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R&D Expenses and Share Value in The Japanese Stock Market

Sophie Nivoix* and Pascal Ngunyen

The growing influence of technology in business activities is driving many firms to devote a greater amount of resources to research and development. It is therefore crucial to understand how the stock market evaluates the benefits of R&D. In this paper, our aim is to investigate whether Japanese investors have rewarded firms that heavily invest in R&D. We first document that R&D expenses have remained fairly stable relative to sales in the past eight years, but with large variations within and between industries. We then show that R&D-firms have achieved a higher return relative to non-R&D firms. However, our regressions and investment simulations indicate that the relation between R&D intensity and stock returns is not significant, suggesting that the Japanese stock market is semi-strong efficient.

Keywords: *R&D expenses, stock returns, market efficiency, Japan*

Introduction

Whilst population ageing has plagued industrialized countries for decades, the phenomenon has reached unprecedented levels in Japan. Indeed, after rapid demographic changes, the country's working population began to decline from 1999 and its population to fall in 2006[1]. Since it has chosen to keep its door closed to immigration, contrary to other countries, Japan will not be able to maintain its living standard and its ranking as a world leading country unless it benefits from strong economic growth. Such a scenario cannot be achieved with a dwindling work force, but may be possible if Japan relies on productivity gains fuelled by a steady flow of innovations. In order to promote innovation, the Japanese authorities have taken steps to create a favourable legal, fiscal and educational environment. For instance, the 1995 Act relative to science and technology supports the close cooperation between industry and academic research. More recently, a Council of scientific and technological policies was created in January 2001 to centralize projects, such as the "21st century robot challenge" programme launched that year by the METI (Ministry of Economy, Trade and Industry) to back the development of domestic robots. In 2007, Japan dominated world markets in industrial and domestic robots, mobile

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[1] Source : National Institute of Population and Social Security Research.

terminals and domotic control. While the country displayed evident weakness in information and communication technologies by the end of the 1990s, it was seen catching up with the development of infrastructures as early as 2001, and 5 years later, was on a par with other industrialized countries in high-speed Internet (Dourille-Feer, 2007).

In this context, firms stepped up their efforts in production automation and shifted their weak value-added operations overseas in the early 1990s. High-value added products are still manufactured domestically, as suggested by the level of Research and Development (R&D) expenses. In 2005 R&D intensity reached 3.18% of Japan's GDP, versus 2.68% in the United States, 1.91% in Europe, and 2.13% in France[2]. In real terms, R&D expenses increased on average by 1.4% in the EU15 between 2001 and 2005, versus 1.7% in the United States and 2% in Japan. In 2004, firms financed 55% of total R&D expenses in the EU15, versus 51% in France, 64% in the United States and 75% in Japan.

Have these recent research promotion efforts been taken into account by the stock market, whose nature is to anticipate future trends? Does the level of R&D expenses affect firm valuation? And is it possible to make significant distinctions between industries? These are the main questions to which the empirical part of this paper attempts to answer. The first section will explain the theoretical context of the study, the second one will present the data we have used, and the third section will summarize the results we have obtained.

Literature Review

The accounting treatment of research and development expenses

The present rules

R&D expenses present an important strategic dimension for firms, as they convey information about their long-term developments. In their annual financial statements, third parties (investors, competitors, banks) find items relative to R&D; usually located in the income statement or in the balance sheet. However, depending on the country, the accounting rules favor one or the other way of presenting the same information, which has an obvious effect on the net income or total assets of a firm, and ultimately, on its market value.

