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# Human Capital Investments and Firm Performance

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## I. Introduction

In the grand sweep of economic history, the evolution of the U.S. economy from an industrial to a knowledge base has been remarkably swift. Far more than ever before, an organization's success in today's "Knowledge Economy" depends on its "intangible" assets and its continued investment in those assets – particularly human capital, defined as the collective skills and knowledge of its workforce. Despite the growing importance of human capital assets, it is not possible for investors to make portfolio decisions on that basis. They do not know which firms make substantial investments in human capital, and as a result, they do not know how firms with higher human capital expenditures tend to perform in the stock market or on the balance sheet.

In large part, this is explained by the fact that standard accounting principles and reporting requirements have failed to address or reflect the existence of these increasingly important sources of corporate value. As a result, information is simply not publicly reported on human capital or many of the other intangible investments that are now driving firm performance (for example, information on even the most basic measure of human capital investments, such as education and training expenditures, is almost never made publicly available to investors).[1] This has made it increasingly difficult for investors to assess firms' future earnings potential and to accurately determine appropriate current values for publicly-traded corporations.

This creates additional problems. First, because firms' investments in intangible areas are not visible to the markets, they are instead treated purely as costs on the corporate balance sheet.[2] Thus, dollar-for-dollar, these hidden investments in human capital reduce corporate earnings. Market pressures to maximize quarterly and annual earnings almost certainly reduce

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[1] There is a legitimate reason for the current accounting treatment of firms' investments in human capital development. People (and their knowledge and skills) are the only organizational "asset" that cannot be owned. Unlike other "assets," employees can permanently walk out the door whenever they choose. Consequently, the future revenue streams attributable to investments in people are not guaranteed to accrue to the firm that made the investment. All this really says, however, is that the returns to investments in human capital are uncertain. But this is a characteristic of other forms of investment as well, including research and development or capital expenditures, and does not explain the failure to measure and report this one particular subset of strategic investments.

[2] Although some other important strategic investments (e.g., research and development) are also accounted for as costs, public reporting requirements ensure that these "costs" (investments) are not hidden.

firms' incentives to invest in human capital, leading to an under-investment by most firms.[3] This, in turn, hurts future performance (assuming the investments are efficient). Thus, despite the increasing frequency with which CEOs repeat the mantra that "people are our most important assets," the market currently creates powerful disincentives for firms to actually invest in their people. One economic consequence: firms' investments in human capital development will be under-financed relative to other forms of investment, and as a result, those investments that are made would be expected to experience above market returns.[4]

For investors, the lack of information on human capital investments makes it more difficult to develop an accurate picture of the future business prospects of a firm. To the extent that human capital increasingly shapes corporate success in the knowledge-based economy, investors today have less relevant information on publicly-traded companies than they did years ago. Yet the relative importance of such information has never been quantified across a wide range of firms. Many questions have been raised—but not yet answered. What are the effects of human capital investments on firm performance? How (if at all) are the effects of these hidden investments reflected in the stock market? If information on human capital investments were available, would investors be able to make better-informed portfolio decisions?

This paper begins to answer these questions by analyzing data from a new database developed by the American Society for Training & Development (ASTD). The database contains standardized information on training expenditures for hundreds of publicly-traded firms, and represents the best vehicle to date for exploring the relationship between human capital investments and firm performance.

In what follows we statistically establish a significant link between firms' investment in training and performance. In particular, firms that make unusually large investments in human

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3 Economic theory also points to another potentially important reason why firms may under-invest in human capital development; "general" (i.e., portable) forms of human capital development are subject to a "free-rider" problem. By "raiding", a firm can benefit from a human capital development investment made be another employer. [This is a direct result of the "problem" that employees cannot be owned.] The raiding/free-rider problem reduces firms' incentives to investment. And unless private capital markets operate with perfect efficiency (an assumption that is unlikely to be met), individual employees will not step in to eliminate that "inefficiency" through financing these investments themselves.

