The effects of R&D expenditure on the firm value: evidence from korean small and medium sized enterprises

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ABSTRACT

This paper shows evidence that the innovative small and medium sized enterprises (SMEs) can maintain higher firm value by innovation activities such as R&D expenditure, asset-counted R&D expenditure, and cost-counted R&D expenditure. The other result shows that asset-counted R&D expenditure has higher effect on the firm value than cost-counted R&D expenditure. Moreover, the additional result shows that the innovative SMEs such as venture business, innobiz firms, and management innovative firms designated by Korea Small and Medium Business Administration (SMBA) for policy purpose maintain higher firm value than the non-innovative ones, because they can receive many advantages from innovation policies that support credit guaranteed service, policy fund, venture investment fund, insurance program, and so on. These results are encouraging evidences for various innovation policies of the Korea SMBA to support the innovative SMEs.

Keywords: R&D expenditure, firm value, innovative SMEs, asset-counted R&D expenditure

INTRODUCTION

The small and medium sized enterprises (hereinafter SMEs) play important roles as driving forces for innovation and employment creation in the national economy. However, the SMEs can not well adapt themselves to changing environment, because information collection, fund raising, labor productivity, and profitability of the SMEs are still weaker than large firms. Fortunately, innovation performance and employment creation of the innovative SMEs are higher than the non-innovative ones because of the various supporting policies of government. According to the research report (Lee, 2008) of Korea Small Business Institute, employment growth ratio of the innovative SMEs from 2002 to 2005 increases 6.2% annually which is 1.9% higher than the non-innovative ones, and innovation ratio increases 11.2% annually which is 4.6% higher than the non-innovative ones.

Although the innovative SMEs are used similar to high-tech SMEs, they refer to SMEs with excellent innovation performance which can be measured by R&D intensity, R&D expenditure ratio, and submitted patent counts. Khan and Manopichetwattana (1989) classify the innovative SMEs and the non-innovative ones on the basis of manager's subjective criterion on innovation performance. The innovative SMEs and non-innovative ones are classified on the basis of R&D intensity which is most frequently used as an objective criterion to measure innovation performance. R&D intensity is measured as R&D expenditure divided by total sales. Grabowski and Muller (1978), and Branch (1974) assert R&D expenditure plays an important role as the innovative driver that increases the future growth opportunities and profitability of the firms. Hence, Chan et al. (1990), and Doukas and Switzer (1992) state R&D expenditure have positive and persistent effects on the firm value.

Innovations can be achieved by the innovation activities such as production of new products, findings of new markets, procurement of new materials, and adoption of new organizing methods. In the knowledge-based economy, innovations have gradually increasing effects on the firm value and economic development. Moreover, as innovation performance is mainly realized by R&D expenditure, It can be stated that R&D expenditure is the driving forces for innovation, and that the intangible assets created by R&D expenditure are the same as 'the storage of innovative knowledge'. Also, innovation activities have important effects on the competitiveness and efficiency of a firm. Hence, R&D expenditure is commonly used as the proxy variable for innovation performance. R&D expenditure creates intangible assets, affects the profitability, and generates excessive stock return in the stock market.

The advanced researches have examined the effects of innovation activities on the firm value, on the ground of the Tobin-q theory. It states that Tobin-q is equal to 1 under the assumption of efficient capital markets, because the long-run equilibrium market value of the bundle of the assets comprising a firm is equal to the book value of those assets (Tobin, 1958). This assumption would be true for developed countries such as USA and UK. Korea is promoted to developed country status as included in the global index series such as FTSE in 2009 and MSCI in 2010. However, Korea stock market still have quite high fluctuation and turnover ratio something like the other Asian countries, individual investors are usually myopic and less rational, and influenced by informal information. These imply the assumption of efficient capital market would not hold in Korea stock market. Therefore, relaxing this assumption, the authors attempt to measure every firm's Tobin-q and include it in the valuation model.

This paper examines empirically the effects of R&D expenditure on the firm value of SMEs using the valuation model based on the Tobin-q theory, which is most widely used in advanced researches. The sample SMEs are classified into the innovative SMEs and non-innovative ones by R&D intensity, and it is expected that the innovative SMEs can maintain higher firm value than the non-innovative ones. It can also be examined whether the innovative SMEs such as venture business, innobiz firm, and management innovative firm designated by Korea Small and Medium Business Administration (hereinafter SMBA) for policy purpose can maintain higher firm value than the non-innovative ones. Moreover, the R&D expenditure as proxy variable of innovation performance is classified into asset-counted R&D expenditure and cost-counted R&D expenditure. Asset-counted R&D expenditure is expected to have higher effect on the firm value than cost-counted R&D expenditure. For robustness test, the effects of R&D expenditure on the firm value including Tobin-q in the valuation model were rechecked. On the ground of these results, the implications for innovation policy of the innovative SMEs are presented.

The paper organizes as follows. Section 1 explains the introduction of this paper, and section 2 reviews the literatures in this field. Section 3 explains research methodology such as hypothesis, data, and valuation model. Section 4 shows the empirical results, and section 5 presents conclusions and limitations of this study.

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Literature Review

Economists assert that innovation plays an important role as driving forces for employment creation and economic development. Schumpeter (1912) claims that firms can increase business profits dramatically by creative destruction of production functions following various innovative activities such as procurement of new materials, production of new products, findings of new markets, and adoption of new organizing methods. Furthermore, he insists these innovative activities become not only the driving forces for economic development, but also the important factors for business fluctuations. Baumol (2001) finds that innovation has a positive effect on employment creation and economic development. The employment growth rate of the innovative SMEs is higher than the non-innovative ones, which is proved in many statistic cases.

The future growth opportunities and profitability of the innovative firms are higher than the non-innovative ones, and their excessive stock return is higher than the non-innovative ones too. Grabowski and Muller (1978) and Branch (1974) present similar results that the innovative SMEs with high R&D intensity show high future growth opportunities and profitability against the non-innovative ones, so the possibilities of excessive stock return are high either. Grabowski and Muller (1978) research relations among R&D expenditure, intangible assets, and profitability of American firms, and find out that innovative SMEs with high R&D intensity achieve approximately 20% more profitability. Branch (1974) examines relations between R&D expenditure and profitability of American firms to find out R&D expenditure have a positive and significant effect on profitability and sales volume at the 1% level, and argues R&D expenditure has a positive effect on future profitability.

Griliches (1981), Connolly et al. (1986), Connolly and Hirschey (1988, 1990), Chauvin and Hirschey (1993), and Hirschey et al. (2001) examine the effects of innovation on the firm value in various aspects using the Tobin-q theory. It states that Tobin-q is equal to 1 under the assumption of efficient capital markets, because the long-run equilibrium market value of the bundle of the assets comprising a firm is equal to the book value of those assets.