The general principle in the reporting of R&D expenses is, generally, to make them appear in the balance sheet, as intangible assets, if these R&D expenses represent an investment that may generate cash flows in the next fiscal years. But the uncertainty about the date and the amount of these flows often compels management to behave cautiously and register R&D as an expense, which explains why there is often no information in the balance sheet regarding the total value of these expenses. Besides this prudential rule, the principle of fidelity would require including the items that will create profits, such as R&D investments, in the balance sheet. Meanwhile, as R&D expenses vary from one year to the next, there is a bias (Dumontier, 2004) because the fiscal year during which high R&D expenses are incurred contains heavier expenses (and less income tax), whereas the next fiscal years receive the profits coming from R&D investments and bear more income tax. And, since financial markets are very sensitive to financial and accounting information because they convey news about future profitability, any bias concerning that information will affect

[2] Source : Eurostat, STAT 07/6, http://ec.europa.eu/eurostat/

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stock prices.

Thus, accounting rules have to achieve a trade-off between accounts' relevance, with the registration of all R&D investments in expenses, and objectivity of accounting information, which implies recording these investments in the balance sheet in order to provide long-term information regarding the firm's R&D. This trade-off is all the more difficult to achieve that it deals with the disclosure of information to an already informationally asymmetric financial market because some investors are finance professionals and have access to very detailed information. The principle retained by the Financial Accounting Standards Board (FASB) in the United States and the International Accounting Standards Committee (IASB) is to disclose those financial accounts that are useful to investors.

In practice, despite attempts to reach international accounting harmonization, there is no single way to account for R&D expenses in all industrialized countries. As Nekhili and Rebai-Azouz (2006) point out, it is possible to distinguish three compulsory reporting regimes for R&D expenses in the income statement. France and the United Kingdom are the countries where the accounting rule is the most flexible, with the IAS 38 (IASC, 1998 and then 2004) enabling firms to register R&D investments as assets if all the following conditions are met: the product has to be well defined, its costs clearly identified, and the feasibility of the product demonstrated. Also, there must be an intention to sell the product in a well-identified potential market, and the firm has to own the resources necessary to the success of this project. If these conditions are not fulfilled, the expense is reported in the income statement. According to the second compulsory regime, which is somewhat stricter than the previous one, the FASB No.2 compels US firms to record almost all R&D investments as expenses as soon as they are incurred. The exception is intangible assets that are bought from other firms (paragraph 11-c) to be used otherwise in the future, which must be registered as assets in the balance sheet and amortized[3]. Finally, the strictest regime includes countries like Germany and Japan[4], in which all R&D investments must be recorded as expenses. Such a constraint is dictated by the uncertainty of future earnings stemming from R&D investments, and the difficulty to value them in comparison with other investments. Indeed, future flows are not only uneasy to estimate, but it is hard to associate future cash flows with a particular project, and thus make specific expenses correspond to the project they are linked to.

If we assumed that uncertainty had disappeared both in the full registration of R&D expenses in the income statement and in their registration in the balance sheet, there would still remain another problem. The purpose of a reporting an item in the balance sheet is to produce more objective financial statements, but there is a risk of window-dressing in the income statement. Indeed, both the exact amount of the expenses to record and their rate of amortization have to be set. Concerning the amount, a tradeoff has to be made with more usual operating expenses, related to R&D or not, and possibly related to employee costs, overheads or raw material costs for example. Concerning the rate of amortization, the duration may not only vary from one industry to the other, but also within the same firm depending on the type of project.

[3] According to APB Opinion No.17, « Intangible assets », replaced by the Rules of SFAS No.142 of June 2001, that makes possible to amortize during the whole effective life of the asset (but not until infinite).

[4] See Accounting Standard Board of Japan, www.asb.or.jp

There is no difference between the two ways of reporting R&D expenses if the costs are stable operating expenses, and equivalent to what would be the amortization of R&D expenses if they had been recorded in the balance sheet. In this case there is neither a fiscal effect nor smoothing of net income, and thus no possible manipulation of return on equity or return on investment ratios, or stock market ratios such as PER, Market-to-book or Tobin Q. But, obviously this situation is rare in practice.