4 This under-investment is also likely to prove harmful to workers' future economic well-being. Once an individual leaves the school system, much (if not most) of the investment that is made in their ongoing learning—especially that learning that may translate into future earnings capacity—will take place at work. Consequently, any forces that reduce incentives for firms to invest in human capital development will tend to harm workers' employment and earnings' prospects.

capital development appear to subsequently enjoy excess stock market returns. This is consistent with the idea that training investments have future benefits to the firm, which the market capitalizes even though they do not immediately appear in accounting profits (and, in fact, may actually reduce current accounting profits through higher costs). The existence of this abnormal return suggests that firms may be under-investing in their workers' human capital development (even without considering the social benefits) and that portfolio investors guided by training expenditures would be expected to outperform the market.

The paper proceeds in five additional sections. Section II provides a brief review of the relevant economics literature. The third section discusses the conceptual issues associated with measuring the relationship between firms' human capital investments and their productivity. The fourth section of the paper reviews the ASTD data, the fifth section presents our empirical findings, and the sixth section provides our conclusion.

## II. Previous Research

Previous research on the effects of private training on firms has focused on productivity measures such as sales, and more generally has been limited by the paucity of data on firms' actual training investments. Not only does the present paper offer more detailed data on the amount of training expenditures and so can better assess the direct relation between training and performance, but it also represents the first attempt to examine the relationship between the human capital investments that firms make in their workers and subsequent stock market performance.

Bartel (1994) presents one of the first attempts to estimate the effects of private training on productivity using firm-level data, using a 1986 sample of 495 manufacturing firms. She finds that the provision of training programs between 1983 and 1986 is positively correlated with firms' 1986 sales per employee. However, the key explanatory variable of interest in her analysis is simply an indicator for whether the firm provides any formal training to employees, and not the dollar amount spent on training.

Holzer *et al.* (1993) analyze data for 157 Michigan manufacturing firms that had applied for state subsidies to support private training programs. They find that receipt of a training subsidy increases training hours within a firm by a factor of two to three in the short term, and reduces output "scrap rates" by around 13 percent. The dollar value of this reduction in scrap rates is between $30,000 and $50,000 per year. The survey does not, however, identify the training costs actually borne (invested) by the firm.

Black and Lynch (1996) analyze data from the National Center on the Educational Quality of the Workforce (EQW)'s national 1994 telephone survey of 2,945 private firms with more than 20 employees.[5] Respondents were asked to report on a variety of 1993 firm characteristics, as well as questions about training practices such as whether the firm provides any formal or structured training or any informal training to its employees. The survey does not include information on firm training expenditures, or any information that would enable us to convert the available indirect training measures into dollar terms. Black and Lynch find that the log of the number (or proportion) of workers who are trained in either 1990 or 1993 does not have a statistically significant correlation with the log of the firm's 1993 sales for either manufacturing or non-manufacturing firms. The provision of computer training has a positive, statistically significant correlation with sales for non-manufacturing firms (although only at the 10 percent significance cutoff), but not for manufacturing establishments. Interpretation of these estimates is complicated further by the fact that the EQW provides only cross-sectional data on firms, which limits the authors' ability to control for unmeasured firm characteristics.[6]

## III. Conceptual Issues

While it is natural to look for the benefits of training activity on measures of productivity, testing for such a relation is difficult to implement. First, uncertainty about the timing between the training investment and pay-off means that the returns may reveal themselves only at some point in the future after some lag of unknown duration. Second, focusing on firm profits or output requires using accounting data that may be excessively smooth. However, if training generates economic returns then that should also be reflected in the firm's equity valuation. Moreover, using stock market valuations avoids both of the pitfalls present with productivity measures. First, since equity market prices are forward looking they incorporate expectations of future benefits whenever they may be realized. Second, the market has incentive to focus on material changes rather than accounting noise, which mitigates some of the measurement and

[5] Our discussion of the EQW survey data draws on Black and Lynch (1998); also see www.irhe.upenn.edu/~shapiro/.

[6] For further discussion of this literature see Bartel (2000).

accounting complications. The validity of this approach is predicated on the assumption that market efficiency holds (i.e., the benefits from training investments are, indeed, recognized and priced by the market).