Wolfe (1994) states innovation has an important role in the competitiveness and efficiency of a firm. Gopalakrishnan and Damanpour (1997) assert the most basic form of firm innovation is technological innovation, and innovation performance is achieved by R&D expenditure. Abbey and Dickson (1983), Capon et al. (1992), Kelm et al. (1995), Paolio and Brown (1978), and Robinson (1990) use R&D expenditure as the proxy variable for innovation performance.

Chan et al. (1990), and Doukas and Switzer (1992) examine relations between R&D expenditure and firm value to find out R&D expenditure has a positive and persistent effect on the firm value. Blundell et al. (1999), and Toivanen et al. (2002) research whether R&D expenditure has an effect on England firms, and find out the bigger the firms' market share, the bigger the effect of R&D expenditure. In particular, Blundell et al. (1999) use R&D expenditure as an input factor for innovation, and patent counts as an output factor for it. Toivanen et al. (2002) state R&D expenditure can be taken as the innovative driver increasing firm value, and assert intangible assets created by the R&D expenditure is the same as 'the storage of innovative knowledge'. Yang and Chen (2003) research the effects of R&D expenditure on the firm value in Taiwan. Reviewing these studies, it is assumed the future profitability, growth opportunities, and excessive stock return of the innovative SMEs is higher than the non-innovative ones.

Research Methodology

Hypothesis

Whether the innovative SMEs maintain high firm value on the ground of future growth opportunities and profitability by innovation are examined. It is expected that the innovative SMEs can maintain higher firm value than the non-innovative ones. Grabowski and Muller (1978), Branch (1974), Chan et al. (1990), Doukas and Switzer (1992), Blundell et al. (1999), Toivanen, et al. (2002), and Yang and Chen (2003) present the evidences that the innovative firms have higher future growth opportunities and profitability than the non-innovative ones. But there is no research that the innovative SMEs can maintain higher firm value than the non-innovative ones yet. Thus, **H1** is below.

H1: The innovative SMEs maintain higher firm value than the non-innovative ones

R&D expenditure as proxy variable for innovation is composed of asset-counted R&D expenditure and cost-counted R&D expenditure. Asset-counted R&D expenditure is counted as the intangible assets in the balance sheet, but cost-counted R&D expenditure is counted as the current expenses in the income statement. Hence, R&D expenditure is classified into asset-counted R&D expenditure and cost-counted R&D expenditure. But there is no research that asset-counted R&D expenditure has higher effect on the firm value than cost-counted R&D expenditure. Thus, **H2** is below.

H2: Asset-counted R&D expenditure has higher effect on the firm value than cost-counted R&D expenditure.

We also examine whether the innovative SMEs such as venture business, innobiz firm, and management innovative firm designated by Korea SMBA for policy purpose can maintain

higher firm value than the non-innovative ones. Korea SMBA designates venture business, innobiz firm, and management innovative firm as innovative SMEs for policy purpose. Innobiz firm means technologically innovative business. Korea SMBA intensively fosters innobiz firm as a growth engine of the national economy by designating SMEs with technological competitiveness and growth potential as innobiz. Management innovative firm means the SMEs that endeavor to upgrade their productivity and create new values by innovating non-technological aspects of their business. But there is no research that the innovative SMEs such as venture business, innobiz firm, and management innovative firm designated by Korea SMBA for the policy purpose maintain higher firm value than the non-innovative ones. Thus, **H3** is below.

H3: The innovative SMEs such as venture business, innobiz firm, and management innovative firm designated by Korea SMBA for the policy purpose maintain higher firm value than the non-innovative ones

Data

We collect the sample SMEs listed on Korea Exchange from 1999 to 2009 in the KIS Value Library database. The SMEs are defined according to Article 3 Section 1 of the 「Enforcement Decree of the Framework Act on Small and Medium Enterprises」. And the sample SMEs are collected according to the criterion as follows: (1) SMEs need to have complete financial reports from 1999 to 2009 since certain variables are lagged for a period of one fiscal year; (2) firms in financial industries (i.e., bank, securities, insurance, financial holding companies) are excluded due to their being subject to special financial regulations; (3) also excluded are M&A firms because of the continuity problems of financial data.

We classify the sample SMEs by two methods. First, the sample SMEs is classified into two groups as the innovative SMEs and the non-innovative ones on the basis of R&D intensity according to the method of Chauvin and Hirschey (1993). The innovative SMEs are defined as the SMEs that have larger than median of R&D intensity, but the non-innovative ones are defined as the SMEs that have smaller than median of R&D intensity, which is measured as R&D expenditure divided by total sales. The total number of firm-year of the sample SMEs that satisfies the above criteria from 1999 to 2009 is 6,776, the number of firm-year of the innovative SMEs is 2,349, and the number of firm-year of the non-innovative ones is 4,427. About 35% among these total numbers of firm-year involve the innovative SMEs. However, our data structure is an unbalanced panel data, because there is no requirement that the firm-year observations data are all available for each firms during the entire periods from the KIS Value Library database.

Second, the sample SMEs is classified into two groups as the innovative SMEs and non-innovative ones by policy purpose. The SMEs such as venture business, innobiz firm, and management innovative firm designated by Korea SMBA for policy purpose are classified as innovative SMEs, but the SMEs undesignated are classified as the non-innovative ones. The innovative SMEs such as venture business, innobiz firm, and management innovative firm can be searched for on the websites as <www.venture-in.co.kr>, <www.innobiz.net>, <www.mainbiz.go.kr>. The number of firm-year of the innovative SMEs is 2,365, and the number of firm-year of the non-innovative ones is 4,411, classified by policy purpose.

Valuation Model

Although firm's assets are composed of tangible and intangible assets, the intangible assets are created mainly by innovations. When a firm is traded on the stock market, the market value of the firm is a useful measure for the value of innovation. That is, this market value reflects investor's valuation for the firm's assets that are composed of tangible and intangible assets. The firm is likely to benefit from innovation when it devotes more to R&D expenditure, and its market value will rise if investors appreciate R&D expenditure. Although some argue that investors are myopic and irrational, it might also be likely that investors are overly optimistic about the effects of innovation on future growth opportunities and profitability because they ignore the uncertainty about the results of R&D expenditure.

To measure the value of innovation, the valuation model described by Griliches (1981) based on Tobin-q theory in which the long-run equilibrium market value of the bundle of the assets comprising a firm is equal to the book value of these assets is used. Deviations from this equilibrium relationship indicate that the market value is out of equilibrium valuation and that the firm has an incentive to undertake additional investment or disinvestment. Assuming the efficient capital market, investors will reassess the firm value and contribute to raise its stock price immediately when it develops innovation. However, Cockburn and Griliches (1988), and Hall (1988) assert that the market value and the book value of assets can be a long-run misvaluation when the intangible assets are created from innovation. Therefore, the authors set up valuation model like equation (1), according to Hall (1988).

$$V = q(A + \gamma\Omega)^{\sigma} \quad (1)$$

where V denotes market value of firm; q denotes Tobin-q; A denotes the value of tangible assets; Ω denotes the value of intangible assets; γ represents the marginal value of intangible assets; and σ stands for reaction coefficient of the market value to the book value of the all assets.

