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# Intangible Investments and their Consequences: New evidence from unlisted Japanese companies

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# Intangible Investments and their Consequences: New evidence from unlisted Japanese companies*

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Abstract

Although there is widespread recognition of the importance of investment in intangibles, this is difficult to observe from the published data, even for listed companies. This study investigates the extent of investments in intangibles and their consequences for unlisted companies in Japan. For this purpose, we employ unique microdata gathered from a recent survey of unlisted companies and financial information from elsewhere matched with the surveyed companies. The analysis covers a broad range of intangible investment activities involving scientific and technological research and development, software production, product development and design, content production, marketing, organizational change, and education and training (both on and off the job). The empirical results suggest that these investments enhance the growth of companies rather than their profitability.

*Keywords:* Intangible investment, Profitability, Growth, Unlisted companies, Japan

*JEL classification:* L25, M21, O33



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## 1. Introduction

Business investments in intangibles are difficult to observe by definition, particularly when compared with tangibles such as plant, machinery, and equipment. However, the importance of investment in intangibles has been recognized and highlighted in recent years. As a result, there is increasing demand for economic analysis to incorporate these intangible activities into modeling as an aid for providing a greater understanding of the economy and business behavior. For example, at the macro level, a number of studies have attempted to define and measure the intangible capital of the economy and to estimate its impact on economic growth: see, e.g., Corrado et al. (2005, 2009) for the US and Fukao et al. (2009) for Japan. Importantly, Corrado et al. (2005) suggested three broad categories of business intangibles in the US, being computerized information, innovative property, and economic competencies. Miyagawa and Hisa (2013) later enhanced and applied this approach at the industry level for the Japanese economy.

In parallel, there are many empirical studies based on firm-level microdata related to intangibles. To start with, there is the hypothesis that research and development (R&D) by firms (as one type of intangible investment) helps create R&D capital (Hall et al., 2010).[1] In turn, advertising by firms (as another type of intangible investment) then accumulates as brand capital (Belo et al., 2014). The measurement of the extent of these investment activities is usually by firm expenditure on the items to which they are related.[2] Existing studies have attempted to capture the business investment in intangibles in similar ways and to estimate their impact on the firm performance. Recently, for example, the hypothesis that organizational capital accumulates according to the level of selling, general, and administrative expenses has been put forward (Tronconi and Marzetti, 2011).

Listed companies often report these intangible capital-related expenditures, and this implies the feasibility of empirical work in the research stream. For listed companies, other published financial information is also easily available. Even more importantly, the current market prices of listed company

[1] The outcomes of R&D activity have also been measured by patents (Griliches, 1981, 1990; Nagaoka et al., 2010). Elsewhere, Bosworth and Rogers (2001), Greenhalgh and Rogers (2006), and Sandner and Block (2011) estimated the value of trademarks in addition to R&D and patents, while Block et al. (2014) considered the relationship between trademarks and the financial valuation of start-ups by venture capitalists.

[2] For pioneering studies, see also Grabowski and Mueller (1978) and Hirschey (1982).

shares can be observed directly through the market where they are listed, thereby providing specific information about the current market values of these companies. This enables us to estimate readily the value of the intangibles of a company, merely by subtracting the value of its tangibles from its current market value.

Using this framework, whether the company is listed or unlisted is critical to the feasibility of empirical analysis. In stark contrast, unlisted companies usually disclose very limited information about their business activities, including even in their financial statements. In particular, it is impossible to observe the current market prices of unlisted company shares. Studies concerning the intangibles of unlisted companies are therefore substantially fewer. However, one promising and realistic alternative involves the use of a questionnaire survey of these companies. The purpose of this study is then to investigate the extent and consequences of intangible investments by unlisted companies in Japan. We employ a unique dataset obtained from a new questionnaire survey of investment in intangibles, and match this with unlisted company financial information from another data source. A remarkable feature of our analysis, as discussed later, is that we incorporate a broad range of intangible investment activities in a single comprehensive survey.[3]

The remainder of the paper is organized as follows. Section 2 provides a brief sketch of the new survey of intangible investments and the dataset constructed for the analysis. Section 3 discusses the level of investments in intangibles by the surveyed unlisted companies. Section 4 examines empirically the relationships between these investments and company performance, as measured by profitability and company growth. Section 5 presents our conclusions.

