difference between one-year monthly manipulation-free measures MPPM (rho = 3) of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s (expressed in percentages per year). For each product from a firm founded by a Ph.D., the matching process identifies the product managed by a non-Ph.D. that belongs to the same style, is in the same size quintile, and is the closest in terms of past one-year performance. Controls include product and matched product assets and their corresponding firm assets. Standard errors are adjusted by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively**.**

Table IV (Continued)
Subsample Analysis: Products from Firms Founded by a Ph.D.

Performance Measure	Performance Difference (Ph.D. - Matched)	Controls	R-squared	Number of Observations
Annual Return (percent/year)	0.823* (0.446)	Yes	0.001	1,329
Sharpe Ratio	1.308* (0.740)	Yes	0.001	1,329
Alpha (bp/month)	7.651** (3.309)	Yes	0.004	1,329
Information Ratio	4.121** (1.816)	Yes	0.001	1,329
MPPM (rho = 3) (percent/year)	0.598[a] (0.393)	Yes	0.001	1,329

[a] denotes *p*-value = 0.13.

Table V
Publication Records in the Sample

This table provides summary statistics of the publications produced by the institutional money management firms from the data set. The indicator variable *Publications*? is set to one if any of the Ph.D.s from the firm had published a paper in a top outlet in economics (American Economic Review, Econometrica, Journal of Political Economy, Quarterly Journal of Economics, Review of Economics Studies) or finance (Journal of Business, Journal of Finance, Journal of Financial Economics, Review of Financial Studies) by the end of the year, and to zero otherwise. The variable No.Pub. is equal to the sum of the firms' Ph.D.s' number of publications in top outlets in economics and finance by the end of the year. The variable Max.Pub. is equal to the largest among the firms' Ph.D.s' number of publications in top outlets in economics and finance by the end of the year.

	Mean	St. Dev.	5th	25th	Median (50th)	75th	95th
Publications?	0.202	0.402	0	0	0	0	1
No.Pub.	3.11	13.96	0	0	0	0	9
ln (1+No. Pub.)	0.367	0.927	0	0	0	0	2.303
Max.Pub.	2.04	8.97	0	0	0	0	7
ln (1+Max. Pub.)	0.326	0.815	0	0	0	0	2.079

Table VI
Performance of Ph.D.-Managed Products by Publication

The dependent variables in this table are performance measures of products managed by Ph.D.s. A product is regarded to be managed by a Ph.D. if a key role in the firm (Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research) is performed by a Ph.D. The first performance measure is the objective- and size-adjusted annual returns of products managed by Ph.D.s (expressed in percentages per year). The second performance measure is the one-year monthly Sharpe ratios of products managed by Ph.D.s (expressed in percentages). The third performance measure is the one-year monthly Carhart alphas of products managed by Ph.D.s (expressed in basis points per month). The fourth performance measure is the one-year monthly information ratios (based on Carhart alphas and idiosyncratic standard deviation) of products managed by Ph.D.s. The fifth performance measure is the one-year monthly manipulation-free measures MPPM (rho = 3) of products managed by Ph.D.s (expressed in percentages per year). All performance measures are adjusted by year, style, and size quintile. The independent variables, each associated with its respective column in the table, are measures of publication output by the firm. *Publications*? is set to one if any of the Ph.D.s from the firm had published a paper in a top outlet in economics (American Economic Review, Econometrica, Journal of Political Economy, Quarterly Journal of Economics, Review of Economics Studies) or finance (Journal of Business, Journal of Finance, Journal of Financial Economics, Review of Financial Studies), and to zero otherwise. The variable No.Pub. is equal to the sum of the firms' Ph.D.s' number of publications in top outlets in economics and finance. The variable Max.Pub. is equal to the largest among the firms' Ph.D.s' number of publications in top outlets in economics and finance. Controls include product and matched product assets and their corresponding firm assets. All specifications contain style and year effects. The number of observations in each specification presented in the table is 6,723, and values of R-squared range from 0.001 to 0.004. Standard errors are adjusted by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table VI (Continued)
Performance Differentials Among Ph.D.-Managed Products by Publication