The market value of firm (V) in equation (1) is composed of the value of tangible assets (A) and the value of intangible assets (Ω). Although it is possible to measure the value of tangible assets, it is very difficult to measure the value of intangible assets. Tobin-q (q) becomes 1 when the market value of the assets converges to match their book value over long term. However, the marginal value (γ) of intangible assets in which the authors are interested is an important factor, because it presents a comparative advantage of intangible assets over tangible assets. According to the role of the marginal value (γ), the intangible assets may act as an innovative driver that can have a greater multiplier effect on the firm value than the tangible assets. The marginal value (γ) of such intangible assets is closely related to innovation such as R&D expenditure and submitted patent counts. The reaction coefficient (σ) of the market value to the book value of the assets converges to 1 over long-term under the assumption of efficient capital market.

Now, assuming that the reaction coefficient (σ) of the market value to the book value of the assets is 1, that is, $\sigma=1$, and dividing both sides of the equation (1) by A, it can be rewritten as equation (2).

$$\frac{V}{A} = \frac{q(A+\gamma\Omega)}{A} = q(1 + \frac{\gamma\Omega}{A}) \quad (2)$$

And taking the logarithm for both sides of equation (2), it can be rewritten as equation (3) to (5).

$$\log\frac{V}{A} = \log\left(\frac{q(A+\gamma\Omega)}{A}\right) \quad (3)$$

$$\log V - \log A = \log q + \log\left(1+\frac{\gamma\Omega}{A}\right) \quad (4)$$

$$\log V = \log q + \log A + \log\left(1+\gamma\frac{\Omega}{A}\right) \quad (5)$$

Exploiting the fact that $\log(1+x) \cong x$ when x is a very small according to the law of large numbers, and introducing multiplicative disturbance error term (ε), the authors can derive as equation (6).

$$\log V = \log q + \log A + \gamma\frac{\Omega}{A} + \varepsilon \quad (6)$$

Equations (7) is the estimation model for equation (6), when Tobin-q (q)≠1, that is, $\log q \neq 0$. Under inefficient capital market conditions, individual investors are usually myopic and less rational, and also influenced by informal information. This implies that Tobin-q (q)=1, that is, $\log q = 0$ will not hold.

$$\log V = \log q + \log A + \gamma X + \beta Z + \mu + \lambda_t + \varepsilon \quad (7)$$

where X matrix denotes intangible assets; Z matrix denotes firm characteristic variables; μ represents firm-specific effects; λ_t represents time-specific effects; and ε stands for error term, respectively.

Equations (8) is the estimation model for equation (6), when Tobin-q (q)=1, that is, $\log q = 0$. Under efficient capital market conditions, individual investors are usually rational either. This implies that Tobin-q (q)=1, that is, $\log q = 0$ will hold. According to the Tobin-q theory, Tobin-q (q) converges to 1 as the market value of the assets converges to match the book value in an efficient capital market.

$$\log V = \log A + \gamma X + \beta Z + \mu + \lambda_t + \varepsilon \quad (8)$$

In order to estimate equation (8) which assumes Tobin-q (q)=1 under efficient capital market conditions, the authors apply fixed effects models as equations (9)~(11) after statistical tests such as the Lagrange multiplier test and the Hausman test. First, the authors identify firm-specific effects (μ) and time-specific effects (λ_t), according to Lagrange multiplier test which Breusch and Pagan (1980) suggest. the authors verify whether fixed effect model is more adequate than random effect model on the ground of Hausman test. Firm-specific effects (μ) are unobservable but have a significant effect on the firm value. They differ across firms, but are fixed for a given firm over time. In contrast, time-specific effects (λ_t) vary over time, but are the same for all firms in a given year, capturing almost economy wide factors that are out of the firm's control.

$$\log V_t = \alpha_0 + \alpha_1 \log A_t + \alpha_2\left(\frac{RD}{K}\right)_t + \alpha_5 ADV_t + \alpha_6 GR_t + \alpha_7 L_t + \mu + \lambda_t + \varepsilon_t \quad (9)$$

$$\log V_t = \alpha_0 + \alpha_1 \log A_t + \alpha_2 (\frac{RDA}{K})_t + \alpha_5 ADV_t + \alpha_6 GR_t + \alpha_7 L_t + \mu + \lambda_t + \varepsilon_t \quad (10)$$

$$\log V_t = \alpha_0 + \alpha_1 \log A_t + \alpha_2 (\frac{RDC}{K})_t + \alpha_5 ADV_t + \alpha_6 GR_t + \alpha_7 L_t + \mu + \lambda_t + \varepsilon_t \quad (11)$$

where $\log V_t$ notes firms' market value in year t; $\log A_t$ notes value of tangible assets in year t; $(RD/K)_t$ represents R&D expenditure ratio in year t; $(RDA/K)_t$ represents asset-counted R&D expenditure ratio in year t; $(RDC/K)_t$ represents cost-counted R&D expenditure ratio in year t; ADV_t stands for advertising expenses ratio in year t; GR_t stands for sales growth ratio in year t; and L_t stands for leverage ratio in year t, respectively.

The dependent variable in equations (9) ~ (11) is firms' market value ($\log V_t$), which is measured as log(market capitalization of equity in year t). The explanatory variables consist of the value of tangible assets and 3 innovation variables. The value of tangible assets ($\log A_t$) is measured as log(book value of tangible assets in year t + book value of inventory assets in year t), which is predicted to have a positive effect on the firm value.

The other explanatory variables are composed of R&D expenditure ratio, asset-counted R&D expenditure ratio, and cost-counted R&D expenditure ratio, which play an important role as the innovative driver that create the value of intangible assets. The 「Statement of Korea Accounting Standards」 No. 3 (Intangible Assets) regulates that the expenditures generated during the research stage must be cost-counted according to the principle that the expenditures generated during the development stage can be capitalized only if they satisfy the asset measurement requirements, and that they must be cost-counted if they do not satisfy the asset measurement requirements. Based on this regulation, the authors classify all R&D expenditure into two groups such as 'asset-counted R&D expenditure' which is counted as intangible assets in the balance sheet and 'cost-counted R&D expenditure' which is counted as costs in the income statement. Therefore, the R&D expenditure ratio $[(RD/K)_t]$ is measured as [(asset-counted R&D expenditure in year t + cost-counted R&D expenditure in year t)/(capital stock in year t)], and the capital stock (K_t) is the same as (total liabilities in year t + total equity capital in year t) in the balance sheet. The asset-counted R&D expenditure ratio $[(RDA/K)_t]$ is measured as [(asset-counted development cost in year t)/(capital stock in year t)], and the cost-counted R&D expenditure ratio $[(RDC/K)_t]$ is measured as [(research cost in year t + cost-counted development cost in year t)/(capital stock in year t)]. Among these explanatory variables, the value of tangible assets ($\log A_t$) is expected to have a positive effect on the firm value, and 3 innovation variables $[(RD/K)_t, (RDA/K)_t, (RDC/K)_t]$ are expected to have positive effects on it.