## 2. Data

[3] This distinguishes this study from others based on other surveys in Japan, including *the Survey of the Financial Statements Statistics of Corporations by Industry* by the Ministry of Finance; *the Basic Survey of Japanese Business Structure and Activities* by the Ministry of Economy, Trade and Industry; *the Survey of Intellectual Property-Related Activities* by the Japan Patent Office (Kani and Motohashi, 2012); and *the Japanese National Innovation Survey* by the National Institute of Science and Technology Policy. These include only some of the intangible investments covered in this study.

*The Survey on Intangible Investments in Japan* was distributed in January 2013 by mail as part of the research project "Research on Intangible Capital in Japan" at the Research Institute of Economy, Trade, and Industry. The subject of the survey was Japanese firms included in the industries shown in Table 1.[4] Along with 2,940 listed companies, the survey included 4,348 unlisted firms sampled from the Corporate Financial Database of Teikoku Databank, Ltd. (TDB), on the proviso that the database also contained the firm's financial information for the last three accounting years.

Altogether, 203 listed companies and 514 unlisted firms provided responses to the survey, with a relatively larger sample and higher response rate for the unlisted firms. The research project purchased additional financial information about these unlisted firms for the last three accounting years from the TDB database, and this enabled us to match the individual data in the questionnaire survey and three years of financial information for the same firms. We thereby focused the analysis on the microdata of unlisted firms.

Of the 514 unlisted firms, we excluded from the sample three firms that were not stock companies (*Kabusiki-gaisya*).[5] We also excluded an additional 13 stock companies that had changed their accounting year-end within the last three accounting years. The survey included a question concerning the level of intangible investment in each of eight categories, so we excluded 39 observations where there was no response in at least one of the eight categories. Finally, we excluded five observations that had at least one missing value and another five observations with at least one obvious outlier in the explained or explanatory variables described in Section 4. In conclusion, we obtained a final dataset for 449 unlisted companies to which we applied all of the analyses in this paper.

Table 1 presents the distribution by industry of the unlisted companies.[6] Overall, there is evidence of a relative uniform distribution over these 22 industries. Broadly, 70 percent of the companies are in

[4] The survey also involved the information and communication, and the broadcast industries. However, we have not included these industries in Table 1 and in the analysis in the paper because unlisted firms in these industries were not included as respondents for the survey.

[5] We excluded one limited partnership (*Gousi-gaisya*), one cooperative, and one social medical corporation. The resulting 511 stock companies included six special limited-liability companies (*Tokurei-yuugen-gaisya*), which remained in the final sample of 449 unlisted companies.

[6] For the industrial classification, we used the company information from the most recent period in the matched

the manufacturing sector (industry codes 1–14) and 30 percent are in the nonmanufacturing sector (industry codes 15–22).

***** Table 1 *****

**3. Investments in intangibles**

In the survey, the following question was used to extract information about the firm's business investments in intangibles.

Q. How have *intangible investments* been executed in your firm in the past five years (fiscal years 2007 to 2011)? Please circle the response that applies to each item from A to H below.

| | | Continual Execution | Occasional Execution | Inexecution |
|---|---|---|---|---|
| A | Scientific and Technological Research and Development | 1 | 2 | 3 |
| B | Software Production | 1 | 2 | 3 |
| C | Product Development and Design | 1 | 2 | 3 |
| D | Content Production | 1 | 2 | 3 |
| E | Marketing | 1 | 2 | 3 |
| F | Organizational Change | 1 | 2 | 3 |
| G | Education and Training (On the job) | 1 | 2 | 3 |
| H | Education and Training (Off the job) | 1 | 2 | 3 |

TDB database.

The responses to this question provided valuable and broad information about each firm's investment activities in intangibles for each of the eight categories in the previous five years.[7] The previous page of the questionnaire provided respondents with more detailed descriptions of each of these categories (A–H) as follows:

A: Execution of scientific and technological research and development (including not only in the natural sciences, but also in the humanities and social sciences)

B: Expenditure on software (such as office and application software, business systems, accounting systems, production management systems, and databases)

C: Execution of product development and design (designing how to handle the product or service, and its function, production, and exterior)

D: Production of content (entertainment and artistic original work expected to contribute to future sales and profits)

E: Execution of marketing (market research, promotional activities and advertising, brand building, change of trademarks, and change of promotional materials)