	Publications?	log(1+No. Pubs.)	log(1+Max. No. Pubs.)
Objective- and Size- Adjusted Annual Return	1.043***	0.364***	0.433***
(percent/year)	(0.266)	(0.115)	(0.131)
Objective- and Size- Adjusted Sharpe Ratio	1.409***	0.325[a]	0.389*
	(0.465)	(0.200)	(0.229)
Objective- and Size- Adjusted Alpha	4.213**	0.617	0.901
(bp/month)	(1.744)	(0.755)	(0.859)
Objective- and Size- Adjusted Information Ratio	4.354***	1.060**	1.300**
	(1.077)	(0.467)	(0.531)
Objective- and Size- Adjusted MPPM (rho = 3)	0.712***	0.204*	0.259**
(percent/year)	(0.257)	(0.111)	(0.127)

Table VII
Portfolio Performance Differentials Among Ph.D.-Managed Products by Publication

This table presents results of Carhart (1997) performance evaluation of zero-cost portfolio strategies formed on the basis of the publication records associated with products managed by Ph.D.s A product is regarded to be managed by a Ph.D. if a key role in the firm (Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research) is performed by a Ph.D. We use three measures of publication output by the firm. *Publications*? is set to one if any of the Ph.D.s from the firm had published a paper in a top outlet in economics (American Economic Review, Econometrica, Journal of Political Economy, Quarterly Journal of Economics, Review of Economics Studies) or finance (Journal of Business, Journal of Finance, Journal of Financial Economics, Review of Financial Studies), and to zero otherwise. The variable No.Pub. is equal to the sum of the firms' Ph.D.s' number of publications in top outlets in economics and finance. The variable Max.Pub. is equal to the largest among the firms' Ph.D.s' number of publications in top outlets in economics and finance. Standard errors are adjusted by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Long:	Ph.D. Products with Publications	Ph.D. Products with 6+ Publications	Ph.D. Products with 11+ Max. Pub.
Short:	Ph.D. Products without Publications	Ph.D. Products without Publications	Ph.D. Products without Publications
Alpha (bp/month)	3.812* (2.182)	6.651** (3.082)	8.083** (3.490)
RMRF	0.006 (0.006)	0.011 (0.009)	0.047*** (0.009)
SMB	0.015** (0.006)	0.050*** (0.009)	0.109*** (0.010)
HML	0.033*** (0.008)	0.081*** (0.011)	0.122*** (0.013)
UMD	0.006 (0.004)	-0.019*** (0.006)	-0.018** (0.008)
R-squared	0.12	0.31	0.50
No. of Months	168	168	168

Table VIII

Performance Differentials Between Ph.D.-Managed and Non-Ph.D. Managed Products: Propensity Matching

The dependent variables in this table are differences between performance measures of products managed by Ph.D.s and their respective matched products managed by non-Ph.D.s. A product is regarded to be managed by a Ph.D. if a key role in the firm (Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research) is performed by a Ph.D. The first performance measure is the difference between objective- and size-adjusted annual returns of products managed by Ph.D.s and their respective matched products managed by non-Ph.D.s, expressed in percentages per year. The second performance measure is the difference between one-year monthly Sharpe ratios of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s (expressed in percentages). The third performance measure is the difference between one-year monthly Carhart alphas of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s (expressed in basis points per month). The fourth performance measure is the difference between one-year monthly information ratios (based on Carhart alphas and idiosyncratic standard deviation) of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s. The fifth performance measure is the difference between one-year monthly manipulation-free measures MPPM (rho = 3) of products managed by Ph.D.s and their respective matched product managed by non-Ph.D.s (expressed in percentages per year). For each product managed by a Ph.D. for the year, the matching process identifies the product managed by a non-Ph.D. that belongs to the same style, is in the same size and performance quintiles, and is the closest in terms of its propensity score. Propensity scores for a firm with a Ph.D. in a key role are calculated by estimating a Logit model with the independent variables log(firm assets), log(number of products), log(number of unique objectives offered), and year indicator variables. Controls in the regression below includes product and firm sizes of the Ph.D. product and its matched non-Ph.D. product, year, and objective indicator variables. Standard errors are adjusted by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table VIII (Continued)
Performance Differentials Between Ph.D.-Managed and Non-Ph.D. Managed Products: Propensity Matching

Performance Measure	Performance Difference (Ph.D. - Matched)	Controls	R-squared	Number of Observations
Annual Return (percent/year)	0.677*** (0.221)	Yes	0.001	6,723
Sharpe Ratio	1.168** (0.458)	Yes	0.001	6,723
Alpha (bp/month)	5.852*** (1.621)	Yes	0.003	6,723
Information Ratio	5.322*** (1.065)	Yes	0.001	6,723
MPPM (rho = 3) (percent/year)	0.793*** (0.213)	Yes	0.001	6,723