The control variables are composed of advertising expenses ratio, sales growth rate, and leverage ratio. The advertising expenses ratio (ADV_t) is measured as [(advertising expenses in year t)/(capital stock in year t)], and is expected to have a positive effect on the firm value. Yang and Chen (2003) report that advertising expenses have positive effect on the firm value as an indicator of brands or quality reputation. The sales growth rate (GR_t) is measured as [(sales in year t - sales in year t-1)/(sales in year t)], and is expected to have a positive effect on the firm value. So, sales growth rate captures the prospects for future growth opportunities and reflects the expected value of the stock market (Connolly et al. 1986; Connolly and Hirschey, 1988, 1990; Chauvin and Hirschey, 1993; Hirschey et al. 2001; Toivanen et al. 2002). The leverage ratio (L_t) is measured as [(total liabilities in year t)/(total equity capital in year t)], and is expected to have a negative effect on the firm value because it leads to increase the cost of debt.

For the robustness test, assuming Tobin-q (q)≠1 under inefficient capital market conditions, the authors estimate fixed effects models as equations (9) ~ (11) including Tobin-q (q). Cockburn and Griliches (1988), Hall (1988), and Yang and Chen (2003) assert that Tobin-q (q) often does not converge to 1 under inefficient capital market conditions. Tobin-q (q)≠1 imply the misvaluation between the market value and the book value of the assets.

$$\log V_t = \beta_0 + \beta_1 \log A_t + \beta_2 \log q_t + \beta_3 (\frac{RD}{K})_t + \beta_6 ADV_t + \beta_7 GR_t + \beta_8 L_t + \mu + \lambda_t + \varepsilon_t \quad (12)$$

$$\log V_t = \beta_0 + \beta_1 \log A_t + \beta_2 \log q_t + \beta_4 (\frac{RDA}{K})_t + \beta_6 ADV_t + \beta_7 GR_t + \beta_8 L_t + \mu + \lambda_t + \varepsilon_t \quad (13)$$

$$\log V_t = \beta_0 + \beta_1 \log A_t + \beta_2 \log q_t + \beta_5 (\frac{RDC}{K})_t + \beta_6 ADV_t + \beta_7 GR_t + \beta_8 L_t + \mu + \lambda_t + \varepsilon_t \quad (14)$$

Tobin-q (q)=1 would be true for developed countries such as USA and UK. Korea is promoted to developed country status as included in the global index series such as FTSE and MSCI. However, Korea stock market still have quite high fluctuation and turnover ratio something like the other Asian countries, individual investors are usually myopic and less rational, and influenced by informal information. This implies that Tobin-q (q)=1 would not hold in Korea stock market. Therefore, relaxing efficient capital market assumption, the authors measure every firm's Tobin-q and include it as an explanatory variable in equations (12) ~ (14). This will allow us to separate the value embodied in the growth opportunities evaluated by investors and other intangible assets created by innovation. In addition, Tobin-q can capture the effects of other factors that are not observed. Tobin-q (q_t) is measured as [(total liabilities in year t + capitalization of equity in year t)/(total assets in year t)] according to the methods of Fama and French (1995), and Boone and Raman (2001), and is expected to have a positive effect on the firm value. Tobin-q (q_t) is taken as a growth opportunities variable reflects the market value of intangible assets that are not recorded in book.

EMPIRICAL RESULTS

Descriptive Statistics and Bivariate Results

Table 1 presents the descriptive statistics and correlation coefficients. Panel A indicates that the mean of firm value and the value of tangible assets is higher than their median respectively, implying that logV and logA are skewed to the left. The means of innovation variables such as R&D expenditure ratio, asset-counted R&D expenditure ratio, cost-counted R&D expenditure ratio are higher than their median respectively, implying that RD/K, RDA/K, and RDC/K are skewed to the left. Among the control variables, advertising expenses ratio, sales growth rate and leverage ratio are higher than their median respectively, implying that ADV, GR and L are skewed to the left too.

Panel B presents the Pearson correlation coefficients. The value of tangible assets has a positive and significant relation with the firm value at the 1% level. The innovation variables such as R&D expenditure ratio, asset-counted R&D expenditure ratio, and cost-counted R&D expenditure ratio have positive and significant relations with the firm value at the 1%, 1%, and 5% levels, respectively. Among the control variables, advertising expenses ratio and sales growth rate have positive and significant relations with the firm value at the 1% level, but leverage ratio has a negative and significant relation with the firm value at the 1% level.

Among the innovation variables, R&D expenditure ratio, asset-counted R&D expenditure ratio, and cost-counted R&D expenditure ratio have not only positive and significant relations with each other at the 1% level, but also have higher correlation coefficients than other variables. Therefore, if these innovation variables are inserted into the regression model simultaneously, a serious multicollinearity problem may arise. Hence, the authors insert these variables individually to the regression model. Moreover, among the control variables, the significant or insignificant coefficients are mixed up. But the coefficients of the former are not over 0.500, and the number of observations is statistically enough. Therefore, multicollinearity problems which may occur often in regression model are nothing to worry about.

The bivariate analyses present that the market value of the innovative SMEs is likely a function of not just one factor, but rather multiple factors such as the value of tangible assets, innovation variables, and the other control variables. Because these factors may have interdependent effects that are not captured in bivariate analyses, the authors take multivariate framework for full examinations of the effects of R&D expenditure on the firm value of SMEs in the next section.

Multivariate Results

In this section, the authors analyze the R&D expenditure effects by assuming that Tobin-q (q)=1, that is, $\log q = 0$ under efficient capital market conditions and then eliminating the Tobin-q(q) from the valuation model. According to the Tobin-q theory, Tobin-q (q) converges to 1 as the market value of the assets converges to match the book value under efficient capital market conditions.

First, the authors compare the R&D expenditure effects between the innovative SMEs and the non-innovative ones classified by R&D intensity. According to the method of Chauvin and Hirschey(1993), the SMEs are classified into the innovative SMEs that have larger than median of R&D intensity and the non-innovative ones that have smaller than median of R&D intensity. Second, the authors compare the R&D expenditure effects between the innovative SMEs and the non-innovative ones classified by policy purpose. Korea SMBA classifies venture business, innobiz firms, and management innovative firms as the innovative SMEs for policy purpose.

