# CREATING COMPETITIVE ADVANTAGE THROUGH RESEARCH AND DEVELOPMENT: AN EMPIRICAL INVESTIGATION OF THE DETERMINANTS OF RESEARCH AND DEVELOPMENT REPORTED ON ANNUAL FINANCIAL STATEMENTS

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## 1. Introduction

The creation, retention and management of intangible assets or intellectual capital is now seen as vital for sustaining competitive advantage in an increasingly competitive world. This is particularly important for developing nations such as Malaysia, which is a relatively small country with an open economy competing in the global arena. Moitra and Krishnamoorthy (2004) indicate that research and development (R&D) is central for maintaining the competitive positions of firms in a world that is increasingly aggressive and technology driven.

The importance of knowledge and knowledge based assets (a synonym for intangible assets) in driving economic performance is widely acknowledged. Bosworth and Rogers (1998) mentioned that change in technology has been acknowledged to improve the performance of firms for a long time. Such changes are generally the result of R&D activities.

When the performance of a large proportion of the firms in an economy improves, the performance of the economy itself will improve. Hulya (2004) points out that economic growth patterns have been explained by endogenous technological growth. R&D activities are related to enduring growth in output rates.

The phenomenal growth of the US economy can be attributed to technology driven by firm level research and development. Research and development carried out by American firms helps the US to continue to dominate the world's economy. The Silicon Valley remains as an impressive example of the exceptional ability of firm level research and development to uplift entire regional economies.

The level of research and development activities in Malaysia is relatively low. Malaysia lagged behind Indonesia and the Philippines in percentage of sales contributed by new products and percentage of R&D to sales in the year 2000 (Jefferson and Zhong, 2004). Malaysia's Gross research and development expenditure as percentage of GDP (GERD) was 0.5 in

the year 2000, as opposed to Singapore's 1.89 (APEC, 2004). The private sector's contribution to research and development expenditure was 58.8 percent in Malaysia, as opposed to Singapore's 62%.

As such, R&D generally, and firm level R&D specifically, can be harnessed much more in Malaysia and similar developing economies to drive firm level performance which will in turn drive economic growth and stability. This study examines the determinants of reported R&D expenditure (where R&D expenditure proxies for R&D activities) in listed Malaysian firms, to gain insights into factors that promote R&D in Malaysian firms. It examines the characteristics of listed firms that undertake R&D in Malaysia and offers policy recommendations for promoting firm level R&D in Malaysia and other developing nations that suffer from similar low levels of R&D. Successful promotion of research and development in private firms can lead to the creation of intangible assets that can boost the growth of local companies and help to establish a competitive edge for the local economy. This competitive edge will enable local firms to successfully match the growing top-notch, international level competition resulting from increasing globalisation, and do well in the global arena.

The next section reviews the literature in this area. The following section looks at data and methodology. This is followed by the presentation and discussion of the results and the final part concludes with a summary and discussion.

## 2. Literature Review

The Schumpeterian effect (Schumpeter, 1942) considers larger firms with greater market power to be more dynamically efficient (Bosworth and Rogers, 1998), with a greater propensity to undertake research and development, and innovate. Arrow (1962) offers the opposite view that the monopoly power of the larger firms reduces incentives for innovation (since they are already doing well without the need to

innovate) as compared to smaller firms (who need to innovate to be able to compete with the bigger firms).

Some research findings support the Schumpeterian viewpoint. Kamian and Schwartz (1982) and Patel and Pavit (1992) conclude that firm size (a proxy for monopoly power) is positively associated with R&D, indicating that firms with greater market power are more inclined to undertake research and development. But other researchers (Scherer, 1965a, 1965b; Bound et al, 1984) have found a U-shaped relationship between R&D and sales (assuming larger sales are indicative of larger firms). Bosworth and Rogers (1998, p. 7) conclude that there is "little support for the Schumpeterian relationship between research and development and size, except, perhaps in certain sectors….". Thus, published research possibly indicates an influence of sectors on the applicability of the Schumpeterian perspective. Our study extends the published literature by exploring whether the Schumpterian perception is also applicable to certain nations, particularly developing nations, in addition to the "certain sectors" mentioned in Bosworth and Rogers (1998).