F: Execution of organizational change (activities aimed at improving business efficiency and effectiveness, such as the planning and implementation of a program of organizational improvement and business restructuring, and the planning and implementation of management strategy)

G, H: Execution of education and training (both on-the-job and off-the-job training, including training programs assigned by the firm away from day-to-day work)

Table 2 summarizes the responses to the question, for all these companies and separately for the manufacturing and nonmanufacturing sectors. Overall, one-quarter of the companies continually executed Scientific and Technological R&D, and then 37 percent did so continually or occasionally. The Product Development and Design category is the more commonly executed type of investment compared to Scientific and Technological R&D, with 36 percent of them continually executing this type

[7] In other words, the survey supposes that these activities accumulate as intangible capital, which is substantially in line with the argument in Corrado et al. (2005).

of intangible investment, and then more than half continually or occasionally. About two-thirds of them executed Software Production, about half were engaged in Marketing, and 58 percent recorded Organizational Change on a continual or occasional basis. Content Production displayed the lowest tendency among the eight intangible investment categories, with 84 percent of companies not executing this type of investment. In contrast, On-the-job Education and Training exhibited the greatest tendency (i.e., the most generally undertaken) with almost half of them continually executing this type of investment, and then almost three quarters continually or occasionally. Off-the-job Education and Training also appears relatively common, with seven out of every ten companies continually or occasionally engaging in this type of investment.

***** Table 2 *****

Regarding differences between the manufacturing and nonmanufacturing sectors, Scientific and Technological R&D was more commonly undertaken in the manufacturing sector, with 32 percent of manufacturing companies continually executing this type of investment, and then almost half continually or occasionally. The proportion of continual execution in Product Development and Design was also substantially higher for manufacturing-sector companies. On the other hand, manufacturing companies displayed a lower tendency for engaging in Marketing, while Organizational Change and Education and Training (On-the-job and Off-the-job) exhibited relatively similar distributions across the two sectors.

## 4. Analysis

Using the constructed dataset, we proceeded to examine the relationship between the business investments in intangibles and the performance of these companies. In particular, we estimated empirically the effects of the extent of these investments on the profitability and growth of the companies (Leitner and Güldenberg, 2010). As the explained variable in the estimation, we specified profitability using one of two variables, being the company’s return on assets (ROA) and the return on

sales (ROS). We also adopted two alternative measures to evaluate company growth, being the company's growth of sales and the growth of employment. We used these specifications for the explained variables because they are both representative of the performance measures in the microanalysis of the companies and obtainable given the limited information available for these unlisted companies.

We specified the explanatory variables for the estimation as follows. First, we constructed an aggregate variable proxying the level of investment in the intangibles of the company, *Score*, by aggregating the responses to the eight categories (A–H) in the survey question, each of which provides values of Continual Execution = 2, Occasional Execution = 1, and Inexecution = 0. Consequently, the value of *Score* ranges from 0 to 16, with larger values generally indicating the greater proclivity of a company to invest in intangibles. We note that this variable is constructed by reversing the order of the responses to the original question described in Section 3.[8] Table 3 details the distribution of *Score*. Overall, one of every ten companies executed none of these investment activities in intangibles (*Score* indicates 0) and about half are distributed in the range 0–6.[9]

***** Table 3 *****

We then specified key characteristics of each company as control variables. As a baseline specification, these comprise 22 industry identifiers, the size of the company, and the differences in their accounting years using 21 industry dummies, the logarithm of the number of employees in the first (i.e., the oldest) year of the three observed accounting years, and an accounting year dummy. The accounting year dummy *Y2009* is defined as one if the first period of the observed three accounting years concludes in calendar year 2009 (i.e., not in 2010). As an additional specification, we attempted to further control

[8] We did this only to improve the intuitive understanding of the empirical results for *Score*, such that a higher value indicates a greater level of investment.

[9] Note that *Score* results from the aggregation of the eight ordinal scale variables. For reference, we provide the Pearson and polychoric correlation coefficients for these eight variables in Table A1.

for financial characteristics of the company, being the current ratio and the debt ratio in the first year of the observed three accounting years.