Table 2 shows the R&D expenditure effects between the innovative SMEs and the non-innovative ones classified by R&D intensity. the authors ascertain the firm-specific effect and time-specific effect by the Lagrange multiplier test. and check out whether fixed effect model is more adequate than the random effect model by the Hausman test.

As the results show, the tangible assets value has a positive and significant effect on the firm value at the 1% level, and all of the innovation variables such as R&D expenditure ratio, asset-counted R&D expenditure ratio, and cost-counted R&D expenditure ratio have positive and significant effects on the firm value at the 1~10% level. Even among the innovation variables, asset-counted R&D expenditure has a higher effect than cost-counted R&D expenditure. Among the control variables, both of advertising expenses ratio and sales growth rate have positive and significant effects on the firm value at the 1~10% level, but leverage ratio has negative and significant effects on it at the 1% level. Yang and Chen (2003) report that advertising expenses have positive effect on the firm value as an indicator of brands or quality reputation. Connolly et al. (1986), Connolly and Hirschey (1988, 1990), Chauvin and Hirschey (1993), Hirschey et al. (2001), and Toivanen et al. (2002) report that sales growth rate captures

the prospects for future growth opportunities and reflects the expected value of the stock market. But leverage ratio has a negative effect on the firm value because it leads to increase the cost of debt.

Comparing the R&D expenditure effects between the innovative SMEs and the non-innovative ones classified by R&D intensity, the former has almost higher effects than the latter. According to the equality tests between the regression coefficients suggested by McDowell(2005), in Model 1 of Table 2, the regression coefficient (α_2=4.747) for R&D expenditure of the innovative SMEs is higher than α_2=2.277 for the non-innovative ones, at the 5% level. In Model 2, the regression coefficient (α_3=4.337) for asset-counted R&D expenditure of the innovative SMEs is higher than α_3=2.505 for the non-innovative ones, at the 10% level. Also, in Model 3, the regression coefficient (α_4=2.560) for cost-counted R&D expenditure of the innovative SMEs is higher than α_4=2.443 for the non-innovative ones, at the 10% level. Thus, **H1** that the innovative SMEs maintain higher firm value than the non-innovative ones is accepted. That is, the innovative SMEs can maintain higher firm value by innovation activities such as R&D expenditure, asset-counted R&D expenditure, and cost-counted R&D expenditure.

Next, comparing the R&D expenditure effects between asset-counted R&D expenditure and cost-counted R&D expenditure, the former has higher effects than the latter. In Model 2 and 3 of Table 2, the regression coefficient (α_3=4.337) for asset-counted R&D expenditure of the innovative SMEs is higher than the regression coefficient (α_4=2.560) for cost-counted R&D expenditure. Thus, **H2** that asset-counted R&D expenditure has higher effect on the firm value than cost-counted R&D expenditure is accepted. Asset-counted R&D expenditure have a persistent effect on the firm value because it is counted as the intangible assets in the balance sheet, whereas cost-counted R&D expenditure have a temporary effect on the firm value because it is counted as the current expenses in the income statement.

Table 3 shows the R&D expenditure effects between the innovative SMEs and the non-innovative ones classified by policy purpose. Comparing the R&D expenditure effects, the innovative SMEs such as venture business, innobiz firms, and management innovative firms classified by policy purpose have almost higher effects than the non-innovative ones. According to the equality tests between the regression coefficients, in Model 1 of Table 3, the regression coefficient (α_2=3.312) for R&D expenditure of the innovative SMEs is higher than α_2=1.818 for the non-innovative ones, at the 1% level. In Model 2, the regression coefficient (α_3=3.156) for asset-counted R&D expenditure of the innovative SMEs is higher than α_3=2.928 for the non-innovative ones, at the 1% level. Also, in Model 3, the regression coefficient (α_4=1.463) for cost-counted R&D expenditure of the innovative SMEs is higher than α_4=1.162 for the non-innovative ones, at the 10% level. Thus, **H3** that the innovative SMEs such as venture business, innobiz firm, and management innovative firm classified for policy purpose have higher valuation than non-innovative ones is accepted. These innovative SMEs can maintain higher firm value than the non-innovative ones, because they can receive many advantages from innovation policies that support credit guaranteed service, policy fund, venture investment fund, insurance program, and so on.

In Model 2 and 3 of Table 3, the regression coefficient (α_3=3.156) for asset-counted R&D expenditure of the innovative SMEs is higher than the regression coefficient (α_4=1.463) for cost-counted R&D expenditure. Thus, **H2** that asset-counted R&D expenditure has higher effect on the firm value than cost-counted R&D expenditure is accepted. Asset-counted R&D expenditure have a persistent effect on the firm value because it is counted as the intangible

assets in the balance sheet, whereas cost-counted R&D expenditure have a temporary effect on the firm value because it is counted as the current expenses in the income statement.

Robustness Test

For robustness test, the authors additionally analyze the R&D expenditure effects by assuming that Tobin-q (q)≠1, that is, $\log q \neq 0$ under inefficient capital market conditions and then including the Tobin-q(q) in the valuation model. Cockburn and Griliches (1988), Hall (1988), and Yang and Chen (2003) assert that Tobin-q(q) often does not converge to 1 under inefficient capital market conditions. Tobin-q (q)≠1 implies the misvaluation between the market value and the book value of the assets.

Table 4 shows the R&D expenditure effects between the innovative SMEs and the non-innovative ones classified by R&D intensity. As the results show, the tangible assets value has a positive and significant effect on the firm value at the 1% level, Tobin-q has positive and significant effects on the firm value at the 1% level, and all of the innovation variables such as R&D expenditure ratio, asset-counted R&D expenditure ratio, and cost-counted R&D expenditure ratio have positive and significant effects on the firm value at the 1~10% level. Even among the innovation variables, asset-counted R&D expenditure has a greater effect than cost-counted R&D expenditure. Among the control variables, both of advertising expenses ratio and sales growth rate have positive and significant effects on the firm value at the 1~10% level, but leverage ratio has negative and significant effects on it at the 1% level.

Comparing the R&D expenditure effects between the innovative SMEs and the non-innovative ones classified by policy purpose, the former has higher effects than the latter. According to the equality tests between the regression coefficients, in Model 1 of Table 4, the regression coefficient (β_3=3.466) for R&D expenditure of the innovative SMEs is higher than β_3=1.686 for the non-innovative ones, at the 1% level. In Model 2, the regression coefficient (β_4=2.940) for asset-counted R&D expenditure of the innovative SMEs is higher than β_4=1.592 for the non-innovative ones, at the 1% level. Also, in Model 3, the regression coefficient (β_5=1.862) for cost-counted R&D expenditure of the innovative SMEs is higher than β_5=1.545 for the non-innovative ones, at the 5% level. Thus, **H1** that the innovative SMEs maintain higher firm value than the non-innovative ones is accepted. That is, the innovative SMEs can maintain higher firm value by innovation activities such as R&D expenditure, asset-counted R&D expenditure, and cost-counted R&D expenditure.

