

# The value relevance of R&D and free cash flow in an efficient investment setup

## Evidence from Chinese A-listed firms

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### Abstract

**Purpose** – The purpose of this paper is to investigate the value relevance of Research and development (R&D) and free cash flow (FCF) in an efficient investment setup. Most importantly, this paper examines whether the value relevance of R&D and FCF is associated with life cycle stages. Furthermore, this paper reports whether the market response to R&D and FCF is different in competitive market as compared to the concentrated market.

**Design/methodology/approach** – The analysis is based on the Ohlson (1995) model for the determination of value relevance of earnings and book value. Capitalized R&D and FCF data comprising of the Chinese A-listed firms from the year 2008 to 2016 are selected for this study. Following Anthony and Ramesh (1992), the authors divided the firm life cycle into different stages. HHI index is used to measure the product market competition.

**Findings** – The main result shows that R&D and FCF are value relevant in Chinese A-listed firms. The impact of R&D and FCF on the value relevance of earnings and book value is also positive and significant. The findings of the effect of R&D and FCF on the value relevance of accounting information signify that the information content ( $R^2 = 0.46$ ) of the mature stage is higher than that of the growth and stagnant stage. The explanatory power measured by  $R^2$  value for competitive industries (0.47) is much higher than the concentrated industries (0.33).

**Research limitations/implications** – Despite taking into account all the possible available variables, there are few limitations of the study. This study only studies the effect of EPS, BPS, R&D and FCF on the value relevance of accounting information. Other determinant such as size, growth, leverage and firm age is ignored. Since the R&D expenditure is discretionary, therefore the findings cannot be generalized to all the sectors. A sector wise comparative study can be done in future, to understand the differences in the information contents of R&D and FCF. Also, the tax effect of R&D is ignored in this study. For future call, the value relevance of tax effect on R&D can be explored.

**Practical implications** – The investors can now determine the present value of all the future cash flows of investing activities. The results of the study are significant for the Chinese investors who should incorporate the R&D and FCF along with investment efficiency. The investors should keep in mind the life cycle stage while investing in a certain stock. The competitive markets have more information content than the concentrated markets. The corporate managers can benefit from this study while issuing new shares. The market responds



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positively to the stock having investment efficient R&D and FCF investment. For the policy implication perspective, the security market regulator should devise the effective pro-effective product market regulations. **Originality/value** – The contribution of this study is manifold. First, according to the authors' knowledge, this is the first study that incorporates investment efficiency with R&D and FCF and explores its effect on the value relevance of accounting information. Second, the impact of R&D on the value relevance is studied by numerous researchers (Lev and Sougiannis, 1996; Han and Manry, 2004). Similarly, FCF-agency cost effect has also been investigated by (Rahman and Mohd-Saleh, 2008; Chen *et al.*, 2012) but the value relevance of R&D and FCF during different life cycle stages still needs to be answered. Finally, this study also tries to answers the question if the market response to R&D and FCF is different in a competitive market as compared to the concentrated market.

**Keywords** R&D expenditures, Free cash flows, Value relevance, Investment efficiency, Product life cycle  
**Paper type** Research paper

## 1. Introduction

The wealth maximization of the principals is the primary goal of a financial manager. For this purpose, the manager should allocate funds at his disposal very efficiently and effectively. Agency theory suggests that opportunistic managers may indulge self-empire buildings if they have too much funds at disposal (Jensen and Meckling, 1976). Research and development (R&D) investment and free cash flows (FCF) are two sources that are regarded as a gauge to measure the information asymmetry. Since managerial discretion determines the level of R&D expenditures and FCF, therefore, the asymmetric problems among managers and principals can be resolved through efficient investment. The financial statements should be value relevant for the efficient investment firms involved in R&D and FCF.

Market response to firm R&D and FCF depends upon the life cycle sub-stages. Faff *et al.* (2016) studied the interdependence of corporate policies during the life cycle stages. They find that during life cycle stages, the investment and equity issuance decreases. We can deduce that the firms need more investment at the early stages; therefore, higher R&D and FCF in early stages are expected. As the firm enters the maturity stage, the firms steady its capital investment and the excess cash is being distributed to the shareholders in the form of dividends. The decline stage is the outcome of the failure of innovation, investing less and distributing more. Due to different priorities of financial manager to varying stages of the lifecycle, the information content of R&D and FCF may differ at each stage.

The difference in the information content of R&D and FCF would not only be found among product lifecycle stage, but this difference may also arise due to product market competition. It has been well documented that the product market competition substitutes for corporate governance in frail markets (Giroud and Mueller, 2011; Ammann *et al.*, 2013; Yu *et al.*, 2017). The market response to investment activities is positive in competitive markets. Therefore, we expect a difference in the information content of R&D and FCF in competitive and concentrated industries.

The purpose of this study is to explore the value relevance of R&D and FCF for the efficient investment firms. Also, we want to find out how the market response to R&D and FCF among different life cycle stages and during the product market competition. This study focuses on the capitalized amount shown in the balance sheet which signifies the managerial discretion. The old Chinese accounting standards for business enterprises do not require the firms to disclose the R&D expenditures. But after 2007 the Chinese accounting system was transformed to International Accounting Standard Board settings; therefore, firms start to show capitalized R&D expenditures in the balance sheet and hence give useful information to the investors. The contribution of this study is manifold. First, to our knowledge, this is the first study that incorporates investment efficiency with R&D and FCF and explores its effect on the value relevance of accounting information. Second, the impact of R&D on the value relevance is studied by numerous researchers (Lev and Sougiannis, 1996; Han and Manry, 2004). Similarly FCF-agency cost effect has also been investigated by (Rahman and Mohd-Saleh, 2008; Chen *et al.*, 2012) but the value relevance of

R&D and FCF during different life cycle stages still needs to be answered. Finally, this study also tries to resolve the query if the market response to R&D and FCF is different in a competitive market as compared to the concentrated market.