Our approach, therefore, is to look at both productivity and equity market valuation. This is similar to the approach used in the literature measuring the impact of investments in intangible assets.[7] Our empirical analysis relies on reduced form regressions of the following form:

$$Y_t = a + bz_{t-1} + cx_{t-1} + d(training_{t-1}) + eY_{t-1} + u_t \quad (1)$$

Where:

- Y is a number of different outcome measures measured at time (t)
- z is a vector of firm-choice inputs essentially reflecting investment decisions such as expenditures on R&D or capital investments
- x is a vector of firm-characteristic "control" variables such as industry and profitability
- u represents all omitted factors, functional form deviations, and measurement errors, and
- a, b, c, d and e represent the parameters to be estimated

Our training measure and each of the other covariates are measured during the previous period, including the lagged value of the outcome measure of interest to control for additional unmeasured heterogeneity in our sample of firms. Furthermore, because our measured training investment is a flow variable, we can also easily transform our regression into a "pseudo" first-differenced regression. In this case, we relate the "flow" of training as captured at a single point in time for each firm with *changes* in productivity, profitability or market valuation, conditioning on changes in other firm characteristics. This has the advantage of eliminating the firm-specific component of the outcome variable and hence much of the concern that the impact of training would be spurious due to unobserved firm characteristics.

In practice the first-difference version of our estimates yield findings quite similar to that of our basic model specification. The reason is that inclusion of the lagged dependent variable in equation (1) is essentially equivalent to estimating a model in which the change in the outcome measure of interest ($Y_t - Y_{t-1}$) is the outcome of interest. The primary distinction between the first-difference model and equation (1) is that the latter does not restrict the coefficient on the lagged outcome measure to equal 1.

## IV. Data

Our analysis uses the 1996-98 training data collected by the American Society for Training & Development (ASTD), which were then merged with 1995-99 Compustat (Standard and Poors) financial data on publicly-traded companies.

The ASTD data were collected using standard measures and definitions for formal education and training investments that were developed by ASTD in partnership with a group of large corporations (members of ASTD's Benchmarking Forum, a consortium created as a vehicle for the sharing of training data, best practices, and other relevant insights). The measures were selected for their capacity to accurately capture relevant information on training investments in a standardized way across diverse organizations. The measures were then embedded in ASTD's "Benchmarking Service;" any organization that submitted their data using ASTD's measures received free benchmarking information from ASTD on how their training investments compared with a variety of comparison groups. All participating organizations were guaranteed that their data would be kept confidential.

The 1996-98 training data were collected by ASTD in the following year (1997-99, as organizations were asked to report on their training investments for the previous year). Some training measures (such as content categories) were slightly modified in some years; in such cases, data were adjusted to ensure consistency across years. Data were provided by two groups of organizations: (1) members of the ASTD Benchmarking Forum, and (2) any other organizations interested in using the measures and submitting their data for benchmarking. Most organizations that have participated in the Benchmarking Service have submitted data in only one year, although some did submit data for two or all three years. Organizations were permitted to submit their data either for a self-contained subunit or for the organization as a whole.

We would expect *a priori* that the firms in our sample overstate the average training investments made by all firms in the economy, since organizations that make limited investments in training would be less likely than other firms to seek benchmarking information from ASTD or even be aware of the ASTD system of metrics. However, our sample does not appear to be

[7] Hall (1999) surveys the literature focusing on patents and R&D activity.

unrepresentative; an analysis of the 1996 ASTD data revealed that they were comparable to a random, national training survey conducted by the Bureau of Labor Statistics in 1995,[8] and the next two years of ASTD data are generally consistent with the 1996 data.

ASTD received over 2,500 data submissions for 1996 to 1998. Of those, 575 were from companies publicly traded on a major United States stock market (New York Stock Exchange, American Stock Exchange, NASDAQ). These publicly-traded firms were selected for our analysis, and their training data were merged with publicly-available financial data obtained from Standard and Poors (S&P) for the years surrounding the training data. For purposes of analysis, stock return data were typically examined in the year following the training data. It should be noted that these years, 1997 to 1999, were marked by significantly higher-than-average returns for the stock market. At the time this analysis was initiated, 1999 financial data were only available for the first half of the year. For analysis purposes, those data were annualized as appropriate for each specific measure. Multiple observations were included in the sample for publicly-traded companies that submitted data in multiple years. A total of 63 firms submitted data in two different years, and 18 firms submitted data for all three years. Data from the companies that had submitted reports from multiple subunits in a single year (N=43) were combined into a single observation, with the subunits weighted by number of employees for purposes of consolidation.