Table 4 provides the definitions and summary statistics for the explained and explanatory variables. The first four rows provide information on the explained variables. Both profitability variables are the average of the profit rate in the last two periods, and both growth variables are the compound annual growth rates between the first and the most recent period (Falk, 2012). These measures permit any relatively long relationships to be reflected as much as possible. For instance, the statistics in Table 4 illustrate that the growth rate of sales tends to be substantially higher than the growth rate of employment in the companies. The next five rows further address the explanatory variables. The *Score* exhibits 6.5 in the mean. The mean for *Y2009* indicates that about two out of every ten companies we include in the analysis had supplied information for accounting years 2009 to 2011, whereas about eight out of ten companies in the sample, i.e., most, represent information for accounting years 2010 to 2012.

***** Table 4 *****

Table 5 provides the empirical results. We estimated all models, [1] to [8], using ordinary least squares.[10] Models [1] to [4] correspond to the regressions for profitability, and Models [5] to [8] represent regressions for growth. Initially, the estimated coefficients for the variable *Score* are positive in all eight models, which suggests a basic positive relationship between the investment in intangibles and company performance. There is no clear difference in the estimated coefficients for *Score* for the two regressions with the one performance variable (e.g., between [1] and [2]).

In particular, all four regressions specifying company growth ([5] to [8]) as the explained variable exhibit statistically significant estimates for *Score*, while only one for profitability, i.e., the ROS [3], is

[10] It would be better if we could apply a more structured analysis (e.g., Evangelista and Vezzani, 2011). However, we concentrate on the estimates using ordinary least squares partly for simplicity, but also because of data limitations precluding such an extended analysis.

statistically significant.[11] Based on these estimates, a one-point increase in *Score* resulted in about a 0.1 percentage point increase in ROS, a 0.3 percentage point increase in the sales growth rate, and a 0.4 percentage point increase in the employment growth rate. These results support our argument that these investments in intangibles tend to enhance the growth rather than the profitability of companies, as measured by sales and employment.[12]

***** Table 5 *****

As a supplemental analysis, we converted the individual values for the eight categorized items A–H (Continual Execution = 2, Occasional Execution = 1, and Inexecution = 0) to Z-values and aggregated the eight Z-values into a new variable *Z-Score* and re-estimated all models, after replacing the variable *Score* with *Z-Score*. Table A2 provides the estimation results. As shown, the results are similar to those of Table 5, with the exception that the estimated coefficient for *Z-Score* in the ROS model [3] is now statistically insignificant.

## 5. Conclusion

Despite their potential importance, the investments in intangibles are generally difficult to figure out, particularly in unlisted companies. After matching the microdata from a survey of intangible investment and financial information for the surveyed companies, we explored business investments in intangibles across broad eight categories. The statistics provide unique and invaluable information for unlisted Japanese companies. We further investigated the relationship between the levels of investment in various types of intangibles and various measures of company performance. The estimation results

[11] As described in Table 4, the variable ROA is defined based on the ordinary profit (*Keizyou-rieki*) of the company. The study also tested other specifications in which the ordinary profit was replaced with operating profit (*Eigyou-rieki*) and net profit after tax. These specifications provided similar results to [1] and [2] in Table 5, for which the coefficients of the *Score* were positive, but statistically insignificant.

[12] This result is somewhat reasonable in that the costs involved in these activities work to reduce profit of the company in the same period.

indicate that intangible investment tends to increase the growth of companies rather than their profitability. Therefore, it is beneficial for them to undertake the investment activities, including in organizational change and education and training, in order to embody their latent strength. In turn, this should contribute positively to economic recovery and prosperity in Japan especially through business expansion and job creation.

The study sheds new light on the investment behavior of unlisted companies using new survey results and proposing simple analyses. It also yields a substantial foundation for future research in this area. It would be useful, for instance, to prepare a complementary survey to extract more information about unlisted companies and extend the analysis of their intangible investments.

## Appendix

Tables A1 and A2.

***** Table A1 *****

***** Table A2 *****

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**Table 1. Industry distribution**