Our analysis is based on the Ohlson (1995) model and data comprise of the Chinese A-listed firms from the year 2008 to 2016. Ordinary least square is estimated after controlling for time and industry effects. The result shows that the investment efficient firm's R&D and FCF are value relevant to the overall sample. The impact of R&D and FCF on the value relevance of earnings and book value is also positive and significant. Life cycle stages depict different information content at each phase. The findings of the effect of R&D and FCF on the value relevance of accounting information signifies that the information content ( $R^2 = 0.46$ ) of the mature stage is higher than that of the growth and stagnant phase. The market does not respond to value relevance of R&D and FCF at the stagnant stage. Mature firms are more stable as compared to growth and stagnant firms. Therefore, the market reacts more to their book values rather than their earnings. This is the reason of value relevance of the book values of R&D and FCF investment. The growth firms pay a high level of dividends, therefore, the value relevance of earnings for R&D and FCF expenditure becomes significant.

In the end, we explore the value relevance of R&D and FCF investment in product market competition. For this purpose, the firms are divided into two sub-samples as competitive industries and concentrated industries based on the Herfindahl–Hirschman index. The result shows that R&D expenditures are value relevant only for competitive industries. The effect of R&D and FCF on the value relevance of book value is significant for concentrated industries, while just R&D are value relevant to the book value competitive industry. The effect of R&D on earnings in concentrated industries is significantly related to the stock price while FCF has a positive impact on earnings in competitive industries. The explanatory power measured by  $R^2$  value for competitive industries (0.47) is much higher than the concentrated industries (0.33).

The investors should keep the life cycle stage in mind while investing in a specific stock. The competitive markets have more information content than the concentrated markets. The corporate managers can benefit from this study while issuing new shares. The market responses positively to the stock having investment efficient R&D and FCF investment. For the policy implication perspective, the security market regulator should devise the pro-effective product market regulations.

## 2. Literature review

### 2.1 *The value relevance of earnings, book value, FCF and R&D*

Accounting information is termed as value relevant if the market price of the stock is associated with the earnings and book value of equity (Ohlson, 1995; Barth *et al.*, 1998). Adequate studies have documented the value relevance of earnings and book value in the Chinese perspective. Jun Lin and Chen (2005) and Liu *et al.* (2014) examined the effectiveness of A-listed and B-listed shares market in China. Their results showed that earnings and book value is more value relevant in the Chinese accounting system as compared to the international accounting standards. The effect of earning and book value on the value relevance of accounting information has been studied by Qu and Zhang (2015) from the period 1991 to 2010 in China. They concluded that the value relevance of earnings has slightly declined while the value relevance of book value has increased over the period. Similarly Shan (2015) found from his research that the earnings and book value is value relevant in Chinese stock market from the period 2001 to 2005.

Jensen (1986) proposed the FCF hypothesis from the perspective of the agency cost. According to him, the opportunistic manager rather than investing the FCF in positive NPV projects utilize the funds for dispensation. He further added that the agency cost of FCF could be curtailed by refraining approach or encouraging approach. Gul and Tsui (1997) and

Rahman and Mohd-Saleh (2008) elaborated that the firms with high FCF and low growth opportunity are more prone to the opportunistic behavior of the managers. Richardson (2006) studied the relationship between the FCF and over investment. He found that the firm with a high level of FCF inclineds to over invest hence supporting the agency perspective. Firms that are reporting FCF in their financial statements are increasing over time. However, these firms do not enjoy an excellent credit rating (Adhikari and Duru, 2006). Chen *et al.* (2016) studied the effect of FCF and corporate governance on the firm investment level in China. The result suggests the agency cost is present in the firms having a high level of FCF which results in over investment.

Similarly, R&D expenditures may lead to low performance if the firm is facing agency problems (Salge and Vera, 2013). Capitalization of R&D has its own merits and demerits. The opponents suggest that R&D expenditures capitalized by the financial manager give them the opportunity to write-off negative NPV projects or high-risk ventures. On the other hand, the proponents think that the value relevance of R&D expenditures is higher when the amount is capitalized because in this way the financial manager realizes the intangibles assets in the balance sheet (Lev and Zarowin, 1999). The opportunistic manager may use excess resources of the organization in self-empire building or investing inefficiently resulting in low performance (Geiger and Cashen, 2002; Tan and Peng, 2003). Osma and Young (2009) in their research investigated the research question if the firms cut R&D expenditures in response to earnings pressure or not? Their result showed that the pressure to report positive earnings and earnings growth in the current period results in the cut in R&D expenditures. The market responds less to the amount of reduction rather than the reason for the decline.

The investment efficiency can bring a positive signal about the firm utilization of the FCF and R&D expenditures. According to Biddle *et al.* (2009), firms with investment efficiency are categorized as either having accounting quality or reporting quality. The market responds more toward the information content of the efficient investment firms, therefore, the R&D and FCF investment reported by these firms should be value relevant. Similarly, Chan *et al.* (1990) advocated that firms engaged in R&D expenditures have positive stock price movement. But this movement depends upon if the firms fall in to the high-tech sector or not. So, our next hypothesis turns out to be as follows:

- H1. Efficient R&D expenditures and efficient FCF are value relevant in Chinese A-listed firms.

## 2.2 Value relevance of R&D and FCF investment during life cycle stages

The concept of the life cycle has a profound history in different fields of knowledge. However, the study that is related to the life cycle stages with the firm performance was propounded by Anthony and Ramesh (1992). According to their research, the market reaction to the capital investment and sales growth varies across different life cycle stages. Black (1998) examined the incremental effect of life cycle stages on cash flows and earnings. He divided the life cycle stage into four sub-stages namely start-up, growth, maturity and decline while cash flows were split into operating, investing and financing activities, respectively. The result shows that the earnings and cash flows have incremental information content at different life cycle stages. Expanding his study further, Black (2003) recommended that although profits are more value relevant than the cash flows measures, yet they depend upon the firm life cycle stage. At start-up stage, the firm may experience negative gains, so the incremental information content at start-up phase is insignificant, but as the firm enters the growth and maturity stage, the incremental effect becomes more value relevant. Kousenidis (2005) re-examines the earnings-return relationship for a sample of firms in Greece across different life cycle stages. The results show that improved information contents are reported when accounted for size, but there is not any consistency

in information contents if examined across different life cycle stages. How life cycle contributes to the determination of annual return was investigated by Xu (2007). The findings suggest that the value relevance of risk factors is dependent on the life cycle stages.