One complication for our analysis comes from the fact that training information was reported by sub-units within firms, while Compustat measures report on the productivity, profitability and market valuation of the firm as a whole. Table 1 provides some sense for the scale of this problem. As seen in the top panel of the table, on average the ASTD surveys capture information on training investments for 9,911 employees. In contrast the average firm size in our sample is equal to 43,431 employees, as indicated by the Compustat data reported in the bottom panel of Table 1. Put differently, for the average firm in our database we measure training investments using a sample of about one-quarter of all employees. As a result our baseline regression estimates implicitly assume that the training investments made by the one-quarter of each firm for which we have training information is representative of the firm as a whole. One way that we attempt to control for potential deviations from this assumption is to

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8 Unfortunately, 1995 has the only year in which the Bureau of Labor Statistics conducted this survey.

include an indicator variable that is equal to 1 for the firms in our sample for which the ASTD survey reports training information for half or more of all the employees in the overall firm.

Table 1 also provides additional detail about the sample of firms used in our analysis.[9] On average these firms invest $28.6 million annually in training, equal to around $700 per employee per year. By way of comparison the Compustat data suggests that firms spend on average around $5,500 per employee on research and development; thus, firms spent about 13 percent as much on training activities as on R&D. To some extent, however, this is a comparison of apples to oranges, since expenditures of training only capture the direct cost of "formal training." These direct costs do not include the "indirect costs" (employees' compensation cost and lost productivity while they are in training, or travel cost and time, or overhead). Nor do these direct costs capture the cost of "informal learning." Some estimates have placed these other, unmeasured cost of at many multiples (5-10) of the direct, measured cost (Bassi, *et al.* 2000).

Another comparison is suggested by the finding that the average firm in our sample receives about $18,000 in net income per employee per year during the 1996-1998 period; thus firms devote around 4 percent of profits to training activities. Understanding the net effects of these training investments on profitability is the goal of the next section.

## V. Empirical Analysis

Table 2 provides some initial evidence that investments in private training improve performance by ranking firms according to their per-employee training investments and comparing performance measures in the following year across quartiles. As seen in the table, firms in the 3rd and 4th quartiles with respect to firm training experience annual changes in share prices equal to 34.3 and 30.7 percent, respectively, roughly double the return experienced by firms in the bottom quartile (15.3 percent). For comparison purposes, this is higher than the 25.5 percent average annual return for the S&P 500 index for the same years (weighted to reflect the yearly composition of the database). The table reveals similarly substantial differences across quartiles with respect to sales per employee, gross profit margin, and market capitalization per

[9] One observation, whose change in stock market price was in excess of 10 standard deviations above the mean, was excluded from the analysis as an extreme outlier after it was found that it was significantly altering total stock return regression results (note: the organization was in the third quartile of training expenditures per employee, and fourth quartile in total stock return).

employee, and somewhat less dramatically for sales per employee, return on assets and Tobin's Q (which is essentially the ratio of market to book value of the firm).

These simple cross-tabulations are suggestive of some relationship between training and performance, although these correlations of course do not necessarily imply a causal effect. In what follows we present the results of our more formal regression analysis, including a calculation of the implied rate of return to private training. We then present the results of a variety of sensitivity and model specification tests.

### *Main Findings*

Table 3 presents the results of regression models that control for each firm's productive capacity as measured by investments, R&D, measures of the firm's financial performance from the past year including gross profit margin, assets, the debt to asset ratio, the price to earnings ratio, the price to sales ratio, and a series of industry dummies for 2-digit SIC codes. To further control for the possibility of omitted variables we also include the lagged value of the dependent value as a control in the model, and to account for the fact that firms completed the ASTD training survey at different points in time we include a series of year dummies to control for period effects. We also include an indicator for whether the business unit that reports on the ASTD survey accounts for more than 50 percent of the firm's total employees. All of our variables are initially measured on a per-employee basis, although similar results are derived for per-firm measures. Because the control variables typically have the expected correlations with firm performance (Table 3), we focus our attention on describing the results for the training expenditure variable.