Existing literature also documents other determinants of R&D expenditure, in addition to size. For instance, output diversification and internal liquidity have been found to be very significant (at the 1 % level) in explaining research and development productivity (Grabowski, 1968). Grabowski's paper employs research and development productivity as the dependent variable. The independent variables include the number of patents, a diversification index and the sum of after tax profits to which depreciation and depletion expenses had been added, scaled by sales.

Fazzari and Athey (1987) found dividend propensity and cash flows to be determinants of R&D. Furthermore, internally generated funding was found to be an important source for expenditure on plant and equipment, indicating a higher reliance on internal rather than external sources for improving production capacity. They used the Value Line Data Base to explore the research and development expenditure of 637 manufacturing firms through the period 1975 to 1985 and employed a generalised least squares approach to address serial correlation and heteroscedacity.

Bagat and Welch (1995) studied 6,549 firms from US, Canada, Great Britain, Germany, France, Netherlands and Japan for the years 1985 to 1990. The variables studied include stock returns, operating cash flows, debt structure and the tax environment. In Japan, debt ratios were found to be positively correlated with research and development expenditures. However, these ratios were negatively correlated in the US. This could indicate that US lenders are less likely to fund R&D. In all countries except Canada, research and development investment was positively predicted by 2-year lagged stock prices. But operating cash flow was not found to be a strong predictor of any future research and development in any country. However, since this

research was based on firms in developed countries, these findings may not be applicable to developing nations.

Reynard (1979) explored the relationship between research and development investment and net profit using the financial information of 25 firms in the chemical industry. Statistically significant relationships were found between decreases in net profit and decreases in research and development investment. He suggests optimal levels of research and development expenditures, which correspond with Scherer's (1965a, 1965b) concept of an inverse U-shaped relationship between research and development and sales.

Kim and Lee (1993) examined 152 public listed firms in Korea, over the period 1985 to 1989. One-year and three-year lagged variables were found to significantly explain research and development investment in all industries. Although sales and net profit were found to be positively correlated with R&D, the strength of the correlations differed across industries.

The studies from the different countries and industries indicate that the determinants of research and development expenditures seem to vary across nations and industries. At present, there is little information on the determinants of R&D expenditure that is peculiar to developing nations, on which to base relevant policy recommendations that are effective in promoting indigenous firm level R&D. This study undertakes to fill this gap in the literature. It also aims to provide a basis for policy planning frameworks that embrace the peculiarities of developing nations, based on studies that examine the determinants of R&D in a developing nation, namely, Malaysia. With recent international financial reporting standards allowing a new category of assets, intangible assets, on the balance sheet, now is an opportune time to address this issue. Firms that choose to undertake R&D that provides benefits over several periods will be able to enhance their balance sheets in form and substance by adding intangible assets.

## 3. Data and methodology

### 3.1 Data

The data for this study was compiled using Perfect Analysis 6. This study is based on the research and development expenditures reported in the annual reports of listed companies in Malaysia, for the years 2004 and 2005. These are the most current years of data available for all of the public listed Malaysian firms at the time of this study.

The published financial data of all of the listed companies were examined for the years 2004 and 2005, and those that reported R&D expenditure were selected. The firms with negative cash flows from operations were excluded, because this study focuses on the influence of the availability of internal funding

(which is assumed to be indicated by positive cash flows) on the likelihood of undertaking firm level research and development. Total assets were used as a proxy for firm size while sales was used as an additional indicator of the availability of internally generated funds.

After excluding outliers and firms with incomplete data, a total of 95 firm-years were found to be suitable for this analysis, and all of this data was utilised. This small number of firms (comprising less than five percent of the public listed firms in each year) is consistent with the low level of research and development indicated in APEC, 2004. The research and development expenditures were used as the dependent variable, with cash flow from operations, net sales and total assets serving as the independent variables. The data from both years were pooled in the analysis.