Based on the above literature, we can conclude that there is information content at different life cycle stages. But do R&D and FCF investment have any information content across different life cycle stages is the question to be answered. Building toward our next hypothesis, we take help from the recent work done by Faff *et al.* (2016). They examine the interdependence of corporate policies during the life cycle stages. They find that the investment and equity issuance decreases over the life cycle stages. So, we can infer that at early stages the firms need more investment, therefore, higher R&D and FCF. Our next hypothesis becomes:

*H2. The information content of R&D and FCF varies across different life cycle stages.*

### *2.3 Value relevance of R&D and FCF investment and product market competition*

Hou and Robinson (2006) has expounded that the firms in concentrated industries earn a lower return because they either are less innovative or due to the barrier to entry insulate firms from un-diversifiable risks. The firms in concentrated markets have monopoly power over the customers; hence all the price shocks are passed onto the customers reflected in the stock price (Peress, 2010). In market where corporate governance is weak the product market competition acts as a substitute and firm value is enhanced (Giroud and Mueller, 2011; Ammann *et al.*, 2013; Yu *et al.*, 2017). Firms inclined toward high R&D activities tend to earn a lot higher if they fall under competitive industries (Gu, 2016). Similarly, Grullon and Michaely (2007) in their research suggest that the cash payout policies in firms belonging to competitive industries are higher than the concentrated sectors. They further elaborate that the agency cost of FCF is more elevated in intensive industries. By using firm-year observations from 1990 to 2010, Laksmna and Yang (2015) conclude that competition, on the one hand, increases the risk-taking activities by the managers while on the other hand it also enhances the investment efficiency. Our next hypothesis becomes as follows:

*H3. The information content of efficient R&D and efficient FCF are more value relevant in competitive industries than concentrated industries.*

## **3. Research design**

### *3.1 Sample selection*

Chinese security market and financial research contains a comprehensive array of data set for Chinese listed companies. The data are collected from Chinese A-listed firms from the year 2008 to 2016. The companies falling in the financial sector are excluded from the analysis because of their unique nature. Since the account closure of all the A-listed firms is on December 31, therefore we took the price of the stocks four months after the announcement of annual reports. This step is needed to adjust for the unobserved information due to herding behavior. The sample size in this study varies depending upon the nature of relationship explored. For example, while taking the whole sample, we have got 17,864 firm-year observations, but they decrease considerably while taking sub-sample based on life cycle stages or product market competition. Since the data comprises of nine years, many companies were listed after 2007 and were included afterward. Therefore, this gives us an unbalanced data. All the variables were Winsor at 1 percent to cope with the outlier's problem.

### *3.2 Model specification*

Based on our hypothesis, we want to explore the value relevance of books and earnings in the first model following Ohlson (1995). We extend the Ohlson model to incorporate FCFs

and R&D expenditure in Model 2. Then we measure the effect of FCFs and R&D expenditure on the value relevance of earnings and book value in Model 3. Model 3 is not only tested for the entire sample, but we also inspect the relationship among different life cycle stages and in product market competition:

$$\text{Price(4th Month)} = f(\text{BPS, EPS, Year dummy, industry dummy}), \quad (1)$$

$$\text{Price(4th Month)} = f(\text{BPS, EPS, FCF} - \text{IE, RnD} - \text{IE, Year dummy, industry dummy}), \quad (2)$$

$$\text{Price(4th Month)} = f[\text{BPS} \times (\text{FCF} - \text{IE, RnD} - \text{IE}), \text{EPS} \times (\text{FCF} - \text{IE, RnD} - \text{IE}), \text{Year dummy, industry dummy}]. \quad (3)$$

### 3.3 Variable measurement

**3.3.1 Dependent variables.** Following Shan (2015) and Ge *et al.* (2010), we have taken the price at the end of the fourth month after the fiscal year ends. We have taken the last trading day if the market is closed on the last day of the fourth month. It is mandatory for the Chinese listed companies to publish the audited financial statement within the first four months of the calendar year.

**3.3.2 Independent variables.** Model 1 comprises two independent variables namely BPS and EPS. BPS is calculated as dividing the net assets during a particular year by the number of shares outstanding. EPS is the measure of earnings per share and is calculated as dividing net income by the number of shares outstanding in a specific year.

Considering Model 2, we incorporate two additional independent variables namely R&D-IE and FCF-IE. R&D-IE is the measure of a firm's R&D investment to total assets falling in investment efficient group. Similarly, FCF-IE is the measure of firm's FCFs to total assets falling in investment efficient group:

$$\text{R\&D} = \frac{\text{Research and development expenditure}}{\text{Total assets}}.$$

Following Chung *et al.* (2005) and Rahman and Mohd-Saleh (2008), we measure the FCFs as follows:

$$\text{FCF} = \frac{\text{Operating income before depreciation} - \text{Total taxes} - \text{Interest expenses} - \text{Preferred and common stock dividend}}{\text{Total assets}}.$$

After calculating the R&D and FCF, we then focused on the firms that are investment efficient. For this purpose, we followed Richardson (2006):

$$\begin{aligned} I_{\text{New}} = & \text{BTM}_{t-1} + \text{Leverage}_{t-1} + \text{Cash}_{t-1} + \text{Age}_{t-1} + \text{Size}_{t-1} + \text{Stock return}_{t-1} \\ & + I_{\text{New } t-1} + \text{Year dummy} + \text{Industry dummy}, \end{aligned} \quad (4)$$

where  $I_{\text{New}} = \text{R\&D expenditure} + \text{Capital expenditure} - \text{Cash receipt from sales of property, plant and equipment divided by lagged total assets}$ .  $\text{BTM}_{t-1} = \text{lagged book to market ratio}$ ;  $\text{Leverage}_{t-1} = \text{previous year total debt divided by last year total assets}$ ;  $\text{Cash}_{t-1} = \text{lagged cash and equivalent scaled by lagged total assets}$ ;  $\text{Age}_{t-1} = \text{the period since the company is listed on the stock exchange (Lagged value)}$ ;  $\text{Stock Return}_{t-1} = \text{change in the market value of the firm divided by the previous year market value}$ ; and  $I_{\text{New } t-1} = \text{Investment calculated as above in year } t-1$ .