As seen in the first column of Table 3, training expenditures have a very small and statistically insignificant correlation with total sales per employee in the next year. Training expenditures actually have a *negative* and statistically significant correlation with income (profits), as seen in column two. This result is unsurprising given that training imposes real costs on firms. Although we have attempted to mitigate this problem by relating training expenditures in one period to income during the subsequent year, this is an imperfect fix given the considerable serial correlation in a firm's annual training expenditures.

On the other hand, private training appears to have a positive effect on long-run measures of a firm's profitability in the future as captured by changes in Tobin's Q and share prices (columns three and four of Table 3), consistent with the idea that training improves productivity with some lag. The results imply that an increase in training expenditures of $100 per employee – equal to around 15 percent of a standard deviation in the training measure – increases the annual change in the firm's stock price by 0.8 percentage points. (By way of comparison, the average percentage change in stock prices for the firms in our analytic sample is equal to 25.1 percentage points, as shown in Table 1).

Our point estimate of the effect of private training on share price suggests that firms are earning a supernormal rate of return from training investments, which implies that they are substantially under-investing in training. The logic behind this conclusion is that in a perfectly competitive market environment, we would expect firms to invest in training up to the point where the marginal returns to training are similar to those derived from other investments. During the year in which the training investments are made the average firm in our sample has a market capitalization equal to $419,664 per employee.[10] Thus our estimates—taken at face value—imply that an additional investment of $100 per employee on training increases the firm's market value by $3,357 per employee ($419,664 × 0.008). Put differently, because the market value of the firm simply reflects the present value of the firm's expected stream of profits (discounted at whatever average rate of return is used by market investors), our estimates suggest that each dollar invested in training leads to $33.57 dollars in benefits to the firm.

Looked at another way, however, these estimates imply a significantly lower, albeit still supernormal, return. As was noted earlier, our measures of the "direct cost" of formal training substantially underestimate the true cost of "learning"—perhaps by as much as a factor of 5-10 (when the cost of employees' time and informal learning are considered). If this is the case, then the return on a dollar invested in "learning" may be more in the range of $3.36 to $6.72.

While this would still be a supernormal return, it would not be out of the question. In fact, the return implied by our estimate for a dollar invested in R&D is $3.44. Researchers have long recognized that the risk associated with R&D investment results in an above average return to it. It may be that an analogous argument applies to investment in training. Not only is it a risky investment (in part because employees might leave the firm after the investment in them

[10] Table 1 shows that during the year after our training measures, the ASTD sample has an average market capitalization of $525,000 per employee. Since the firms in our sample experience a 25.1 percent increase in market value on average following the year in which we have measured training investments, the average market valuation in the "base year" is equal to $525,000 / 1.251 = $419,664.

has been made), it is an investment that the market knows nothing about (since it is not reported). The confluence of these two phenomena would be expected to generate above average returns.

It may also be the case that the training measure used in our analysis is serving, at least in part, as a marker for other unmeasured firm-level attributes that are correlated with a firm's long-term profitability (and thus equity market valuation). From the perspective of an individual firm, this possibility means that an incremental increase in training expenditures may not yield the same dramatic increase in stock share prices that are implied by our estimates in column 4 of Table 3—or possibly even the much lower, but still supernormal returns outlined above (336%-672%).