The effect on market valuation

The relation between stock prices and asset value is relatively clear when most assets are tangible, such as plants and equipment. However, in modern economies a large fraction of a firm's value is likely to reflect its intangible assets, such as trademarks or patents. Hence, when a firm owns huge amounts of such intangibles, the lack of accounting information makes the stock valuation process more difficult.

One type of intangible asset, which is the firm's R&D activity, has become increasingly important with the acceleration of scientific and technological progress. Then, we can wonder if share prices correctly take into account the accumulated value of the firm's R&D. In an efficient market, the stock price must fully reflect this information, and there should be no relation between R&D intensity and future stock returns.

However, firms with high R&D activity may have anticipations related to new untested technologies that are difficult to forecast, and the profits these firms are expecting to receive may appear only much later, whereas the life cycle of the products they created could be quite short. Contrary to fixed tangible assets (property, plants and equipment) or stocks, R&D activities not only imply a long-term horizon, but they can generate large losses. This leads to an increase in total risk relative to the returns of firms without R&D expenses. As a result, the accounting information about the R&D activity of a firm may be of limited usefulness, because identifying the major parameters of success can be exceptionally difficult. Moreover, the usual benchmarks used by investors such as PER or PBR (price-to-book ratio) will provide misleading indications (typically these ratios will suggest that the firm is overvalued if investors do not adjust the value of the firm's accounts for the long term earnings expected from its R&D expenses).

The benefits and costs expected from R&D expenses should, in principle, be reflected in the actual stock prices of listed firms, but also in the characteristics of future price distributions. This derives from the fact that R&D activities have to succeed in either selling new products or at least improving the production process, which finally leads to new market openings and/or a decrease in manufacturing costs, and thus, a larger market share and higher net income (through higher quantities sold and a decline of operating costs). As this earnings increase may generate an increase in long-term dividends, the stock value should increase. If it is not the case, it may be because the market does not anticipate a higher return for R&D investments than the average return of other activities, because of a higher risk, for example.

Several studies have analyzed the relation between the accounting method of R&D expenses and the market value of shares. According to Zhao (2002) the relevance of R&D information is influenced by the various accounting and legal rules of each country. As he shows it in his study of France, Germany, the United Kingdom and the United States over the period 1990-1999, when R&D investments are recorded in the balance sheet, they contribute the most to value creation. According to Lev and Sougiannis (1996) R&D expenses

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Table 1. R&D expenses as a percentage of sales for Japanese listed firms (1999-2006)

	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
Average	**3.06%**	**2.89%**	**2.89%**	**3.18%**	**3.12%**	**3.07%**	**2.94%**	**2.96%**
Median	2.31%	2.12%	2.08%	2.25%	2.25%	2.20%	2.09%	2.04%
Maximum	21.77%	22.52%	21.54%	33.59%	24.51%	30.66%	23.29%	27.31%
Minimum	0.003%	0.009%	0.02%	0.002%	0.01%	0.007%	0.009%	0.006%
Standard-error	**2.90%**	**2.80%**	**2.86%**	**3.42%**	**3.25%**	**3.30%**	**3.00%**	**3.21%**
Skewness	1.97	2.19	2.36	2.95	2.34	2.94	2.29	2.57
Kurtosis	5.83	7.37	8.50	14.83	7.89	14.33	7.59	9.82

that are recorded in the balance sheet and their amortization expenses are positively correlated with future returns for US stocks. Other studies have found that R&D expenses have a positive influence on the market value of a firm, Chan et al. (1990), Chauvin and Hirschey (1993), and Szewczyk et al. (1996)) for the US market. In addition, Jose et al. (1986) find that differences in R&D expenses (measured by the R&D/Sales ratio) compared to the industry average are not appreciated by investors, which should induce firms to stay within the norm of their industry. In the US market again, Cockburn and Griliches (1988) or Pakes (1985) point out that intangibles depend on R&D expenses and existing patents or licenses, which are taken into account by the market when it valuates the firm. Over relatively short period (1988-1990) Chauvin and Hirschey (1993) find a significantly positive relation between stock prices and R&D expenses, which suggests that investors value R&D investments with a long term horizon. Bae and Kim (2003) report similar findings over the period 1996-1998. Their conclusion is that the US stock market tends to value R&D investments better than the Japanese market does, and the regression models with a two year lag or more for the variables related to R&D seem to capture a more relevant relation between R&D and the market value of the firm. Over the period 1998-2000 the French market has displayed the opposite effect. Cazavan-Jény and Jeanjean (2005) find a negative relation between the recoding of R&D investments in the balance sheet and stock returns.