The regression is run each year for each industry in the panel data. The residuals from the Equation (4), depict the investment inefficiency. Since we are interested in firms investment efficiency rather than over investment or underinvestment, therefore, following Ma and Jin (2016) we took the absolute value of residuals. A higher level of residuals signifies over investment, and a lower level of residuals depicts underinvestment; consequently we made the middle two quartiles to indicate investment efficiency. Investment efficiency is a dummy variable that makes the value of 1 if the firms absolute investment efficiency value falls in to the middle two quartiles, zero otherwise. After the calculation of investment efficiency, we arranged our sample firms as the firms with R&D and FCF investment having the values of 1 that denotes investment efficiency.

**3.3.3 Life cycle measurement.** Following Anthony and Ramesh (1992) and Xu (2007), we divide the firms into three life cycle stages. The division of these groups is based on the dividend payout ratio, sales growth, capital expenditure scaled by the total value of the firm and firm age. The first stage of the life cycle is the growth group characterized by high level of dividend payout, sales growth and capital expenditure ratio. Generally, these firms are young. The second group called as mature firms have a moderate level of dividend payout, sales growth and capital investment. These firms have a firm age in the middle two quartiles of the whole sample firm's age. The last group named as the stagnant group has a low level of dividend payout, sales growth and capital expenditure. These firms are older than the other two groups. Each year partition is made on the above criteria for each industry. A firm's ranking may vary each year based on the group it may fall in. Table I elaborate the life cycle expectation during each stage.

**3.3.4 Product market competition measurement.** Herfindahl–Hirschman index is widely used to measure the product market competition and is also followed in our study. This index is calculated by summing up the sales-based squared market shares of all the firms in the industry during a particular year:

$$HHI_{jt} = \sum_{i=1}^{N_{jt}} s_{ijt}^2,$$

where  $S_{ijt}$  denotes the market share of the firm “ $i$ ” in industry  $j$  in year  $t$ .  $N_{jt}$  is the number of firms in industry  $j$  in year  $t$ . Following Yu *et al.* (2017), we excluded firms with either missing sales values or where sales are negative. Also excluded are the industries that contain less than five firms during a particular year.

## 4. Research findings

### 4.1 Descriptive results and correlation analysis

Table II, Panel A reports the summary statistics of the overall data. The average stock price during the nine-year period of all the firms included in the sample is 16.78. The average leverage value in Chinese A-listed firms is 47.2 percent. The average values of EPS and BPS

| Variables           | Lifecycle stages |        |          |                                    |
|---------------------|------------------|--------|----------|------------------------------------|
|                     | Growth           | Mature | Stagnant |                                    |
| Dividend payout     | High             | Medium | Low      | Table I.<br>Life cycle descriptors |
| Sales growth        | High             | Medium | Low      |                                    |
| Capital expenditure | High             | Medium | Low      |                                    |
| Firm age            | Young            | Adult  | Old      |                                    |

Table II.  
Variables attributes

| Variables                                           | N      | Mean     | SD      | Min.    | Max.  |
|-----------------------------------------------------|--------|----------|---------|---------|-------|
| <i>Panel A: overall summary statistics</i>          |        |          |         |         |       |
| Price                                               | 19,273 | 1678     | 15.54   | 0.730   | 4135  |
| Growth                                              | 17,956 | 2582     | 16.28   | -0.975  | 1450  |
| Leverage                                            | 20,519 | 0.472    | 1.030   | 0.00712 | 0.94  |
| Size                                                | 20,519 | 21.82    | 1.323   | 13.76   | 2851  |
| Firm age                                            | 20,178 | 8.872    | 6.416   | 1       | 26    |
| EPS                                                 | 22,908 | 0.376    | 0.682   | -22.41  | 17.53 |
| BPS                                                 | 22,908 | 4.475    | 3.178   | -23.96  | 60.42 |
| R&D/TA                                              | 12,317 | 0.00194  | 0.00887 | 0       | 0.277 |
| FCF/TA                                              | 14,211 | -0.202   | 0.480   | -47.07  | 9.740 |
| R&D-IE                                              | 10,317 | 0.000762 | 0.00576 | 0       | 0.277 |
| FCF-IE                                              | 12,211 | -0.0703  | 0.170   | -3.713  | 0.540 |
| <i>Panel B: partition based on lifecycle stages</i> |        |          |         |         |       |
| <i>Growth firms</i>                                 |        |          |         |         |       |
| Price                                               | 2,455  | 13.76    | 11.37   | 1.520   | 1740  |
| Growth                                              | 2,655  | 6.526    | 26.02   | -0.707  | 1450  |
| Leverage                                            | 2,674  | 0.526    | 0.196   | 0.0250  | 0.932 |
| Size                                                | 2,674  | 22.61    | 1.210   | 18.52   | 27.34 |
| Firm age                                            | 2,674  | 9.998    | 4.855   | 1       | 26    |
| EPS                                                 | 2,797  | 0.347    | 0.715   | -5.903  | 16.54 |
| BPS                                                 | 2,797  | 4.383    | 2.642   | -4.066  | 42.25 |
| R&D/TA                                              | 2,277  | 0.00297  | 0.0129  | 0       | 0.277 |
| FCF/TA                                              | 2,674  | -0.248   | 0.233   | -2.416  | 0.507 |
| R&D-IE                                              | 2,277  | 0.00152  | 0.0108  | 0       | 0.277 |
| FCF-IE                                              | 2,674  | -0.101   | 0.191   | -1.690  | 0.304 |
| <i>Mature firms</i>                                 |        |          |         |         |       |
| Price                                               | 7,226  | 14.92    | 14.08   | 1.660   | 4135  |
| Growth                                              | 7,488  | 2.829    | 16.99   | -0.975  | 1450  |
| Leverage                                            | 7,773  | 0.493    | 0.493   | 0.00917 | 0.91  |
| Size                                                | 7,773  | 22.04    | 1.324   | 13.76   | 2851  |
| Firm age                                            | 7,597  | 11.47    | 5.648   | 1       | 26    |
| EPS                                                 | 8,363  | 0.355    | 0.742   | -5.573  | 17.53 |
| BPS                                                 | 8,363  | 4.178    | 3.075   | -23.96  | 60.42 |
| R&D/TA                                              | 6,796  | 0.00217  | 0.00930 | 0       | 0.229 |
| FCF/TA                                              | 7,541  | -0.206   | 0.414   | -28.96  | 1.072 |
| R&D-IE                                              | 6,796  | 0.00108  | 0.00608 | 0       | 0.229 |
| FCF-IE                                              | 7,541  | -0.0947  | 0.192   | -3.713  | 0.540 |