From the perspective of an individual investor, however, it is far less important whether the correlation between training and stock value represents a causal training effect on firm performance or instead whether training is simply a leading indicator for other productive firm activities or attributes. In the short run, so long as the underlying structural relationship between training and whatever firm characteristics affect productivity continues to hold, investment portfolios that incorporate information about firm training expenditures will yield supernormal rates of return. Consistent with these results, hypothetical portfolios selected on the basis of a firm's training expenditures per employee yielded returns that were significantly higher than major market indices. Portfolios comprised of only firms that spent more than $1,000 per worker on training, weighted by regression-predicted returns using a reduced set of variables (including training per employee), outperformed the S&P 500 index by an annual average of 24.5 percentage points from 1997 to 1999.[11]

### *Sensitivity Analysis*

The key results shown in Table 3 already control for a large number of firm-specific factors so as to reduce concerns about a spurious correlation. In particular, including the lagged dependent variable should capture much of the unobservable firm-level characteristics that we cannot measure – such as quality of management. Additionally the results of our robustness

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[11] Although full data were not available at the time of this analysis, initial estimates indicate that a similar portfolio outperformed the S&P 500 index by 4.7 percentage points during 2000. This finding is important because 2000 was a significantly different year in the stock market than the other three years in this analysis, as major market indices declined sharply during 2000, in contrast to their large positive returns in 1997-99. This provides some evidence

checks, which are summarized briefly in Table 4, do not appear to be very sensitive to decisions about the following:

- whether to measure our variables on a per-firm or per-employee basis
- whether to weight the analysis by firm size (which implicitly treats each employee rather than each firm as a single training experiment)
- whether to estimate a first-difference model rather than the lagged-dependent-variable model used in Table 3
- the choice of other control variables to include in the models

The one estimation decision to which our findings are somewhat sensitive concerns the functional form of the regression model. As it turns out, the key correlation from Table 3 between training expenditures and stock prices appears to be driven by the difference in market performance by firms at the very top and very bottom of the training distribution. This conclusion comes from ranking the firms in our sample by their training investments per employee, dividing the sample into twentieths on this basis, and then re-estimating our regression model replacing the simple training measure used in column 4 of Table 3 with dummy indicator variables that identify into which of the twenty groups each firm falls. When we re-estimate our model using this type of non-parametric step function, the only statistically significant contrast in stock price changes is between the top 5% of firms (which on average spend more than $2,700 per employee on training per year) and the bottom 5% (which spend less than $50 per employee). None of the other training indicators are statistically significant, even though the difference in training expenditures between other groups is also quite substantial. (For example, the second-to-highest group spends around $1,700 per employee per year on training, although these firms do not appear to experience a higher stock price return relative to the firms that spend the least on training).

What explains the sensitivity of our stock-price estimates to decisions about functional form? One possibility is that there are sharp non-linearities in the causal relationship between training investments and long-term firm performance. For example, modest increments in training expenditures for most firms may have little effect on the firm's performance, although unusually

that an investment strategy based on firms' human capital investments can produce better-than-average returns in a variety of market conditions.

high training investments above some threshold may have disproportionately beneficial consequences for the firm's long-term outcomes.  An alternative explanation that we cannot rule out is that even our very rich model specification fails to capture heterogeneity between the firms that spend the most and the least on training, and that these unmeasured differences are driving our estimates.  Neither explanation, however, rules out the possibility of using information about firm training expenditures to extract supernormal rates of return from the stock market. However, if this were to become a widespread practice, these explanations could somewhat complicate efforts to construct investment portfolios that yield above-market returns over the long term.

**VI. Conclusions**

In a well-functioning economy capital markets allocate resources to the most productive firms.  The prospect of increasing shareholder value motivates firms to engage in productive activities while the lure of above-average returns leads investors to direct funds to the firms that undertake such activities.  The analysis presented here suggests that excess returns have not been eliminated in the case of training investments that firms make in their workers.  Firms that engage in unusually high levels of training subsequently experience far higher gains in stock-market valuation compared with those firms spending the least on employee training.  Whether these differences reflect the causal effects of training on firm productivity, or whether the high-training firms are simply more productive in other unmeasured ways, cannot yet be determined with absolute certainty.

Nevertheless, our results highlight an unexploited investment opportunity – the possibility of investing in those firms that engage in the highest levels of training.  This opportunity could have the additional effect of motivating firms to document and publicly reveal their training investments, as well as encouraging them to undertake additional training investments.  This latter possibility could, in turn, create benefits not only for firms and their investors, but also for workers and society.