Next, comparing the R&D expenditure effects between asset-counted R&D expenditure and cost-counted R&D expenditure, the former has higher effects than the latter. In Model 2 and 3 of Table 4, the regression coefficient (β_4=2.940) for asset-counted R&D expenditure of the innovative SMEs is higher than the regression coefficient (β_5=1.862) for cost-counted R&D expenditure. Thus, **H2** that asset-counted R&D expenditure has higher effect on the firm value than cost-counted R&D expenditure is accepted. Asset-counted R&D expenditure have a persistent effect on the firm value because it is counted as the intangible assets in the balance sheet, whereas cost-counted R&D expenditure have a temporary effect on the firm value because it is counted as the current expenses in the income statement.

Table 5 shows the R&D expenditure effects between the innovative SMEs and the non-innovative ones classified by policy purpose. Comparing the R&D expenditure effects, the innovative SMEs such as venture business, innobiz firms, and management innovative firms

classified by policy purpose have almost higher effects than the non-innovative ones. According to the equality tests between the regression coefficients, in Model 1 of Table 5, the regression coefficient (β_3=3.741) for R&D expenditure of the innovative SMEs is higher than β_3=2.479 for the non-innovative ones, at the 5% level. In Model 2, the regression coefficient (β_4=3.154) for asset-counted R&D expenditure of the innovative SMEs is higher than β_4=2.661 for the non-innovative ones, at the 1% level. Also, in Model 3, the regression coefficient (β_5=1.725) for cost-counted R&D expenditure of the innovative SMEs is higher than β_5=1.605 for the non-innovative ones. Thus, **H3** that the innovative SMEs such as venture business, innobiz firm, and management innovative firm classified for the policy purpose maintain higher firm value than non-innovative ones is accepted. These innovative SMEs can maintain higher firm value than the unclassified non-innovative ones, because they can receive many advantages from innovation policies that support credit guaranteed service, policy fund, venture investment fund, insurance program, and so on.

In Model 2 and 3 of Table 4, the regression coefficient (β_4=3.154) for asset-counted R&D expenditure of the innovative SMEs is higher than the regression coefficient (β_5=1.725) for cost-counted R&D expenditure. Thus, **H2** that asset-counted R&D expenditure has higher effect on the firm value than cost-counted R&D expenditure is accepted. Asset-counted R&D expenditure has a persistent effect on the firm value because it is counted as the intangible assets in the balance sheet, whereas cost-counted R&D expenditure have a temporary effect on the firm value because it is counted as the current expenses in the income statement

CONCLUSIONS

This paper examines the effects of R&D expenditure on the firm value of the SMEs listed on the Korea Exchange. The main results of this paper can be summarized as follows.

First, the innovative SMEs maintain higher firm value than the non-innovative ones. Among the innovation variables, all of R&D expenditure ratio, asset-counted R&D expenditure ratio, and cost-counted R&D expenditure ratio have positive and significant effects on the firm value. That is, the innovative SMEs can maintain higher firm value by innovation activities such as R&D expenditure, asset-counted R&D expenditure, and cost-counted R&D expenditure.

Second, asset-counted R&D expenditure has higher effect on the firm value than cost-counted R&D expenditure. Asset-counted R&D expenditure has a persistent effect on the firm value because it is counted as the intangible assets in the balance sheet, whereas cost-counted R&D expenditure have a temporary effect on the firm value because it is counted as the current expenses in the income statement.

Third, the innovative SMEs such as venture business, innobiz firms, and management innovative firms designated by the Korea SMBA for policy purpose maintain higher firm value than the non-innovative ones. These innovative SMEs can maintain higher firm value than the non-innovative ones, because they can receive many advantages from innovation policies that support credit guaranteed service, policy fund, venture investment fund, insurance program, and so on.

Fourth, even when Tobin-q is included into the evaluation model assuming that Tobin-q (q)≠1 under inefficient capital market conditions, innovation variables such as R&D expenditure, asset-counted R&D expenditure, and cost-counted R&D expenditure have positive and significant effects on the firm value.

In conclusion, the authors find out the innovative SMEs can maintain higher firm value by innovation activities such as R&D expenditure, asset-counted R&D expenditure, and cost-counted R&D expenditure. Also, asset-counted R&D expenditure has higher effect on the firm value than cost-counted R&D expenditure. Furthermore, the innovative SMEs such as venture business, innobiz firms, and management innovative firms classified by policy purpose can maintain higher firm value than the non-innovative ones, because they can receive many advantages from innovation policies that support credit guaranteed service, policy fund, venture investment fund, insurance program, and so on. These results are encouraging evidences for various innovation policies of the Korea SMBA to support the innovative SMEs.

This paper may have a few limitations because it may be only early study about the effects of R&D expenditure on the firm value. Specifically, this paper may not adequately capture all of the subtle features of innovation. Therefore, it is necessary to expand sample firms and control variables, and use more elaborate analysis methods in the future studies.

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Table 1: Descriptive Statistics and Correlation Coefficients

Panel A: Descriptive Statistics

Variable	Number of Observations (n)	Mean	Standard Deviation	Minimum	Maximum	Median
logV	6,776	0.2397	0.1043	0.1958	0.3055	0.2348
logA	6,776	0.2362	0.0746	0.1390	0.2935	0.2358
RD/K	6,776	0.0215	0.0278	0.0001	0.3613	0.0097
RDA/K	6,776	0.0227	0.0189	0.0001	0.3613	0.0094
RDC/K	6,776	0.0146	0.0179	0.0001	0.3036	0.0075
ADV	6,776	0.0069	0.0173	0.0001	0.2879	0.0056
GR	6,776	0.0613	0.3535	-0.9977	0.9932	0.0596
L	6,776	0.4565	0.2564	0.0012	1.9992	0.4491

Panel B: Correlation Coefficients

Variable	logV	logA	RD/K	RDA/K	RDC/K	ADV	GR	L
logV	1							
logA	0.343**	1						
RD/K	0.039**	0.108**	1					
RDA/K	0.085**	0.034**	0.774**	1				
RDC/K	0.030*	0.133**	0.737**	0.144**	1			
ADV	0.039**	0.096**	0.120**	0.034**	0.150**	1		
GR	0.183**	0.049**	0.064**	0.066**	0.027*	0.083**	1	
L	-0.158**	0.338**	0.023**	0.021*	0.012*	0.014	0.013	1

Notes: logV is the firm's market value. logA, RD/K, RDA/K and RDC/K, are the value of tangible assets, R&D expenditure ratio, asset-counted R&D expenditure ratio and cost-counted R&D expenditure ratio. ADV, GR, and L are advertising expenses ratio, sales growth rate, and leverage ratio, respectively. Pearson correlation coefficients are reported below the diagonal. ** and * denote statistical significance at the 1% and 5% levels, respectively, using a two-tailed test.