### 3.2 Hypothesis development

The Schumpeterian perspective assumes that larger enterprises are more likely to be able to devote the necessary resources for R&D, and thus are more likely to pursue R&D. Thus, we expect that firms that pursue research and development tend to be larger in size. However, an alternative perspective is that smaller firms are more likely to undertake research and development in order to successfully compete with the larger firms (Arrow, 1962).

Assuming that the larger firms in developing nations are more likely to pursue R&D (due to the fact they are able to devote more resources for R&D and are likely to be sophisticated enough to undertake R&D) and using the value of net assets as a proxy for firm size, the following hypothesis is tested:

H_1: Total assets are positively correlated with research and development expenditures

Sales can be a determinant of R&D, considering that healthy sales would provide sufficient resources for firms to pursue R&D and help to maintain an edge in the marketplace. Essentially, sales serves as an indicator of the availability of internal funds for pursuing R&D. The operating cash flows is an additional, more direct, indicator of internal liquidity. While Fazzari and Athey (1987) and Reynard (1979) found significant association between the indicators of internal funds and R&D activities, Bagat and Welch (1995) did not find operating cash flow to be a good predictor of future R&D expenditure in developing nations. The findings of Bagat and Welch (1995), however, may not be applicable to developing nations, since various well-funded institutional structures exist in developed nations that may be able to carry out R&D on behalf of private industries. In contrast, firms in developing nations may need to carry out their own R&D to meet their specific needs, and such R&D is more likely to be carried out if internal funds are available. Based on this view, the proxies for internal funds should be positively associated with R&D expenditure. Thus, the following hypotheses are developed, with both sales and cash flows from operations serving as proxies for the availability of internal funds:

H_2: Sales are positively correlated with R&D expenditures

H_3: Operating cash flows are positively correlated with R&D expenditures

### 3.3 Estimation model:

The following model was used to study the determinants of firm-level R&D:

$$\text{Log}(\text{R\&D}_{it}) = \alpha_1 + \beta_1 \log(\text{TA}_{it}) + \beta_2 \log(\text{NSLS}_{it}) + \beta_3 \log(\text{OCF}_{it}) + \text{Y05} + \varepsilon_{it}$$

Where,

$\text{R\&D}_{it}$ = research and development expenditure for firm i in the year t

$\text{TA}_{it}$ = total assets for firm i in the year t; $\beta_1$ = coefficient of the log of total assets for firm i in the year t,

$\text{NSLS}_{it}$ = net sales for firm i in the year t; $\beta_2$ = coefficient of the log of net sales for firm i in the year t,

$\text{OCF}_{it}$ = operating cash flows for firm i in the year t; $\beta_3$ = coefficient of the log of net sales for firm i in the year t,

Y05 = a dummy variable that takes the value of 1 for the year 2005, and 0 otherwise.

$\varepsilon_{it}$ = the error term for firm i in the year t,

And log stands for the natural logarithm of the relevant variable.

The results of the stepwise regression is given in Figure 2.

## 4. Results
### 4.1 Data Description

**Table 1.** Breakdown of R&D expenditure by sector

| Industry Sector | 2005 | | 2004 | |
|---|---|---|---|---|
| | No. of firms | Percentage | No. of firms | Percentage |
| Trading / Services | 11 | 22% | 9 | 20% |
| Technology | 6 | 12% | 4 | 9% |
| Properties | 1 | 2% | 2 | 4% |
| Plantation | 6 | 12% | 7 | 16% |
| Industrial Products | 9 | 18% | 7 | 16% |
| Consumer Products | 14 | 28% | 14 | 31% |
| Construction | 3 | 6% | 2 | 4% |
| Total | 50 | 100% | 45 | 100% |

Most of the firms that conduct R&D are found in the trading and services and consumer products sectors. Both of these sectors account for around half of the total number of firms that record R&D expenditures. Relatively fewer firms record R&D in the technology, plantation and industrial products sectors while there is very little R&D activity in the properties and construction sectors. There was little change in this distribution over the two years.