Our results also suggest that more effort should be applied to understanding what makes high-training firms unusually productive.  Given the widespread belief that human capital investments improve productivity in other contexts, the odds are good that this process of discovery will reveal that private training expenditures do, in fact, have a substantial causal effect on firm performance.  The end result is that encouraging investors to begin to pay attention to how firms invest in the human capital of their employees could promote a process through which firms begin to view their workers as assets rather than costs.

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**Table 1**
**Descriptive Statistics for Firm Sample**

| | N | Mean | Standard error |
|---|---|---|---|
| Variables from ASTD Firm Survey | | | |
| Estimated total training exp ($1,000) | 462 | $28,580 | $3,029 |
| Training exp. per employee | 493 | $704 | $28 |
| # of employees on which training data are based | 493 | 9,911 | 1,651 |
| Dummy, training data for at least 50% of organization | 457 | 0.40 | 0.02 |
| | | | |
| Variables from Compustat | | | |
| # of employees | 462 | 43,431 | 4,273 |
| Total R&D exp. ($ mil.) | 493 | $259.4 | $38 |
| R&D exp. per employee | 493 | $5,479 | $502 |
| Dummy, no R&D | 493 | 0.56 | 0.02 |
| Total capital exp. ($ mil.) | 421 | $721.0 | $101 |
| Capital exp. per employee | 412 | $22,413 | $2,754 |
| Total assets ($ mil.) | 474 | $23,808 | $3,257 |
| Assets per employee ($1,000) | 446 | $729 | $69 |
| Sales per employee ($1,000)* | 438 | $285 | $12 |
| Income per employee ($1,000)* | 437 | $18 | $1.8 |
| Gross Profit Margin (%) | 454 | 34.2 | 3.1 |
| Return on Assets (%) | 458 | 4.3 | 0.36 |
| Mkt capitalization per employee ($1,000) | 449 | $525 | $40 |
| Price to earnings ratio | 431 | 29.52 | 2.50 |
| Price to sales ratio | 477 | 1.75 | 0.08 |
| Price to book ratio | 480 | 3.81 | 0.38 |
| Tobin's Q* | 383 | 1.64 | 0.09 |
| Stock market return (% change stock price)* | 476 | 25.1 | 2.9 |
| | | | |
| Industry, 2-digit SIC codes (%): | 493 | | |
| Agriculture | | 0.0 | |
| Mining / construction | | 3.2 | |
| Food / tobacco | | 3.4 | |
| Textiles / apparel | | 0.8 | |
| Lumber / furniture / paper | | 4.7 | |
| Chemicals / petroleum | | 9.5 | |
| Rubber / leather / stone / glass | | 1.0 | |
| Metals | | 2.6 | |
| Machinery | | 6.1 | |
| Technology | | 13.0 | |
| Transportation equipment | | 8.3 | |
| Transportation services | | 2.4 | |

| | |
|---|---|
| Telecom services | 5.3 |
| Utilities | 7.3 |
| Trade | 8.7 |
| Financial | 18.9 |
| Services | 4.7 |

SOURCE: Authors' calculations from ASTD 1996-1998 firm training survey and Compustat data.  All descriptive statistics are for same year as training data except for those marked with (*), which were used as dependent variables and are calculated for the following year.

**Table 2**
**Firm Productivity, Profitability and Market Valuation by Training Investments**

| | Training Expenditures Per Employee: | | | |
|---|---|---|---|---|
| | Bottom quartile | $2^{nd}$ quartile | $3^{rd}$ quartile | Top quartile |
| N | 118 | 120 | 121 | 117 |
| Annual stock market return (% change in share price) | 15.3 | 20.0 | 34.3 | 30.7 |
| Tobin's Q | 1.63 | 1.42 | 1.75 | 1.79 |
| Sales per employee ($1,000) | 175.7 | 302.5 | 343.8 | 320.8 |
| Income per employee ($1,000) | 11.5 | 15.0 | 19.3 | 24.5 |
| Gross profit margin | 22.8 | 37.4 | 35.7 | 40.4 |
| Return on Assets | 4.2 | 4.4 | 3.2 | 5.5 |
| Market capitalization per employee ($1,000) | 263.2 | 533.5 | 638.5 | 668.2 |

SOURCE: Authors' calculations from ASTD training and Compustat data.