However, no long term study has showed that the recording of R&D in the balance sheet generates a change in the financial performance of the firm, not even that R&D expenses have a higher explanatory power in relation to stock returns, net income or the market value of a firm. This means that from a statistical viewpoint no accounting method appears to do better in the long run. Thus, the fact that in Japan all R&D expenses are recorded in the income statement does not hinder comparisons with studies in other countries (the United States in particular). Our goal is to determine whether the Japanese stock market values firms with R&D expenses at a higher price. If it is the case, we will try to identify which firms or which industries show the strongest relation between stock return and R&D expenses. We will test the hypothesis of a relation between these two variables in the framework of a long term investment in an asset portfolio.

Methodology

Data description

Our data consist of all the listed firms on the Tokyo Stock Exchange that registered R&D expenses in their income statement over the 1999-2006 period. All the data come from the Nikkei NEEDS database, and the industries follow the Nikkei classification. The R&D intensity in Japan can be directly observed, as we can see it in 1.1, in the income statement. Nevertheless, in order to avoid any size bias in our data, we have chosen the R&D expenses/Sales ratio. As these expenses are not registered in the asset side of the balance sheet, the use of fixed assets or total assets would have been less relevant. Table 1 presents yearly descriptive statistics for the R&D expenses/Sales ratio for the 641 firms we have studied.

What can we conclude from the above figures? First, the average R&D expenses appear fairly stable over the eight years (the fiscal year-end is at the end of March of the following year for the majority of the firms). As it does not seem to reflect the efforts by the Japanese government to support research since the end of the 1990s, we have to analyze the situation depending on each industry. The median is also stable, which confirms the values of Bae and Kim (2003) on a smaller sample (241 firms) and within a shorter period (1996-1998) just before the one we have referred to. Let us mention that over a previous period (1985-2000) Xu and Zhang (2004) have pointed out that R&D expenses relative to sales were stable overall too, which indicates a long term strategy by firms in the field of innovation, regardless of the industrial policies decided by the authorities.

The standard error of the distribution of R&D expenses increases slightly, which is confirmed by an irregular but growing kurtosis, and a skewness coefficient indicating fatter right tails. This stronger asymmetry for values above the average is logical for a distribution which is bounded below on the left side, but it tends to grow and could thus be explained by a global R&D effort, which became more intense after 2001. We will now look at the heterogeneity that exists between industries.

Table 2. shows the average R&D expenses for all industries including at least 14 firms, which means 591 of the 641 firms. The industries missing here (mines, insurance, agriculture, oil, air and sea transport) include both few data and weaker R&D expenses than the others, as shows the average of 3.13% of the 16 industries studied, comparatively to the global values of table 1. We can see at first glance that there are major differences between industries, with high expenses for pharmaceutical firms (10.73%), electrical appliance firms (5.03%) and precision instrument firms (4.04%), as well as a weaker heterogeneity of expenses among these industries than among the others on average. At the other extreme, construction and wholesale have few R&D on average, but sometimes show important differences between firms of the same industry.

Besides the average dispersion of R&D expenses over the 8 years within each industry, a look at the yearly evolution of these expenses allows us to distinguish several trends in a rather stable situation Table 1 In some industries, such as construction, textile, metal products, iron and steel, non-ferrous metals, information and communication, or transport equipment, R&D expenses decrease relatively to sales over the 8 years. For pharmaceuticals and precision instruments these expenses - while already high - are still increasing.