### 4.2 Estimation results

**Table 2.** Descriptive statistics (natural logarithms of variables)

| Variable | Log Total Assets | Log Net Sales | Log R&D Expenditure | Log Cash flow from Operations |
|---|---|---|---|---|
| Arithmetic Mean | 20.42 | 19.98 | 13.80 | 17.66 |
| Median | 20.31 | 19.87 | 13.90 | 17.51 |
| Standard Deviation | 1.54 | 1.56 | 2.34 | 1.80 |

**Table 3.** Results of the regression analysis

| Independent Variables | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Intercept (t-statistic) | -0.950322 (-0.447354) | -5.329117 (-1.990261)** | -4.897055 (-1.841439) * |
| Log (OCF) (t-statistic) | 0.837033 (7.110260)*** | 0.402760 (3.220893)*** | 0.436194 (3.162783)*** |
| Y05 | -0.059836 (-0.161819) | -0.158805 (-0.460494) | -0.163157 (-0.473753) |
| Log (NSLS) (t-statistic) | | 0.605475 (3.141259) *** | 0.720052 (2.455611)** |
| Log (TA) (t-statistic) | | | -0.162007 (-0.607865) |
| Adjusted R-squared | 0.405479 | 0.452349 | 0.447962 |
| F-statistic (probability F-statistic) | 33.39629 (0.000000)*** | 27.15602 (0.000000)*** | 20.27238 (0.000000)*** |

*All of the models employ least squares regression with white heteroskedasticity-consistent standard errors and covariance*
*\*\*\* result is significant at the 1% level*
*\*\*   result is significant at the 5% level*
*\*     result is significant at the 10% level*

The three models are able to explain around 40 to 45 percent of the variation in research and development expenditures. The operating cash flow is found to be highly significant in explaining research and development expenditures, in all the three models. It continues to remain very significant (at the 1% level) when additional explanatory variables are added to the regression analysis in Models 2 and 3. Both the operating cash flows and net sales are found to be significant in explaining research and development expenditures in Models 2 and 3, with net sales being significant at the 1% and 5% levels respectively. The coefficients of both of these variables have the expected positive sign. Surprisingly, the coefficient for total assets (Model 3) indicates a negative correlation between firm size and research and development activity. However, total assets are not significantly associated with research and development expenditures. The year dummy is also found to be insignificant, indicating that the time periods do not influence the results much. This is to be expected, since the years under consideration are very close.

## 5. Discussion of results

These results indicate that size (proxied by total assets) is insignificant in explaining the tendency to undertake research and development amongst the listed firms in Malaysia (Model 3). As such, the Schumpeterian perspective that research and development activities tend to be conducted by only larger firms is thus not applicable to the Malaysian context, and any policies to promote firm level research and development in Malaysia must consider this. Since the smaller firms are also likely to undertake R&D, policy makers should consider broad national level initiatives that would encourage the smaller firms to pursue research and development and produce innovative products and services that would give an edge in the global marketplace, rather than considering initiatives aimed at just the larger players. A positive association between cash flows from operations and R&D, provides support for the perspective that the availability of internal funds increases the likelihood of conducting R&D. All the three models above indicate that cash flows from operations is very significant in explaining R&D expenditures. Thus it appears that firms that choose to

undertake research and development expenditures in Malaysia depend on internal, rather than external, funds. Basically, these results concur with Fazzari and Athey (1987) while differing from Bhagat and Welch (1995) who did not find internal funds to be a significant determinant of research and development activities. It is possible that Bhagat and Welch's findings are characteristic of the developed nations, and may not reflect the situation in developing nations.

Models 2 and 3 indicate that sales are significantly associated with R&D expenditure, offering further support for Fazzari and Athey's conclusions that internal funding is a significant determinant of R&D. These findings do not reject the possibility of the existence of an inverse U shaped relationship between R&D and sales (Scherer, 1965a, 1965b), because these results may indicate the presence of the ascending arm of the inverted U shape. Since the total population of firms that undertake research and development in the relatively small Malaysian market is, in comparison to the larger markets of developed nations covered in the literature, very limited in size, it is difficult to ascertain the presence or absence of the inverse U shaped curve with this data. It is possible that firms with strong sales might be undertaking R&D to gain a competitive advantage and maintain the excellent sales.