**Table 3**
**Regression-adjusted Effects of Private Training on Firm Performance and Stock Market Value**

| | Sales / employee (x1000) | Income / employee (x1000) | Tobin's Q / employee | Stock Market Return (%) |
|---|---|---|---|---|
| Training / employee | 0.004 [0.56] | -0.092 [2.51]** | 0.044 [1.75]* | 0.008 [1.68]* |
| Assets / employee | 0.103 [1.08] | 0.916 [2.29]** | -0.091 [0.24] | 68.96 [1.48] |
| Investment / employee (x100) | -0.003 [0.65] | 0.031 [1.95]* | -0.006 [0.47] | -0.010 [1.63] |
| R&D / employee (x100) | -0.003 [0.29] | 0.103 [2.04]** | 0.056 [1.42] | 0.082 [1.85]* |
| Dummy, no R&D | -0.014 [0.08] | 1.285 [1.94]* | 0.736 [1.43] | 10.51 [0.99] |
| Lagged dependent variable | 0.986 [65.12]*** | 0.666 [15.12]*** | 0.841 [15.60]*** | 0.354 [4.40]*** |
| Assets (x100) | | | | 0.0086 [1.16] |
| Market capitalization (x100) | | | | 0.009 [0.64] |
| Debt / assets | 0.083 [1.28] | 0.049 [0.18] | -0.177 [0.79] | 14.02 [0.54] |
| Beta | | | -0.021 [0.36] | 12.48 [1.63] |
| Gross profit margin | | | 0.002 [1.09] | -0.073 [0.31] |
| Return on assets | | | 0.0008 [0.84] | 1.278 [1.06] |
| Price / earnings | 0.003 [0.18] | 0.006 [4.71]*** | 0.002 [3.13]*** | 0.375 [4.00]*** |
| Price / sales | | | -0.018 [0.62] | -9.425 [2.54]** |
| Price / book | | | | -0.721 [1.94]* |
| Sales / employee | | | -0.0002 [0.95] | -0.021 [0.71] |
| Income / employee | | | 0.0007 [0.28] | 0.137 [0.40] |
| Reporting 50% | 0.011 [0.60] | -0.176 [2.39]** | -0.061 [1.18] | -8.817 [1.36] |
| Year dummies | Yes | Yes | Yes | Yes |
| Industry dummies | Yes | Yes | Yes | Yes |
| Constant term | 0.102 [0.80] | -0.012 [0.03] | -0.470 [1.28] | -5.80 [2.03]** |
| Number of observations | 342 | 313 | 292 | 314 |
| Adjusted R-squared | 0.96 | 0.76 | 0.79 | 0.19 |

NOTES: OLS regressions, first row of each column is the dependent variable. All explanatory variables measured in the year prior to the year in which the firm performance variables are measured. T-statistics in brackets; * = Statistically significant at 10%; ** = Statistically significant at 5%; *** = Statistically significant at 1%.

**Table 4**
**Sensitivity Analyses for Regression-adjusted Effects of Private Training on Firm Performance and Stock Market Value**

| | Sales / employee | Income / employee | Tobin's Q / employee | Stock Market Return |
|---|---|---|---|---|
| Variables measured per firm rather than per employee | 0.004 [0.44] | -0.096 [2.70]** | 0.045 [1.81]* | 0.008 [1.68]* |
| Weighted least squares, using # employees per firm as weights | -0.013 [1.96]* | -0.094 [3.39]*** | 0.017 [0.79] | 0.008 [1.88]* |
| First difference model specification[a] | -0.001 [0.08] | -0.028 [0.75] | 0.013 [0.60] | 0.008 [1.72]* |

NOTES: OLS regressions, first row of each column is the dependent variable. All explanatory variables measured in the year prior to the year in which the firm performance variables are measured. T-statistics in brackets; * = Statistically significant at 10%; ** = Statistically significant at 5%; *** = Statistically significant at 1%. a = First difference model specification for stock market return equation uses single-year stock price return as the outcome measure, since this variable is already in "change" form.