(continued)

(continued)

Stagnant firms

|          |       |          |         |         |       |
|----------|-------|----------|---------|---------|-------|
| Price    | 7.049 | 20.11    | 18.05   | 1.950   | 370.5 |
| Growth   | 6.439 | 0.595    | 7.493   | -0.975  | 145.0 |
| Leverage | 7.666 | 0.410    | 1.425   | 0.00712 | 0.94  |
| Size     | 7.666 | 21.38    | 1.169   | 15.57   | 28.51 |
| Firm age | 7.532 | 5.893    | 6.603   | 1       | 26    |
| EPS      | 8.144 | 0.395    | 0.606   | -22.41  | 5.763 |
| BPS      | 8.144 | 4.922    | 3.285   | -20.99  | 31.54 |
| R&D/TA   | 6.750 | 0.00154  | 0.00660 | 0       | 0.167 |
| FCF/TA   | 6.446 | -0.167   | 0.654   | -47.07  | 9.740 |
| R&D/IE   | 6.750 | 0.000470 | 0.00358 | 0       | 0.129 |
| FCF/IE   | 6.446 | -0.0564  | 0.157   | -2.744  | 0.319 |

Panel C: partition based on product market competition

Concentrated industry

|          |       |          |         |        |       |
|----------|-------|----------|---------|--------|-------|
| Price    | 6.189 | 15.62    | 16.45   | 1.660  | 370.5 |
| Growth   | 6.282 | 3.973    | 20.52   | -0.975 | 145.0 |
| Leverage | 6.740 | 0.514    | 0.631   | 0.0105 | 0.91  |
| Size     | 6.740 | 22.07    | 1.527   | 13.76  | 28.51 |
| Firm age | 6.645 | 10.40    | 6.661   | 1      | 26    |
| EPS      | 7.537 | 0.365    | 0.730   | -22.41 | 17.53 |
| BPS      | 7.537 | 4.243    | 3.115   | -23.96 | 42.25 |
| R&D/TA   | 5.831 | 0.00152  | 0.00803 | 0      | 0.216 |
| FCF/TA   | 6.338 | -0.189   | 0.268   | -4.368 | 1.088 |
| R&D/IE   | 5.831 | 0.000612 | 0.00491 | 0      | 0.216 |
| FCF/IE   | 6.338 | -0.0820  | 0.179   | -2.744 | 0.540 |

Competitive industry

|          |        |         |         |         |       |
|----------|--------|---------|---------|---------|-------|
| Price    | 10.541 | 17.71   | 15.34   | 1.520   | 413.5 |
| Growth   | 10.300 | 1.687   | 12.93   | -0.975  | 145.0 |
| Leverage | 11.373 | 0.433   | 1.144   | 0.00712 | 0.94  |
| Size     | 11.373 | 21.71   | 1.159   | 16.71   | 27.10 |
| Firm age | 11.158 | 7.990   | 6.253   | 0       | 26    |
| EPS      | 11.767 | 0.375   | 0.653   | -6.024  | 15.38 |
| BPS      | 11.767 | 4.700   | 3.122   | -7.293  | 60.42 |
| R&D/TA   | 9.992  | 0.00231 | 0.00941 | 0       | 0.277 |
| FCF/TA   | 10.323 | -0.203  | 0.603   | -47.07  | 9.740 |
| R&D/IE   | 9.992  | 0.00104 | 0.00682 | 0       | 0.277 |
| FCF/IE   | 10.323 | -0.0802 | 0.181   | -3.713  | 0.382 |

Table II.

Table II.

| Difference of means test<br>Variables | Growth   | Mature   | Stagnant | Difference (growth –<br>mature) | Difference (mature –<br>stagnant) | Competitive | Concentrated | Difference (competitive –<br>concentrated) | Growth | Firm<br>age | VIF  |
|---------------------------------------|----------|----------|----------|---------------------------------|-----------------------------------|-------------|--------------|--------------------------------------------|--------|-------------|------|
| R&D/TA                                | 0.00297  | 0.00217  | 0.00154  | 0.008**                         | 0.00063                           | 0.00231     | 0.00152      | 0.0079**                                   |        |             | 1.66 |
| FCF/TA                                | 0.248    | 0.206    | 0.167    | 0.042***                        | 0.039                             | 0.203       | 0.189        | 0.14**                                     |        |             | 1.89 |
| R&D-IE                                | 0.00152  | 0.00108  | 0.000470 | 0.0044***                       | 0.00061                           | 0.00104     | 0.000612     | 0.00042***                                 |        |             | 1    |
| FCF-IE                                | 0.101    | 0.0947   | 0.0564   | 0.0063**                        | 0.0501                            | 0.0802      | 0.0820       | -0.0018**                                  |        |             | 1.07 |
| <i>Panel D: correlation analysis</i>  |          |          |          |                                 |                                   |             |              |                                            |        |             |      |
| Price                                 | 1        |          |          |                                 |                                   |             |              |                                            |        |             |      |
| EPS                                   | 0.4950*  | 1        |          |                                 |                                   |             |              |                                            |        |             | 1.29 |
| BPS                                   | 0.4705*  | 0.6101*  | 1        |                                 |                                   |             |              |                                            |        |             | 1.02 |
| R&D-IE                                | 0.0320*  | -0.0097  | -0.0089  | 1                               |                                   |             |              |                                            |        |             | 1.66 |
| FCF-IE                                | 0.0785*  | 0.0706*  | 0.0508*  | -0.0610*                        | 1                                 |             |              |                                            |        |             | 1.07 |
| Size                                  | -0.1403* | 0.1705*  | 0.2694*  | 0.0056                          | -0.0995*                          | 1           |              |                                            |        |             | 1.29 |
| Leverage                              | -0.0817* | -0.1290* | -0.1515* | -0.01                           | -0.1214*                          | -0.0004     | 1            |                                            |        |             | 1.05 |
| Growth                                | -0.0469* | 0.0241*  | -0.0229* | -0.0186*                        | 0.0441*                           | 0.0467*     | 0.0167*      | 1                                          |        |             | 1.02 |
| Firm age                              | -0.2648* | -0.1244* | -0.2213* | 0.0052                          | -0.1410*                          | 0.2696*     | 0.1108*      | 0.1122*                                    |        | 1           | 1.2  |