Discussion and Results

After a global description of the R&D expenses and an outlining of the differences within the same domain of industry, we have to further our analysis to understand

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Table 2. R&D expenses as a percentage of sales by industry in Japan (average over 1999-2006)

Industry	# obs.	Average expenses	Standard error /average expenses
Pharmaceuticals	23	10.73%	0.46
Electric appliances	106	5.03%	0.61
Precision instruments	22	4.04%	0.52
Information and communication	19	3.52%	1.47
Chemicals	92	3.22%	0.59
Transport equipement	37	2.90%	0.66
Machinery	80	2.77%	0.75
Glass and ceramic	15	2.34%	0.64
Textile	21	2.10%	0.64
Non-ferrous metals	22	1.91%	0.78
Other products	21	1.90%	0.98
Metal products	21	1.22%	0.76
Food and beverages	43	1.13%	0.79
Iron and steel	17	1.05%	0.63
Construction	38	0.77%	1.16
Wholesale	14	0.48%	1.58
Total	**591**	**3.13%**	**0.75**

to what extent R&D intensity covers a large scale of values. In order to do this we built quintiles based on the R&D expenses/Sales ratio, which has been recalculated each year. Table 3 shows the main results, while presenting the two extreme quintiles and the ratio of the values of these two quintiles (high/low).

The figures in bold indicate the values of R&D expenses corresponding to the years at the beginning of which the quintiles were built. The other values on a same line show what the R&D expenses of the same firms were during the years preceding or following the calculation year. When we look at these results we can first notice that firms belonging to the high R&D quintile report expenses on average 20 times higher than those in the low R&D quintile. The first quintile is mostly composed of pharmaceutical firms, electric appliances and precision instruments that have largely been influenced by government impetus to favour research since the beginning of the 2000 decade.

Nevertheless, we have to remember that innovation dynamics also vary according to industry factors that cannot be overwhelmed by a national blueprint (Lechevalier, 2006). Then, we have to point out that there is a clear stability in the composition of extreme quintiles, as shown by R&D expenses which remain particularly high or low, before or after the year of quintiles building. Thus, we have found the confirmation of what table 1 indicated, meaning that R&D policy is set by firms for the long run. We do not notice any particular deviation affecting this long term horizon in the course of years 2000-2001 or 2001-2002.

We now focus on the stock market valuation of firms that reported R&D expenses. Table 4 shows the evolution of the Nikkei 225 index over 12 months (to the end of March), the average stock returns[5] of firms investing in R&D, and the

[5] measured from the stock price variation of firms over 12 months. Source : Eurostat, STAT 07/6, http://ec.europa.eu/eurostat/

Table 3. R&D expenses of Japanese listed firms as a percentage of sales by quintiles, over 1999-2006 (in bold: values of expenses corresponding to the years at the beginning of which the quintiles are built)