Table 2: R&D Expenditure Effects between Innovative SMEs and Non-innovative Ones Classified by R&D Intensity

Variable		Model 1		Model 2		Model 3	
Variable Name	Coefficient	Innovative SMEs	Non-innovative SMEs	Innovative SMEs	Non-innovative SMEs	Innovative SMEs	Non-innovative SMEs
Constant	α_0	-8.536*** (-10.29)	-1.113* (-1.88)	-9.074*** (-10.69)	-1.130* (-1.90)	-9.570*** (-11.17)	-1.090* (-1.83)
logA	α_1	4.984*** (13.55)	1.149*** (34.57)	5.027*** (13.88)	1.147*** (34.49)	5.252*** (14.27)	1.147*** (34.54)
RD/K	α_2	4.747*** (4.36)	2.277** (2.12)				
RDA/K	α_3			4.337*** (4.40)	2.505** (2.45)		
RDC/K	α_4					2.560** (2.38)	2.443* (1.69)
ADV	α_5	2.323* (1.73)	1.860*** (4.07)	2.729** (2.12)	2.097*** (4.09)	2.020** (2.00)	1.844*** (4.07)
GR	α_6	2.759*** (6.82)	3.169*** (9.21)	2.717*** (6.76)	3.173*** (9.22)	2.729*** (6.63)	3.168*** (9.20)
L	α_7	-1.983*** (-10.07)	-1.982*** (-13.14)	-1.092*** (-10.32)	-1.976*** (-13.14)	-1.334*** (-10.25)	-1.987*** (-13.15)
Number of Observations (n)		2,349	4,427	2,349	4,427	2,349	4,427
Number of Firms (g)		376	577	376	577	376	577
R^2 – Within		0.3317	0.2945	0.3323	0.2944	0.3216	0.2942
R^2 – Between		0.2081	0.4321	0.2072	0.4316	0.2054	0.4307
R^2 – Overall		0.2261	0.4217	0.2251	0.4211	0.2200	0.4212
Lagrange Multiplier Test		643.34***	2949.09***	640.81***	2984.03***	757.91***	2924.47***
Hausman Test		222.38***	52.50***	190.51***	55.11***	284.06***	44.36***
Wald Test (F – value)		89.42***	246.04***	98.16***	244.98***	77.84***	245.63***
Regression Coefficients Equality T (t – value)		H_0: Innovative SMEs(α_2) – Non-innovative SMEs(α_2) = 0: 2.466(2.38)**					
		H_0: Innovative SMEs(α_3) – Non-innovative SMEs(α_3) = 0: 1.840(1.89)*					
		H_0: Innovative SMEs(α_4) – Non-innovative SMEs(α_4) = 0: 0.121(1.73)*					

Notes: In the regression models, dependent variable is logV, and explanatory variables are logA, RD/K, RDA/K and RDC/K. The control variables are composed of firm characteristic variables such as ADV, GR, and L which stand for advertising expenses ratio, sales growth rate, and leverage ratio, respectively. The White corrected t-statistics for the t-test are reported in parentheses. ***,**,* denote statistical significance at the 1%, 5% and 10% levels, respectively, using a two-tailed test.

Table 3: R&D expenditure Effects between Innovative SMEs and Non-innovative Ones Classified by Policy Purpose

Variable		Model 1		Model 2		Model 3	
Variable Name	Coefficient	Innovative SMEs	Non-innovative SMEs	Innovative SMEs	Non-innovative SMEs	Innovative SMEs	Non-innovative SMEs
Constant	α_0	-3.881*** (-2.62)	-2.032*** (-3.68)	-3.597** (-2.47)	-2.035*** (-3.72)	-3.364** (-2.29)	-1.995*** (-3.55)
logA	α_1	1.415*** (18.79)	1.183*** (40.37)	1.393*** (19.11)	1.181*** (40.48)	1.363*** (18.33)	1.175*** (39.30)
RD/K	α_2	3.312*** (3.14)	1.818* (1.88)				
RDA/K	α_3			3.156*** (4.29)	2.928*** (2.72)		
RDC/K	α_4					1.463* (1.71)	1.162 (1.26)
ADV	α_5	3.980*** (3.42)	4.131*** (3.67)	4.805*** (4.12)	4.058*** (3.67)	4.887*** (3.94)	4.690*** (3.80)
GR	α_6	1.229*** (10.93)	2.351*** (8.81)	1.175*** (10.96)	2.335*** (8.80)	1.151*** (10.78)	2.308*** (8.67)
L	α_7	-1.455*** (-14.12)	-1.273*** (-12.76)	-1.281*** (-14.15)	-1.256*** (-12.77)	-1.248*** (-13.99)	-1.313*** (-12.84)
Number of Observations (n)		2,365	4,411	2,365	4,411	2,365	4,411
Number of Firms (g)		215	401	215	401	215	401
R^2 – Within		0.3105	0.3029	0.3146	0.3039	0.3060	0.3022
R^2 – Between		0.3531	0.4217	0.3515	0.4228	0.3369	0.4191
R^2 – Overall		0.3053	0.3596	0.3069	0.3606	0.2968	0.3579
Lagrange Multiplier Test		1056.01***	4219.10***	1073.46***	4203.13***	1062.52***	4249.71***
Hausman Test		85.32***	822.76***	79.73***	303.17***	87.60***	300.46***
Wald Test (F – value)		130.35***	339.99***	135.38***	345.39***	130.73***	322.59***
Regression Coefficients Equality T (t – value)		H_0: Innovative SMEs(α_2) – Non-innovative SMEs(α_2) = 0: 1.490(4.56)***					
		H_0: Innovative SMEs(α_3) – Non-innovative SMEs(α_3) = 0: 0.230(3.70)***					
		H_0: Innovative SMEs(α_4) – Non-innovative SMEs(α_4) = 0: 0.306(1.75)*					

Notes: In the regression models, dependent variable is logV, and explanatory variables are logA, RD/K, RDA/K and RDC/K. The control variables are composed of firm characteristic variables such as ADV, GR, and L which stand for advertising expenses ratio, sales growth rate, and leverage ratio, respectively. The White corrected t-statistics for the t-test are reported in parentheses. ***,**,* denote statistical significance at the 1%, 5% and 10% levels, respectively, using a two-tailed test.