for the Chinese listed firms is 0.37 and 4.47 per share, respectively. The FCF shows an average negative value while the R&D/TA is 0.19 percent.

Further looking at Panel B, we get a picture of the all the three life cycle stages. The stagnant firms show less growth (0.595) as compared to mature (2.83) and growth (6.53) firms. Growth firms take a higher level of leverage (0.52) than that of the stagnant (0.41) and mature firms (0.49). The level of R&D/TA in mature and growth firms is much greater 0.217 percent and 0.297 percent as compared to stagnant firms which are 0.154 percent. This emphasizes on the fact that the growth firms require more R&D investment to expand as compared to other two groups. The average FCF/TA for all the three groups is negative, but the negative value is much higher in growth firms (−0.24) than that of the mature (−0.21) and stagnant firms (−0.17). One of the possible explanations for this higher negative value of mature firms is having a high level of capital expenses. Since the FCF is calculated after deducting the capital expenditure from the income before interest and taxes, therefore we get an average high negative value of FCF/TA in growth firms.

Panel C depicts the summary statistics based on the product market competition. The panel is divided into two groups. The first panel shows the firms falling in concentrated industries while the second group reports the summary statistics of firm laying in competitive industries based on the Herfindahl–Hirschman index. The average market price per share in concentrated sectors is 15.62 while in competitive industries is 17.71. Firms in competitive industries invest more in R&D activities (0.231) than their counterparts (0.15). This shows that competition makes the firm invest more in R&D investment to gain a competitive advantage. Correspondingly, due to the high capital investment, the value of FCF/TA in competitive industries (−20.3) is less than the concentrated industries (−18.9). The investment efficiency of concentrated industry (37.18 percent) is slightly higher than the competitive firms (35.62 percent).

Table III shows the correlation coefficient for the variables. The coefficient values among independent variables are much less than 0.8 which shows no presence of multicollinearity problem. We also test the multicollinearity diagnostic through VIF analysis and find all the values well low at the critical level. The market price per share shows a positive and significant relationship with EPS, BPS, FCF-IE and R&D-IE supporting our null hypothesis.

## 4.2 Regression results

**4.2.1 Value relevance of R&D and FCF investment.** The value relevance of earnings and book value is depicted in Model 1 of Table IV while the value relevance of FCF-IE and R&D-IE is shown in Model 2. Both models reveal that the earning and book value are value relevant in Chinese listed firms (EPS  $\beta = 8.52$   $p$ -value < 0.01; BPS  $\beta = 1.24$   $p$ -value < 0.01) in

| Variables      | Model 1           | Model 2           | Model 3           |
|----------------|-------------------|-------------------|-------------------|
| EPS            | 8.523*** (0.190)  | 7.185*** (0.186)  | 7.167*** (0.194)  |
| BPS            | 1.237*** (0.0394) | 1.057*** (0.0407) | 1.095*** (0.0434) |
| FCF-IE         |                   | 3.593*** (0.507)  | 0.485 (0.821)     |
| R&D-IE         |                   | 69.82*** (14.69)  | −18.04 (28.73)    |
| BPS × R&D-IE   |                   |                   | 10.49 (7.019)     |
| BPS × FCF-IE   |                   |                   | 0.628*** (0.207)  |
| EPS × R&D-IE   |                   |                   | 178.2*** (50.62)  |
| EPS × FCF-IE   |                   |                   | 3.242*** (1.189)  |
| Constant       | 8.560*** (0.781)  | 9.530*** (0.738)  | 9.354*** (0.738)  |
| F-stats        | 326.48***         | 458.18***         | 290.09***         |
| R <sup>2</sup> | 0.410             | 0.397             | 0.400             |

**Notes:** Standard errors in parentheses. \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table III.**  
Value relevance of  
earnings, book value,  
free cash flow  
and R&D