	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
High R&D quintile 99	**7.64%**	6.66%	6.77%	7.57%	7.38%	7.27%	6.86%	6.97%
Low R&D quintile 99	**0.38%**	0.53%	0.56%	0.57%	0.62%	0.61%	0.57%	0.55%
High/low ratio 99	**20.00**	12.65	12.15	13.27	11.95	12.01	12.00	12.78
High R&D quintile 00	6.93%	**7.46%**	6.98%	7.71%	7.66%	7.58%	7.10%	7.22%
Low R&D quintile 00	0.67%	**0.38%**	0.54%	0.50%	0.51%	0.52%	0.48%	0.51%
High/low ratio 00	10.27	**19.38**	12.84	15.34	14.99	14.69	14.74	14.29
High R&D quintile 01	7.01%	7.04%	**7.38%**	7.77%	7.93%	7.84%	7.33%	7.55%
Low R&D quintile 01	0.50%	0.43%	**0.36%**	0.37%	0.39%	0.38%	0.40%	0.39%
High/low ratio 01	13.91	16.49	**20.64**	21.08	20.44	20.43	18.53	19.11
High R&D quintile 02	7.02%	6.83%	7.10%	**8.46%**	8.13%	7.92%	7.36%	7.60%
Low R&D quintile 02	0.52%	0.45%	0.38%	**0.34%**	0.37%	0.38%	0.40%	0.40%
High/low ratio 02	13.60	15.15	18.47	**24.65**	21.83	20.69	18.21	18.99
High R&D quintile 03	6.86%	6.74%	6.95%	8.01%	**8.41%**	8.12%	7.48%	7.66%
Low R&D quintile 03	0.69%	0.47%	0.54%	0.54%	**0.35%**	0.37%	0.41%	0.40%
High/low ratio 03	9.93	14.30	12.82	14.91	**24.21**	21.98	18.33	19.01
High R&D quintile 04	6.71%	6.63%	6.81%	7.89%	8.13%	**8.41%**	7.69%	7.88%
Low R&D quintile 04	0.68%	0.52%	0.59%	0.57%	0.40%	**0.36%**	0.38%	0.37%
High/low ratio 04	9.87	12.74	11.59	13.90	20.58	**23.44**	20.13	21.28
High R&D quintile 05	6.55%	6.54%	6.67%	7.63%	7.79%	8.001%	**7.97%**	7.98%
Low R&D quintile 05	0.69%	0.54%	0.61%	0.61%	0.46%	0.40%	**0.35%**	0.35%
High/low ratio 05	9.43	12.08	10.91	12.53	17.08	19.92	**22.88**	22.62
High R&D quintile 06	6.58%	6.53%	6.74%	7.54%	7.73%	7.91%	7.79%	**8.27%**
Low R&D quintile 06	0.58%	0.53%	0.47%	0.48%	0.48%	0.44%	0.39%	**0.32%**
High/low ratio 06	11.25	12.27	14.20	15.64	16.07	18.13	20.13	**25.69**

returns on the high or the low R&D quintile portfolios according to the formation year of the quintile (bold figures).

We can generally see that R&D firms exhibit higher stock returns than the Nikkei index, which includes large firms, but not only R&D firms. Since the average size of the sample firms is smaller than the average size of the index firms, this indicates that the presence of R&D generates an effect large enough to mitigate a possible size effect. Then, the yearly analysis shows that the high R&D quintile does not exhibit returns that are consistently higher than those of the low R&D quintile. If R&D appears as a factor that potentially generates stock return, its intensity appears less critical than its existence. Besides, the stability in the quintile composition, which is easy to see in Table 3, allows us to notice that the difference in returns in column have the same magnitude for a given year, regardless of the year in which the quintile is built.

Following these results, we carry out an investment simulation based on a buy-and-hold strategy, but with a possible reformation of the portfolio on a yearly basis. Figure 1 shows the cumulated returns of four portfolios: the portfolio including all R&D firms, the Nikkei 225 index, the

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Table 4. Average stock returns of R&D firms (1999-2006)