Table IX
Panel Estimation

The dependent variables in this table are five product performance measures. The first performance measure is objective- and size-adjusted annual return, expressed in percentages per year. The second performance measure is one-year monthly Sharpe ratio. The third performance measure is one-year monthly Carhart alpha (expressed in basis points per month). The fourth performance measure is one-year monthly information ratio (based on Carhart alphas and idiosyncratic standard deviation). The fifth performance measure is one-year monthly manipulation-free measure per month (rho = 3), expressed in percentages. The key dependent variable in the specifications is the indicator variable *Ph.D. Key*?, set to one if a Ph.D. performs a key role in the firm (Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research) that year, and to zero otherwise. Other controls include product and firm sizes, year, and objective indicator variables. Standard errors are adjusted by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Performance Measure	*Ph.D. Key*?	Controls	R-squared	Number of Observations
Annual Return (percent/year)	0.426*** (0.137)	Yes	0.01	23,384
Sharpe Ratio	0.646*** (0.237)	Yes	0.02	23,384
Alpha (bp/month)	3.358*** (1.494)	Yes	0.01	23,384
Information Ratio	2.460*** (0.555)	Yes	0.01	23,384
MPPM (rho = 3) (percent/year)	0.560*** (0.146)	Yes	0.02	23,384

Table X
Panel Estimation: Alternative Ph.D. Measure

The dependent variables in this table are five product performance measures. The first performance measure is objective- and size-adjusted annual return, expressed in percentages per year. The second performance measure is one-year monthly Sharpe ratio. The third performance measure is one-year monthly Carhart alpha (expressed in basis points per month). The fourth performance measure is one-year monthly information ratio (based on Carhart alphas and idiosyncratic standard deviation). The fifth performance measure is one-year monthly manipulation-free measure per month (rho = 3), expressed in percentages. We define Ph.D. Intensity as the ratio of the number of Ph.D.s in the firm performing a key role in the firm (Principal, CEO, Chief Investment Officer, Chief Investment Strategist, Senior Investment Officer, Partner, President, Portfolio Manager, Investment Manager, Chief Portfolio Manager, Senior Portfolio Manager, Lead Portfolio Manager, Advisor, Strategist, Chairman, Managing Director, and Director of Research) and the number of domestic equity products the firm manages that year. The key dependent variable is the indicator variable *High Ph.D. Intensity*?, set to one if the value of Ph.D. Intensity is equal to or greater than the top quintile of its distribution (0.12), and to zero otherwise. Other controls include product and firm sizes, year, and objective indicator variables. Standard errors are adjusted by clustering that accounts for heteroskedasticity and dependence of observations across the firm to which the Ph.D. product belongs. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Performance Measure	*Ph.D. Intensity High*? (Top Quintile)	Controls	R-squared	Number of Observations
Annual Return (percent/year)	0.310** (0.145)	Yes	0.01	23,384
Sharpe Ratio	0.635** (0.251)	Yes	0.01	23,384
Alpha (bp/month)	3.200* (1.690)	Yes	0.01	23,384
Information Ratio	2.399*** (0.588)	Yes	0.01	23,384
MPPM (rho = 3) (percent/year)	0.318** (0.154)	Yes	0.02	23,384

APPENDIX

Table A.I
Ph.D.s from the Sample With At Least Three Publications in Top Outlets in Economics (AER, Econometrica, JPE, QJE, RES) and Finance (JB, JF, JFE, RFS)

Name		Number of Publications
Shleifer,	Andrei	79
Fama,	Eugene	76
Ross,	Stephen	57
Roll,	Richard	40
Lakonishok,	Josef	36
Vishny,	Robert	34
Thaler,	Richard	33
Madhavan,	Ananth	17
Lee,	Charles	13
Lerner,	Eugene	11
Schlarbaum,	Gary	11
Dunn,	Kenneth	10
Kon,	Stanley	9
Richard,	Scott	7
Rosen,	Kenneth	7
Scott,	James	7
Tuttle,	Donald	7
Breeden,	Douglas	6
Knez,	Peter	6
Rudd,	Andrew	6
Garvey,	Gerald	5
Laffer,	Arthur	5
Meese,	Richard	5
Rosenberg,	Barr	5
Lieberman,	Charles	4
Carhart,	Mark	3
Dravid,	Ajay	3
Maloney,	Kevin	3
Sorensen,	Eric	3