In essence, the firms that pursue R&D in Malaysia seem to be characterised by high sales and internal liquidity, indicating that internal funds are important for the creation of R&D based intangible assets in listed firms.

## 6. Summary and Conclusions

### 6.1 Policy recommendations

This study finds operating cash flows and sales to be significantly associated with R&D activities, in Malaysia. Total assets, a proxy for firm size, are not significantly associated with R&D expenditures.

The results indicate that research and development activities are undertaken by not only the larger firms in Malaysia. As such, policy frameworks that would encourage the smaller firms that have good sales and operating cash flows to undertake research and development activities are likely to be effective in uplifting firm level, and subsequently national level, R&D activities as well as improving both firm level and national level intangible assets and competitiveness.

These results can be used as a basis for several recommendations for promoting firm-level research and development in Malaysia, to generate local research and development activities that can develop core intangible assets and innovative products, processes and services that will help drive the competitiveness of Malaysian firms. Combined with the fact the new international financial reporting standards (effective for Malaysian firms from 2006) allow research and development expenditures that provide benefits over several periods to be capitalised under a new classification of assets called intangible assets (providing greater visibility for these assets than the previous standards), this is an opportune time to encourage R&D amongst Malaysian firms, to strengthen their balance sheet in form and substance. In addition, the policy recommendations suggested below are also applicable to other developing economies that are similar to Malaysia. These recommendations are summarised in Figure 1.

The policymakers should consider tax concessions, subsidies and other direct government support (including matching grants, with the government providing funds that will match the funds set aside by the firms) for research and development activities for all companies that undertake R&D. This is a broad incentive covering all firms. However, when smaller firms undertake research, it is likely that they will face a shortage of funds, facilities and expertise to produce research of high quality.

The government could provide special grants for research by firms in the private sector, including top up funds for promising research projects, to address the issue of limited resources. This step calls for the provision of a special national level fund for promoting firm-level research and a committee that is able to vet promising proposals and appraise their funding needs. The brainpower and expertise in local universities can be tapped for this committee.

The lack of good research facilities and expertise can be overcome by actively pursing university-private sector linkages, whereby the private firms can be permitted to temporarily use the facilities of local universities to conduct their research. Such private sector-university linkages should ideally be run by joint teams of academicians from different disciplines (e.g. accounting, finance, costing, information technology and engineering experts from the academia and team members from the firms) so the final products are practical and relevant to the industry's needs. A full scale proposal on issues such as the ownership of the resulting Intellectual Property (e.g. patents, copyrights, etc) and the responsibilities of the university and the private firm must be agreed to beforehand to prevent thorny problems later that may lead to abandoning good research.

To maximise the effectiveness of these initiatives, policymakers should target firms with high sales and operating cash flows. They could begin by targeting the sectors where indigenous R&D occurs most frequently (such as the consumer products and the trading and services sectors in Malaysia), for this indicates the areas where R&D initiatives are most likely to be taken up quickly.

Firms that meet the criteria of high sales and cash flows from operations, within the sectors that most frequently undertake R&D, should be considered to be "qualifying firms" that will be considered by the high level research and development committee for

the special initiatives to further promote firm level long-term research and development.

In addition to the initiatives discussed above, the high level research and development committee could invite all firms to provide information on areas where they would like to conduct research and development but do not have the means to do so (e.g. a lack of funds, expertise, facilities, and so on). If many firms in a certain sector request for research in a particular area, the committee could then invite universities to explore the possibility of undertaking such research and submit proposals that address the issues identified. Indeed, when there is indication of strong industry side demand for certain high calibre research projects, experts from several universities and the private sector can work together in a national level initiative to produce very high quality research and relevant products, processes and services that can compete successfully in international markets.