**Table IV.**  
Value relevance of  
R&D and FCF across  
different life  
cycle stages

| Variables                                                                                  | VR stagnant       | VR mature         | VR growth         | VR effect stagnant | VR effect mature  | VR effect growth |
|--------------------------------------------------------------------------------------------|-------------------|-------------------|-------------------|--------------------|-------------------|------------------|
| EPS                                                                                        | 9.569*** (0.441)  | 7.272*** (0.243)  | 4.867*** (0.334)  | 10.00*** (0.462)   | 7.159*** (0.259)  | 4.755*** (0.346) |
| BPS                                                                                        | 0.967*** (0.0777) | 0.873*** (0.0554) | 1.211*** (0.0980) | 0.961*** (0.0809)  | 0.929*** (0.0622) | 1.195*** (0.106) |
| FCF-IE                                                                                     | 4.365*** (1.118)  | 2.359*** (0.603)  | 1.452 (1.091)     | 2.093 (1.450)      | -0.889 (1.132)    | 2.501 (2.078)    |
| R&D-IE                                                                                     | 124.2*** (43.91)  | 89.33*** (18.21)  | 54.99** (21.93)   | -84.01 (80.61)     | 5.468 (35.94)     | -2.347 (51.75)   |
| BPS × R&D-IE                                                                               |                   |                   |                   | 29.52 (19.85)      | 19.09* (9.806)    | -4.879 (10.66)   |
| BPS × FCF-IE                                                                               |                   |                   |                   | 0.191 (0.398)      | 0.790*** (0.304)  | -0.103 (0.415)   |
| EPS × R&D-IE                                                                               |                   |                   |                   | 129.6 (158.6)      | 62.50 (59.01)     | 354.0*** (94.97) |
| EPS × FCF-IE                                                                               |                   |                   |                   | 14.71*** (3.162)   | 0.838 (1.391)     | 2.189*** (2.578) |
| Constant                                                                                   | 7.526*** (1.289)  | 7.522*** (0.989)  | 5.088** (2.047)   | 7.390*** (1.284)   | 7.227*** (0.991)  | 5.260*** (2.052) |
| F-stats                                                                                    | 101.71            | 166.38            | 44.99             | 113.47             | 188.64            | 50.78            |
| R <sup>2</sup>                                                                             | 0.379             | 0.464             | 0.399             | 0.385              | 0.466             | 0.404            |
| <b>Notes:</b> Standard errors in parentheses. * $p < 0.1$ ; ** $p < 0.05$ ; *** $p < 0.01$ |                   |                   |                   |                    |                   |                  |

Model 1 while FCF-IE and R&D-IE are value relevant in Model 2 (FCF-IE  $\beta = 3.59$   $p$ -value  $< 0.01$ ; R&D-IE  $\beta = 69.82$   $p$ -value  $< 0.01$ ). The results of Model 1 are consistent with the researches done in the Chinese context by (Liu and Liu, 2007; Ge *et al.*, 2010; Shan, 2015). The  $R^2$  reported in Model 1 is 0.41 which is slightly less than reported by Shan (2015) whose  $R^2$  value was 0.49 for the period 2001–2005. The  $R^2$  reported for Model 2 is reported at 0.397.

Model 3 of Table IV shows the effect of FCFs and R&D expenditure on the value relevance of accounting information. For this purpose, the interaction terms FCF-IE $\times$ EPS, FCF-IE $\times$ BPS, R&D-IE $\times$ EPS and R&D-IE $\times$ BPS are introduced. The results show a positive and significant effect of FCFs on the value relevance of earnings ( $\beta = 3.24$ , SE = 1.19,  $p$ -value  $< 0.01$ ) and book value ( $\beta = 0.63$ , SE = 0.21,  $p$ -value  $< 0.01$ ). The effect of R&D expenditures on the value relevance of earnings is positive and significant ( $\beta = 178.2$ , SE = 50.62,  $p$ -value  $< 0.01$ ) while the book value has an insignificant effect. The F-statistics of the model is 290.09 significant at 1 percent level while the  $R^2$  reported for the model is 0.4.

**4.2.2 Life cycle effect on the value relevance of R&D and FCF investment.** Table V displays the effect of R&D and FCF expenditure on the value relevance of earnings and book value over the product life cycle stages. EPS, BPS, R&D and FCF have a positive and significant association in all the three stages of the product life cycle. Only the FCF relationship with the market value of price is insignificant. The effect of R&D and FCF on the value relevance of earnings and book value is also displayed in the last three columns for the three life cycle stages. In stagnant firm's sample, only the interaction term FCF-IE $\times$ EPS is significant meaning that the market does not value the stagnant firm's R&D and FCF. For the mature firms book value of R&D ( $\beta = 19.09$ , SE = 9.81,  $p$ -value  $< 0.1$ ) and FCF ( $\beta = 0.79$ , SE = 0.31,  $p$ -value  $< 0.01$ ) are value relevant. Looking at the growth firms we find that R&D and FCF investment are value relevant for earnings (FCF-IE $\times$ EPS:  $\beta = 2.189$ , SE = 2.58,  $p$ -value  $< 0.01$ ; R&D-IE $\times$ EPS  $\beta = 354$ , SE = 94.97,  $p$ -value  $< 0.01$ ). The reported  $R^2$  is greater in mature firms with a value of 0.46. The  $R^2$  for growth firms is 0.41 while stagnant firms report 0.38  $R^2$ .

Above results show that market gives less response to the earnings and book value of R&D and FCF investment in stagnant firms. Mature firms are more stable firms, and the market responds more to their book values rather than earnings. That is the reason why the book values of R&D and FCF investment are value relevant. The growth firms, shows a higher level of growth and pays a high level of dividends, therefore, the value relevance of earnings for R&D and FCF expenditure becomes significant.

**4.2.3 Value relevance of R&D and FCF investment in product market competition.** Table V shows the effect of R&D and FCF investment on the value relevance of earnings and book

| Variables           | Concentrated market | Competitive market | Concentrated market | Competitive market |
|---------------------|---------------------|--------------------|---------------------|--------------------|
| EPS                 | 3.740*** (0.345)    | 8.836*** (0.223)   | 3.503*** (0.358)    | 8.992*** (0.234)   |
| BPS                 | 0.978*** (0.0750)   | 1.057*** (0.0486)  | 1.067*** (0.0810)   | 1.028*** (0.0520)  |
| FCF-IE              | 4.601*** (0.964)    | 2.924*** (0.577)   | 0.515 (1.524)       | 1.844* (0.955)     |
| R&D-IE              | -4.332 (33.28)      | 88.57*** (15.47)   | -296.9*** (98.59)   | 0.748 (28.85)      |
| BPS $\times$ R&D-IE |                     |                    | 30.58* (16.03)      | 18.99** (8.115)    |
| BPS $\times$ FCF-IE |                     |                    | 1.302*** (0.379)    | -0.0335 (0.244)    |
| EPS $\times$ R&D-IE |                     |                    | 581.8*** (173.0)    | 55.62 (53.76)      |
| EPS $\times$ FCF-IE |                     |                    | -3.617 (2.165)      | 5.530*** (1.425)   |
| Constant            | 8.341*** (0.961)    | 5.714*** (0.401)   | 8.099*** (0.965)    | 5.747*** (0.406)   |
| F-stats             | 90.01               | 622.6              | 79.63               | 470.93             |
| $R^2$               | 0.327               | 0.470              | 0.331               | 0.472              |