	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
Nikkei 225	24.84%	36.08%	-15.19%	-24.90%	42.70%	-1.24%	46.20%	1.13%
R&D firms	20.14%	0.38%	-0.09%	-9.30%	73.66%	18.89%	48.05%	-7.73%
High R&D quintile 99	**37.08%**	-2.18%	-10.58%	-14.99%	69.76%	13.13%	43.13%	-5.89%
Low R&D quintile 99	**3.99%**	3.65%	-10.78%	-4.20%	72.84%	22.25%	41.74%	-11.55%
High R&D quintile 00	40.48%	**-1.54%**	-9.00%	-16.52%	67.06%	14.90%	42.66%	-5.25%
Low R&D quintile 00	10.95%	**2.20%**	-10.08%	-6.62%	74.77%	23.17%	42.77%	-11.96%
High R&D quintile 01	42.03%	-1.54%	**-8.26%**	-15.56%	61.86%	16.52%	41.65%	-4.81%
Low R&D quintile 01	2.34%	4.04%	**-10.51%**	-5.33%	78.89%	24.27%	41.82%	-11.06%
High R&D quintile 02	51.67%	-5.27%	-10.66%	**-18.76%**	66.45%	15.68%	40.92%	-5.40%
Low R&D quintile 02	3.71%	2.93%	-6.60%	**-4.78%**	78.58%	22.70%	44.51%	-10.97%
High R&D quintile 03	49.31%	-4.63%	-5.55%	-17.23%	**64.29%**	17.37%	43.44%	-6.93%
Low R&D quintile 03	5.21%	3.07%	-10.02%	-4.86%	**75.70%**	22.67%	42.57%	-8.52%
High R&D quintile 04	48.40%	-5.61%	-5.08%	-15.29%	65.90%	**19.16%**	43.24%	-8.48%
Low R&D quintile 04	3.64%	3.52%	-10.26%	-4.26%	79.20%	**22.73%**	43.48%	-7.73%
High R&D quintile 05	51.16%	-8.53%	-9.25%	-15.59%	65.49%	12.42%	**41.64%**	-8.08%
Low R&D quintile 05	4.59%	3.91%	-6.06%	-3.81%	77.89%	22.53%	**42.49%**	-9.25%
High R&D quintile 06	52.81%	-9.60%	-9.10%	-16.24%	64.35%	16.02%	37.57%	**-7.79%**
Low R&D quintile 06	0.80%	5.38%	-5.39%	-2.26%	73.15%	22.36%	46.11%	**-7.93%**

portfolio representing firms in the high R&D quintile ("Quint 1 R&D"), and the one representing firms in the low R&D quintile ("Quint 5 R&D").

Transaction costs have been neglected, but this does not produce a significant bias considering the large return differentials. The portfolio including all R&D firms exhibits a higher return than the other portfolios over the whole period, and particularly since 2002-2003. This was not the case before 2002, which is consistent with the results of Chan et al. (2001) regarding the US market. But contrary to these authors, we do not find low past returns ("loser" portfolio) for high R&D firms. Thus, mean-reversion or even the tendency to extrapolate past returns does not seem to exist in Japan, at least concerning this factor.

Figure 1 shows the cumulated annual returns of four annually-rebalanced portfolios over the period 1999-2006. All R&D firms is the portfolio including all listed firms with reported R&D expenses; Nikkei 225 is the Japanese market index; Quint 5 R&D is the portfolio including firms in the lowest R&D/sales quintile; Quint 1 R&D is the portfolio including firms in the highest R&D/sales quintile.

The Nikkei 225 index is seen to underperform the other portfolios from 2002-2003. As for the quintile portfolios, they display similar cumulated returns after underperforming initially. The difference of mean test (t-test in Table 5) indicates significant differences for only 3 years. As evidenced from Table 4, the critical factor is more the actual existence of R&D than its intensity.

Moreover, the observation of an association between high values of relative R&D expenses and high stock returns does not always imply a direct causality relation. In order to clarify this point, we ran linear regressions of stock returns on R&D/Sales. For all the 641 R&D firms, we used

regressions without time lag:

$R_t = a_0 + a_1 R\&D_t/sales_t + e_t$ with $E(e_t) = 0$

or with a time lag d of 1 year or more :
$R_{t+d} = a_0 + a_1 R\&D_t/sales_t + e_t$ with $E(e_t) = 0$

Regressions including the return on the Nikkei 225 index as a proxy for the market portfolio provided similar conclusions. We found no significant regression regardless of the time lag, the year, and the industry, even the ones that are heavily involved in R&D. We will not detail the results here, which are nearly all characterized by a slope depending on the market trend (bullish or bearish) far more than by the R&D intensity, and by a R^2 below 0.05.

Does it mean that the stock market is unable to appreciate the R&D efforts despite the table 4 results? Certainly not, as at least two explanations can be suggested here.