**Figure 1.** National strategies for developing intangible assets[1]

I.) Via promotion of firm level R&D

Step 1 : Identify sectors that are R&D intensive
- Examine which sectors carry out R&D at present
- Focus preliminary attention on these sectors

Step 2 : Identify firms that are most likely inclined to carry out R&D
- Criteria for qualifying firms within the identified sectors: high sales, high positive cash flows from operations

Step 3 : Identify barriers to high calibre research and offer solutions to qualifying firms
- Shortage of funds to intensify R&D : offer top up funds, colloborative research projects to spread costs across more firms, reseach grants
- Lack of expertise : set up joint research task forces pooling brainpower from industry, university and national research centres.
- Lack of an understanding of the full advantage of R&D : educate the firms that R&D can be capitalised under a new category on the balance sheet which will improve the financial statements in form and substance.
- Lack of motivation to conduct R&D : Offer tax concessions, subsidies, mathing grants.

Step 4 : Monitor the success of the firms that have adopted the R&D
 initiatives, use these as a basis to launch further initiatives across more industries and firms.

II.) Via addressing industry's research needs (applicable to regional groups, such as ASEAN)

Step 1 : Indentify the research needs of firms
- Conduct a large scale survey of the research needs of firms

Step 2 : Indentify barriers to top calibre research that will meet industry needs
- Include appropriate items in the sruvey questionaire to determine wether the lack of finance, expertise or other factors are dampening firm and industry level R&D

Step 3 : Set-up national/international level R&D colloborative circles that will
 include partners from the academia, industry and
 national and international organisations that are able to
 successfully conduct the research demanded by the
 industry.

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[1] Items in I. are elaborated further in section 6.1. Policy recommendations while items in II. are covered in detail section 6.3. Implications and further research

*6.2 Limitations*

This study is based on firms that have reported research and development activities in their annual reports. It does not capture the firms that may have conducted research and development but failed to report it. As such, it could possibly understate the research and development levels in public firms. Furthermore, it also does not capture the research and development expenditure that may have been capitalised under the then existing accounting regulations. However, capitalisation of research and development expenditure under the accounting standards is only allowed when the firms are able to establish that these expenditures will result in a future inflow of economic benefits, and that the benefits exceed the expenditures. For the case of Malaysian firms, Tong (1997, p. 240) states: "In general, it is believed that the relationship between current research and development costs and the amount of future benefits is normally uncertain and difficult to establish. For this reason, research and development costs are normally treated as a period expense and charged to income in the period they are incurred." Since Malaysian firms are more likely to expense than capitalise research and development expenditures, the research and development expenditures should serve well as a proxy for research and development activities.

Indeed, the number of firms used in this study represents roughly 5% of the listed firms in Malaysia in the years studied. The low figure is consistent with the overall low levels of research and development reported for Malaysia. As such, the limitation discussed above is not likely to significantly affect the results presented here.

A second limitation is that smaller firms that are not listed are not captured in this study. A large scale survey instrument in addition to a study of published annual reports is an excellent supplementary vehicle for studying research and development in these smaller firms. Such a study will be able to delve deeper into the research needs of the smaller companies in Malaysia. Such a study can also be extended to all of the nations in a particular grouping, such as ASEAN, and international resources can be established to promote R&D within the member nations in each group.

*6.3 Implications and further research*

It is possible to get further insights into the determinants of research and development in Malaysia and other developing nations through a large scale survey.

Since the new international financial reporting regulations allow firms to report intangible assets on balance sheets, the expenses incurred in the pursuit of research and development activities that provide long term benefits can now be capitalised and reported as intangible assets in a separate category on the balance sheet. Thus, these accounting regulations provide greater incentives for firms to undertake R&D. Surveys can also explore if the presence of these standards, which seek to portray a more realistic view of the assets of an organisation, have the side effect of encouraging a greater inclination to undertake research and development, that can potentially be capitalised, in Malaysia and other developing nations.

For the firms listed on the stock exchanges of developing nations , the absence of items in the intangible assets category may be interpreted as a lack of managerial sophistication, especially when compared with firms in developed nations, by international investment fund managers, resulting in these firms losing out on investment funds in the global arena. As such, it is beneficial for firms in developing nations to take a serious look at the research and development activities and consider a means of establishing intangible assets on their balance sheets.

Future research can be undertaken with a large scale survey of listed firms in developing nations worldwide to get the views of accountants and managers of public listed companies on the importance of intangibles assets, for improving firm performance as well as the appearance and strength of the balance sheet.

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