**Notes:** Standard errors in parentheses. \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table V.**  
Value relevance of  
R&D and FCF and  
effect of product  
market competition

value in competitive and concentrated industries. The FCF are value relevant in both concentrated ( $\beta = 4.61$ ,  $SE = 0.96$ ,  $p\text{-value} < 0.01$ ) and competitive industries ( $\beta = 2.93$ ,  $SE = 0.57$ ,  $p\text{-value} < 0.01$ ). However, R&D expenditures are value relevant only for competitive industries ( $\beta = 88.57$ ,  $SE = 15.47$ ,  $p\text{-value} < 0.01$ ). The effect of R&D and FCF on the value relevance of book value is significant for concentrated industries ( $\beta = 30.58$ ,  $SE = 16.03$ ,  $p\text{-value} < 0.1$ ;  $\beta = 1.31$ ,  $SE = 0.38$ ,  $p\text{-value} < 0.01$ ) while only R&D are value relevant for the book value ( $\beta = 18.99$ ,  $SE = 8.12$ ,  $p\text{-value} < 0.05$ ) in competitive industries. The effect of R&D on earnings in concentrated industries is significantly related to the stock price ( $\beta = 581.8$ ,  $SE = 173$ ,  $p\text{-value} < 0.01$ ) while FCF has a positive effect on earnings in concentrated industries ( $\beta = 5.53$ ,  $SE = 1.43$ ,  $p\text{-value} < 0.01$ ). The  $R^2$  value for competitive industries (0.47) is much higher than the concentrated industries (0.33).

## 5. Discussion and practical implications

Life cycle stages predict different information contents for R&D and FCF in an efficient investment setup. Agency theory predicts that firms with funds at disposal are prone to opportunistic behavior unless the funds are utilized efficiently. An important question that arises is how the market incorporates the information contents of R&D and FCF at different life cycle stages? Another important issue that needed to be answered was the effect of product market competition on the value relevance of R&D and FCF. This study contributes to the literature of value relevance by adding a new measure of R&D and FCF by keeping in view the efficient investment. The results show that the R&D and FCF are value relevant in Chinese A-listed firms. R&D and FCF are priced differently at different life cycle stage. The incremental power of R&D and FCF depends upon the life cycle stage.

The discretionary nature of R&D and FCF make investors uncertain about valuing the stocks. After the adoption of international accounting standards in 2007, the Chinese listed companies have made an effort to report the R&D expenditures in the balance sheet. The investors can now determine the present value of all the future cash flows of investing activities. The results of the study are significant for the Chinese investors who should incorporate the R&D and FCF along with investment efficiency. The investors should keep in mind the life cycle stage while investing in a certain stock. The competitive markets have more information content than the concentrated markets. The corporate managers can benefit from this study while issuing new shares. The market responds positively to the stock having investment efficient R&D and FCF investment. For the policy implication perspective, the security market regulator should devise the effective pro-effective product market regulations.

## 6. Conclusion and recommendations

Although some studies have focused on the value relevance of R&D and FCF, few studies have investigated the value relevance over the life cycle stages and during the product market competition. This study examines the effect of R&D and FCF investment on the value relevance of accounting information over the product lifecycle and during the product market competition. Ohlson (1995), model is used to predict the value relevance of accounting information from the year 2008 to 2016. The R&D and FCF used in this study are for efficient investment firms. Finally, the sample is divided into growth, mature and stagnant firms based on the life cycle hypothesis while centered on product market competition we have divided the sample firms into concentrated industries and competitive industries.

The result shows that the investment efficient firm's R&D and FCF are value relevant to the overall sample. The effect of R&D and FCF on the value relevance of earnings and book value is also positive and significant. This implies that the market gives weight to the information content of FCF and R&D. However, the market responds more to the earnings than the book value in case of R&D expenditures.

Life cycle stages depict different information content at each stage. Our second objective was to find out whether the market incorporates the information content of R&D and FCF in each stage. The findings of the effect of R&D and FCF on the value relevance of accounting information signifies that the information content ( $R^2 = 0.46$ ) of the mature stage is higher than that of the growth and stagnant stages. The market does not respond to value relevance of R&D and FCF at the stagnant stage. Mature firms are more stable firms, and the market reacts more to their book values rather than earnings. That is the reason why the book values of R&D and FCF investment are value relevant. The growth firms, show a higher level of growth and pay a high level of dividends, therefore, the value relevance of earnings for R&D and FCF expenditure becomes significant.

At last, we explore the value relevance of R&D and FCF investment in product market competition. For this purpose, the firms are divided into two sub-samples as competitive industries and concentrated industries based on Herfindahl–Hirschman index. The result shows that R&D expenditures are value relevant only for competitive industries. The effect of R&D and FCF on the value relevance of book value is significant for concentrated industries, while only R&D are value relevant for the book value competitive industries. The effect of R&D on earnings in concentrated industries is significantly related to the stock price while FCF has a positive impact on earnings in competitive industries. The explanatory power measured by  $R^2$  value for competitive industries (0.47) is much higher than the concentrated industries (0.33).

Despite of accounting for all the possible scenarios, this study still can be improved on future account. This study only explores the effect of EPS, BPS, R&D and FCF on the value relevance of accounting information. Other determinant such as size, growth, leverage and firm age is ignored. Since the R&D expenditure is discretionary, therefore the findings cannot be generalized to all the sectors. A sector wise comparative study can be done in future, to understand the differences in the information contents of R&D and FCF. Also, the tax effect of R&D is ignored in this study. For future call, the value relevance of tax effect on R&D can be explored.

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