| | | N | % |
|---|---|---|---|
| 1 | Foods | 15 | 3.3 |
| 2 | Textiles and Apparels | 31 | 6.9 |
| 3 | Pulp and Paper | 22 | 4.9 |
| 4 | Publishers and Printing | 25 | 5.6 |
| 5 | Chemicals | 6 | 1.3 |
| 6 | Plastic Products | 26 | 5.8 |
| 7 | Ceramic, Stone and Clay Products | 30 | 6.7 |
| 8 | Iron and Steel | 25 | 5.6 |
| 9 | Nonferrous Metals | 32 | 7.1 |
| 10 | Metal Products | 23 | 5.1 |
| 11 | General Machinery | 11 | 2.5 |
| 12 | Electrical Machinery | 8 | 1.8 |
| 13 | Transportation Machinery | 26 | 5.8 |
| 14 | Precision Machinery | 34 | 7.6 |
| 15 | Construction | 21 | 4.7 |
| 16 | Wholesale and Retail Trade | 12 | 2.7 |
| 17 | Eating and Drinking Places | 22 | 4.9 |
| 18 | Real Estate | 19 | 4.2 |
| 19 | Transportation | 23 | 5.1 |
| 20 | Hotels | 11 | 2.5 |
| 21 | Amusement Services | 16 | 3.6 |
| 22 | Other Services | 11 | 2.5 |
| | Total | 449 | 100.0 |

**Table 2. Investment activities in intangibles**

Total (%)

| | Continual Execution | Occasional Execution | Inexecution | Total |
|---|---|---|---|---|
| A Scientific and Technological R&D | 24.5 | 12.9 | 62.6 | 100.0 |
| B Software Production | 29.8 | 36.1 | 34.1 | 100.0 |
| C Product Development and Design | 36.1 | 17.8 | 46.1 | 100.0 |
| D Content Production | 5.6 | 10.0 | 84.4 | 100.0 |
| E Marketing | 21.6 | 30.1 | 48.3 | 100.0 |
| F Organizational Change | 23.2 | 34.5 | 42.3 | 100.0 |
| G Education and Training (On the job) | 47.9 | 26.1 | 26.1 | 100.0 |
| H Education and Training (Off the job) | 35.4 | 34.1 | 30.5 | 100.0 |

N=449

Manufacturing (%)

| | Continual Execution | Occasional Execution | Inexecution | Total |
|---|---|---|---|---|
| A Scientific and Technological R&D | 31.5 | 14.6 | 53.8 | 100.0 |
| B Software Production | 25.8 | 39.8 | 34.4 | 100.0 |
| C Product Development and Design | 40.8 | 17.5 | 41.7 | 100.0 |
| D Content Production | 4.5 | 8.0 | 87.6 | 100.0 |
| E Marketing | 18.2 | 27.7 | 54.1 | 100.0 |
| F Organizational Change | 22.0 | 35.4 | 42.7 | 100.0 |
| G Education and Training (On the job) | 46.2 | 26.4 | 27.4 | 100.0 |
| H Education and Training (Off the job) | 33.1 | 36.0 | 30.9 | 100.0 |

N=314

Nonmanufacturing (%)

| | Continual Execution | Occasional Execution | Inexecution | Total |
|---|---|---|---|---|
| A Scientific and Technological R&D | 8.1 | 8.9 | 83.0 | 100.0 |
| B Software Production | 39.3 | 27.4 | 33.3 | 100.0 |
| C Product Development and Design | 25.2 | 18.5 | 56.3 | 100.0 |
| D Content Production | 8.1 | 14.8 | 77.0 | 100.0 |
| E Marketing | 29.6 | 35.6 | 34.8 | 100.0 |
| F Organizational Change | 25.9 | 32.6 | 41.5 | 100.0 |
| G Education and Training (On the job) | 51.9 | 25.2 | 23.0 | 100.0 |
| H Education and Training (Off the job) | 40.7 | 29.6 | 29.6 | 100.0 |

N=135

**Table 3. Distribution of Score**

| | Total | | Manufacturing | | Nonmanufacturing | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| 0 | 46 | 10.2 | 35 | 11.2 | 11 | 8.2 |
| 1 | 26 | 5.8 | 20 | 6.4 | 6 | 4.4 |
| 2 | 39 | 8.7 | 24 | 7.6 | 15 | 11.1 |
| 3 | 16 | 3.6 | 10 | 3.2 | 6 | 4.4 |
| 4 | 33 | 7.4 | 25 | 8.0 | 8 | 5.9 |
| 5 | 28 | 6.2 | 20 | 6.4 | 8 | 5.9 |
| 6 | 36 | 8.0 | 28 | 8.9 | 8 | 5.9 |
| 7 | 28 | 6.2 | 18 | 5.7 | 10 | 7.4 |
| 8 | 37 | 8.2 | 21 | 6.7 | 16 | 11.9 |
| 9 | 32 | 7.1 | 20 | 6.4 | 12 | 8.9 |
| 10 | 33 | 7.4 | 19 | 6.1 | 14 | 10.4 |
| 11 | 30 | 6.7 | 24 | 7.6 | 6 | 4.4 |
| 12 | 30 | 6.7 | 24 | 7.6 | 6 | 4.4 |
| 13 | 21 | 4.7 | 15 | 4.8 | 6 | 4.4 |
| 14 | 9 | 2.0 | 6 | 1.9 | 3 | 2.2 |
| 15 | 2 | 0.5 | 2 | 0.6 | 0 | 0.0 |
| 16 | 3 | 0.7 | 3 | 1.0 | 0 | 0.0 |
| Total | 449 | 100.0 | 314 | 100.0 | 135 | 100.0 |