Table 4: R&D Expenditure Effects between Innovative SMEs and Non-innovative Ones Classified by R&D Intensity under Inefficient Capital Markets

Variable		Model 1		Model 2		Model 3	
Variable Name	Coefficient	Innovative SMEs	Non-innovative SMEs	Innovative SMEs	Non-innovative SMEs	Innovative SMEs	Non-innovative SMEs
Constant	β_0	-6.304*** (-10.02)	-0.884* (-1.81)	-6.730*** (-10.37)	-0.898* (-1.84)	-6.572*** (-10.68)	-0.865* (-1.77)
logA	β_1	3.804*** (14.55)	1.263*** (44.56)	3.851*** (14.83)	1.262*** (44.50)	3.004*** (15.16)	1.203*** (44.53)
Logq	β_2	8.707*** (29.46)	8.822*** (23.81)	8.702*** (29.22)	8.822*** (23.81)	8.782*** (29.85)	8.823*** (23.80)
RD/K	β_3	3.466*** (3.62)	1.686** (2.29)				
RDA/K	β_4			2.940*** (2.97)	1.592*** (2.94)		
RDC/K	β_5					1.862* (1.66)	1.545* (1.68)
ADV	β_6	3.375* (1.73)	4.564*** (5.43)	3.885* (1.70)	4.767*** (5.45)	2.043* (1.69)	4.563*** (5.43)
GR	β_7	1.745*** (5.65)	1.883*** (5.34)	1.722*** (5.60)	1.886*** (5.35)	1.726*** (5.59)	1.882*** (5.34)
L	β_8	-1.595*** (-12.32)	-1.538*** (-17.50)	-1.682*** (-12.38)	-1.533*** (-17.50)	-1.756*** (-12.33)	-1.541*** (-17.50)
Number of Observations (n)		2,349	4,427	2,349	4,427	2,349	4,427
Number of Firms (g)		376	577	376	577	376	577
R^2 – Within		0.2357	0.5461	0.2349	0.5460	0.2329	0.5458
R^2 – Between		0.1440	0.5587	0.1413	0.5581	0.1388	0.5582
R^2 – Overall		0.1297	0.5568	0.1252	0.5562	0.1188	0.5566
Lagrange Multiplier Test		1069.30***	4714.68***	1153.25***	4778.11***	1371.07***	4654.20***
Hausman Test		167.92***	432.98***	201.23***	445.37***	189.37***	19.95***
Wald Test (F – value)		274.55***	381.96***	277.99***	381.46***	254.86***	381.99***
Regression Coefficients Equality Test (t – value)		H_0: Innovative SMEs(β_3) – Non-innovative SMEs(β_3) = 0: 1.778(3.15)***					
		H_0: Innovative SMEs(β_4) – Non-innovative SMEs(β_4) = 0: 1.339(2.88)***					
		H_0: Innovative SMEs(β_5) – Non-innovative SMEs(β_5) = 0: 0.306(2.49)**					

Notes: In the regression models, dependent variable is logV, and explanatory variables are logA, logq, RD/K, RDA/K and RDC/K. The control variables are composed of firm characteristic variables such as ADV, GR, and L which stand for advertising expenses ratio, sales growth rate, and leverage ratio, respectively. The White corrected t-statistics for the t-test are reported in parentheses. ***,**,* denote statistical significance at the 1%, 5% and 10% levels, respectively, using a two-tailed test.

Table 5: R&D Expenditure Effects between Innovative SMEs and Non-innovative Ones Classified by Policy Purpose under Inefficient Capital Markets

Variable		Model 1		Model 2		Model 3	
Variable Name	Coefficient	Innovative SMEs	Non-innovative SMEs	Innovative SMEs	Non-innovative SMEs	Innovative SMEs	Non-innovative SMEs
Constant	β_0	-1.388 (-1.51)	-1.464*** (-3.26)	-1.055 (-1.18)	-1.452*** (-3.22)	-1.036 (-1.11)	-1.425*** (-3.12)
logA	β_1	1.326*** (27.78)	1.257*** (50.77)	1.297*** (28.55)	1.251*** (50.76)	1.289*** (26.80)	1.250*** (49.73)
Logq	β_2	8.082*** (28.92)	7.883*** (22.58)	8.038*** (28.24)	7.859*** (22.49)	8.094*** (28.34)	7.860*** (22.04)
RD/K	β_3	3.741*** (4.91)	2.479*** (3.19)				
RDA/K	β_4			3.154*** (5.49)	2.661*** (2.86)		
RDC/K	β_5					1.725* (1.70)	1.605 (1.19)
ADV	β_6	3.462* (1.84)	4.208*** (5.27)	3.752* (1.76)	4.845*** (5.36)	3.960* (1.79)	4.790*** (5.44)
GR	β_7	2.727*** (9.11)	1.373*** (5.02)	2.677*** (9.10)	1.339*** (4.90)	2.674*** (8.86)	1.348*** (4.95)
L	β_8	-1.937*** (-18.70)	-1.267*** (-16.33)	-1.752*** (-18.76)	-1.262*** (-16.35)	-1.811*** (-18.58)	-1.312*** (-16.35)
Number of Observations (n)		2,365	4,411	2,365	4,411	2,365	4,411
Number of Firms (g)		215	401	215	401	215	401
R^2 – Within		0.6458	0.5342	0.6466	0.5343	0.6416	0.5320
R^2 – Between		0.4640	0.5101	0.4587	0.5096	0.4509	0.5062
R^2 – Overall		0.5417	0.5089	0.5406	0.5087	0.5350	0.5058
Lagrange Multiplier Test		2066.72***	5735.56***	2115.06***	5732.24***	2062.90***	5778.36***
Hausman Test		814.91***	35.21***	809.02***	33.40***	30.65***	19.72***
Wald Test (F – value)		347.45***	496.85***	352.67***	495.61***	327.76***	473.68***
Regression Coefficients Equality Test (t – value)		H_0: Innovative SMEs(β_3) – Non-innovative SMEs(β_3) = 0: 1.257(2.52)**					
		H_0: Innovative SMEs(β_4) – Non-innovative SMEs(β_4) = 0: 0.501(4.67)***					
		H_0: Innovative SMEs(β_5) – Non-innovative SMEs(β_5) = 0: 0.126(1.51)					

Notes: In the regression models, dependent variable is logV, and explanatory variables are logA, logq, RD/K, RDA/K and RDC/K. The control variables are composed of firm characteristic variables such as ADV, GR, and L which stand for advertising expenses ratio, sales growth rate, and leverage ratio, respectively. The White corrected t-statistics for the t-test are reported in parentheses. ***,**,* denote statistical significance at the 1%, 5% and 10% levels, respectively, using a two-tailed test.