Figure 1. Cumulated Annual Returns

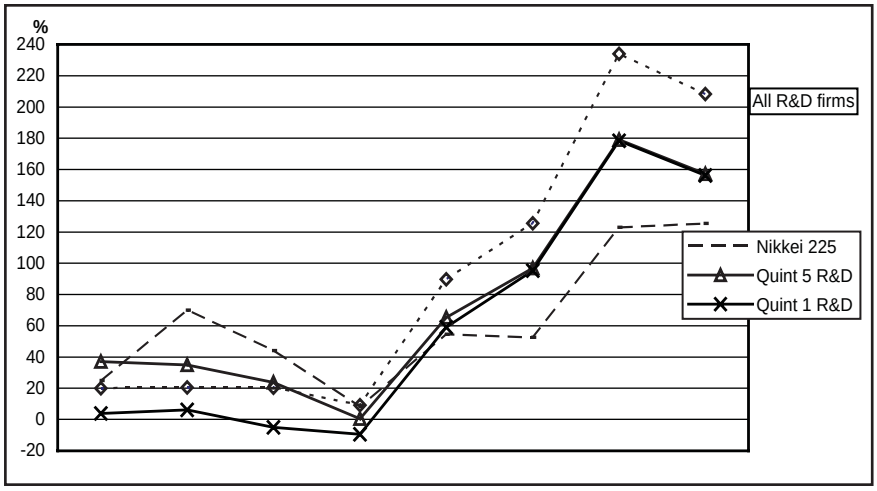

Table 5. Difference of mean test between returns of the extreme quintiles of R&D expenses over the period 1999-2006 (50 firms per quintile on average)

$p(z>z_0)$	Quintile 1 (high R&D)	Quintile 5 (low R&D)
99-00	0.021*	0.009**
00-01	0.273	0.261
01-02	0.000**	0.002**
02-03	0.047*	0.000**
03-04	0.368	0.062
04-05	0.099	0.464
05-06	0.102	0.071
06-07	0.464	0.488

* different (at the 5% level) from the average of all R&D firms
** different (at the 1% level) from the average of all R&D firms

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The first one is to view our study within the framework of the market's semi-strong efficiency, and to assume that investors are unable to generate abnormal returns while using information related to the R&D intensity of firms. However, the higher returns of R&D firms since 2002 should be further investigated. Thus, we could take the risk level into account in order to check if there is a real difference in the risk-return relationship. This particularly important point will be analyzed in a future study. The second explanation is related to the existence of many other factors influencing stock returns and the market valuation of a firm. Beside risk, it is very likely that firms with high R&D expenses show characteristics different from other firms in terms of cash flow generation as well as of size, market valuation, or even growth rate. These aspects will also be studied in future research.

Conclusion

In this comprehensive analysis of listed Japanese firms with reported R&D expenses, we have highlighted several results. First, R&D expenses expressed as a proportion of sales have, on average, been remarkably stable over the period 1999-2006, in spite of persistent efforts by the Japanese government to promote research since the end of the 1990s. We have also shown that there is a clear permanence in the industry composition of extreme quintiles. This suggests that R&D is undertaken with a long-term view, regardless of the fact that Japanese accounting rules do not allow firms to capitalize R&D investments in their balance sheets, contrary to several other countries. On the other hand, there is a large dispersion in R&D intensity, not only between industries as one could expect, but also within each industry.

Regarding the relation between R&D expenses and stock returns, we found higher returns for R&D firms, but no direct relation between R&D intensity and stock returns. Besides, our linear regressions do not show a significant relation between the R&D expenses of Japanese firms and their stock returns over the same year or subsequent years. This suggests that investors correctly assess the value of R&D information and that the Japanese stock market is semi-strong efficient. However, we cannot rule out that other risk factors, such as size and growth, which tend to be associated with R&D expenses, might explain the return of Japanese firms.

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