Score = A+B+C+D+E+F+G+H

**Table 4. Definitions of variables**

| | Definition | Mean | Median | S.D. |
|---|---|---|---|---|
| ROA (%) | 100×(Ordinary Profit/Total Assets$_{-1}$ + Ordinary Profit$_{-1}$/Total Assets$_{-2}$)/2 | 4.129 | 3.161 | 5.078 |
| ROS (%) | 100×(Operating Profit/Sales + Operating Profit$_{-1}$/Sales$_{-1}$)/2 | 3.346 | 2.647 | 4.644 |
| Sales Growth (%) | 100×(Square Root of (Sales/Sales$_{-2}$) –1) | 4.800 | 2.441 | 12.308 |
| Employment Growth (%) | 100×(Square Root of (Employment/Employment$_{-2}$) – 1) | 1.370 | 0.000 | 12.370 |
| Score | A+B+C+D+E+F+G+H | 6.497 | 7.000 | 4.229 |
| Emp | Employment$_{-2}$ | 351.399 | 136.000 | 750.884 |
| Current Ratio (%) | 100×(Current Assets$_{-2}$/Current Liabilities$_{-2}$) | 188.008 | 142.359 | 187.295 |
| Debt Ratio (%) | 100×(Total Debt$_{-2}$/Total Assets$_{-2}$) | 67.960 | 71.011 | 22.876 |
| Y2009 | Accounting Date$_{-2}$ in 2009 | 0.187 | 0.000 | 0.390 |

N=449

**Table 5. Estimation results**

| | ROA | | | | ROS | | | | Sales Growth | | | | Employment Growth | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [1] | | [2] | | [3] | | [4] | | [5] | | [6] | | [7] | | [8] | |
| | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E | Coef. | S.E. | Coef. | S.E. |
| Score | 0.0663 | 0.0616 | 0.0524 | 0.0606 | 0.1090 | 0.0540 * | 0.0976 | 0.0534 | 0.2926 | 0.1433 * | 0.3035 | 0.1435 * | 0.4387 | 0.1460 ** | 0.4441 | 0.1466 ** |
| log(Emp) | 0.6082 | 0.2649 * | 0.5145 | 0.2624 | -0.1123 | 0.2324 | -0.1836 | 0.2311 | -2.6083 | 0.6166 ** | -2.4962 | 0.6211 ** | -4.0796 | 0.6282 ** | -4.0262 | 0.6345 ** |
| Current Ratio | - | | -0.0022 | 0.0014 | - | | -0.0016 | 0.0013 | - | | 0.0034 | 0.0034 | - | | 0.0016 | 0.0034 |
| Debt Ratio | - | | -0.0478 | 0.0115 ** | - | | -0.0379 | 0.0101 ** | - | | 0.0448 | 0.0272 | - | | 0.0218 | 0.0278 |
| Y2009 | -0.1374 | 0.6241 | -0.2019 | 0.6137 | -0.3189 | 0.5477 | -0.3729 | 0.5406 | 0.5656 | 1.4529 | 0.6053 | 1.4527 | -0.0264 | 1.4803 | -0.0062 | 1.4840 |
| S.E. | 4.9431 | | 4.8562 | | 4.3381 | | 4.2775 | | 11.5075 | | 11.4957 | | 11.7244 | | 11.7432 | |
| $R^2$ | 0.1032 | | 0.1385 | | 0.1742 | | 0.2009 | | 0.1726 | | 0.1782 | | 0.1497 | | 0.1510 | |
| Adj-$R^2$ | 0.0525 | | 0.0855 | | 0.1275 | | 0.1517 | | 0.1258 | | 0.1276 | | 0.1016 | | 0.0987 | |

N=449. Twenty-one industry dummies and a constant term are included in the estimation. Significance level: ** $p < 0.01$, * $p < 0.05$.

**Table A1. Correlation coefficients**

Pearson

| | | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|---|
| A | Scientific and Technological R&D | 1 | | | | | | | |
| B | Software Production | 0.2710 | 1 | | | | | | |
| C | Product Development and Design | 0.5074 | 0.2542 | 1 | | | | | |
| D | Content Production | 0.0356 | 0.1799 | 0.1571 | 1 | | | | |
| E | Marketing | 0.2187 | 0.2426 | 0.4710 | 0.2472 | 1 | | | |
| F | Organizational Change | 0.3932 | 0.3455 | 0.4319 | 0.1998 | 0.5077 | 1 | | |
| G | Education and Training (On the job) | 0.3971 | 0.3225 | 0.4126 | 0.1994 | 0.4129 | 0.5919 | 1 | |
| H | Education and Training (Off the job) | 0.3786 | 0.3577 | 0.3788 | 0.1581 | 0.3845 | 0.5635 | 0.8233 | 1 |

N=449

Polychoric

| | | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|---|
| A | Scientific and Technological R&D | 1 | | | | | | | |
| B | Software Production | 0.3736 | 1 | | | | | | |
| C | Product Development and Design | 0.6865 | 0.3318 | 1 | | | | | |
| D | Content Production | 0.0900 | 0.3144 | 0.2801 | 1 | | | | |
| E | Marketing | 0.3137 | 0.3109 | 0.6067 | 0.3975 | 1 | | | |
| F | Organizational Change | 0.5254 | 0.4307 | 0.5484 | 0.3341 | 0.6290 | 1 | | |
| G | Education and Training (On the job) | 0.5741 | 0.4163 | 0.5450 | 0.3697 | 0.5503 | 0.7469 | 1 | |
| H | Education and Training (Off the job) | 0.5242 | 0.4464 | 0.4923 | 0.2674 | 0.4920 | 0.6896 | 0.9276 | 1 |

N=449

**Table A2. Estimation results (Z-Score)**

| | ROA | | | | ROS | | | | Sales Growth | | | | Employment Growth | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [1] | | [2] | | [3] | | [4] | | [5] | | [6] | | [7] | | [8] | |
| | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E | Coef. | S.E. | Coef. | S.E. |
| Z-Score | 0.0559 | 0.0492 | 0.0440 | 0.0485 | 0.0832 | 0.0432 | 0.0735 | 0.0427 | 0.2357 | 0.1146 * | 0.2454 | 0.1147 * | 0.3522 | 0.1167 ** | 0.3571 | 0.1172 ** |
| log(Emp) | 0.6059 | 0.2644 * | 0.5131 | 0.2619 | -0.1037 | 0.2321 | -0.1741 | 0.2308 | -2.6026 | 0.6155 ** | -2.4905 | 0.6199 ** | -4.0695 | 0.6271 ** | -4.0150 | 0.6332 ** |
| Current Ratio | - | | -0.0022 | 0.0014 | - | | -0.0016 | 0.0013 | - | | 0.0034 | 0.0034 | - | | 0.0016 | 0.0034 |
| Debt Ratio | - | | -0.0477 | 0.0115 ** | - | | -0.0379 | 0.0101 ** | - | | 0.0451 | 0.0272 | - | | 0.0221 | 0.0278 |
| Y2009 | -0.1306 | 0.6242 | -0.1966 | 0.6139 | -0.3135 | 0.5481 | -0.3689 | 0.5410 | 0.5883 | 1.4533 | 0.6292 | 1.4531 | 0.0069 | 1.4807 | 0.0275 | 1.4844 |
| S.E. | 4.9423 | | 4.8558 | | 4.3399 | | 4.2794 | | 11.5066 | | 11.4943 | | 11.7234 | | 11.7418 | |
| $R^2$ | 0.1035 | | 0.1387 | | 0.1735 | | 0.2002 | | 0.1727 | | 0.1784 | | 0.1499 | | 0.1512 | |
| Adj-$R^2$ | 0.0528 | | 0.0856 | | 0.1268 | | 0.1509 | | 0.1259 | | 0.1278 | | 0.1018 | | 0.0989 | |

N=449. Twenty-one industry dummies and a constant term are included in the estimation. Significance level: ** $p < 0.01$, * $p < 0.05$.