Asia-Pacific Journal of Business (아태비즈니스연구) APJB
Vol. 14, No. 4, December 2023 (pp.23-36) ISSN 2233-5900 (Print)
https://doi.org/10.32599/apjb.14.4.202312.23 ISSN 2384-3934 (Online)

Equity Financing for Innovation and Firm Value: International Evidence*

Jin-Young Yang[a]

[a]Department of Global Finance and Banking, Inha University, South Korea

Received 30 November 2023, Revised 15 December 2023, Accepted 22 December 2023

Abstract

Purpose - This study investigates the impact of equity financing on the valuation of R&D investments using a sample of firms from 33 countries from 1997 to 2018.
Design/methodology/approach - I use a modified version of the valuation regression widely used in the literature.
Findings - I find evidence that R&D investments are more highly valued when financed through equity. In contrast, debt financing does not affect the valuation of R&D investments. I also document that the impact of equity financing on R&D investment valuation weakens during the financial crisis.
Research implications or Originality - In light of the distinctive characteristics of innovative investment, previous research investigates its relationship with financing. What remains unexamined, however, is how financing choices impact the way investors value innovative investments. This study seeks to bridge this gap in the existing body of research using a sample of firms from 33 countries from 1997 to 2018, for 22 years.

Keywords: Financing, Firm Value, Innovation, Research and Development, Valuation
JEL Classifications: G10, G30, G32

Ⅰ. Introduction

Innovative investment has received considerable attention in the literature because of its contribution to economic growth. The literature highlights the unique characteristics of innovative investment in comparison to fixed capital investment. Kerr and Nanda (2015) identify four traits of innovative investment that result in restrictions on financing research and development (R&D) for innovation. First, uncertainty is an inherent feature of innovation investment: it is unknown what the possible outcomes of an innovative project may be and what the probabilities of those outcomes are (Knight, 1921). Second, the return on the innovative project is characterized by extreme skewness (e.g., Scherer and Harhoff, 2000). Third, a firm and its investors may experience information asymmetry with respect to innovative activities. Lastly, firms with innovative projects have a high percentage of intangible assets. Due to the unique characteristics of innovative investment, the nature of financial constraints on it is likely to

* This work was supported by INHA UNIVERSITY Research Grant.
[a] First Author, E-mail: jyyang@inha.ac.kr
[a] Corresponding Author, E-mail: jyyang@inha.ac.kr

differ from that on fixed capital investment. Thus, finance can have a dissimilar impact on innovative investment compared to fixed capital investment. In light of the distinctive characteristics of innovative investment, previous research investigates its relationship with financing (e.g., Hsu, Tian and Xu, 2014). What remains unexamined, however, is how financing choices impact the way investors value innovative investments. This study seeks to bridge this gap in the existing body of research using a sample of firms from 33 countries from 1997 to 2018, for 22 years.

Equity financing can improve the information environment of a firm as it can motivate investors to produce new information, reducing private information about the firm. The literature presents models where managers possessing private information make security design choices to encourage investors to produce additional information about the firm, thereby reducing the information asymmetry between managers and investors. Under specific conditions, equity finance is found to be the best choice for firms to motivate investors to obtain new information about the firm (Fulghieri and Lukin, 2001; Chemmanur and Jiao, 2011; Yang and Zeng, 2019; Fulghieri, Garcia and Hackbarth, 2020). The possession of superior information results in increased profitability when trading with more information-sensitive securities. The payoff structure of a security determines its information sensitivity. Due to its greater sensitivity to information, equity is preferred by investors with privileged information over debt. Hence, equity promotes information production by investors. When investors generate information, it results in a reduction of private information in the market. Thus, through equity financing, the level of information asymmetry between a firm's managers and investors, and among investors can be diminished, improving the firm's informational environment.

The use of equity financing can elevate the valuation of innovative investments over other financing forms, as it diminishes the amount of private information in the market. Easley and O'hara (2004) focus on how private information in the market affects a firm's cost of capital. In their model, there are two types of investors: informed investors are in possession of private information, a characteristic not shared by uninformed investors. The informational disadvantage of uninformed investors leads them to overinvest in stocks with unfavorable news and underinvest in stocks with favorable news. The authors deduce that the risk arising from the existence of private information is a form of systematic risk, and as such, investors demand compensation for bearing this risk in equilibrium. This signifies that firms with more private information are required to offer higher expected returns on their stocks, causing an increase in their financing costs. Their results show that private information has the effect of increasing a firm's discount rate, which leads to a reduction in its valuation. Therefore, equity financing could potentially have a positive impact on a firm's valuation by decreasing the firm's private information.

Equity financing can be particularly beneficial for new innovative investments, as firms with such investments tend to have an initially higher equity valuation. Pástor and Veronesi (2009) develop a model where a firm's stock price experiences an initial boost due to the introduction of a new technology, before ultimately falling. In their model, due to the uncertainty of a new technology, firms are reluctant to adopt it extensively in the beginning. The authors posit that the risk associated with a new technology is mostly idiosyncratic when it is utilized on a small scale. According to them, the low sensitivity of debt payoff to a firm's superior performances means that debt markets are unlikely to display the price reaction to new innovation predicted in equity markets. Thus, when a firm raises a larger proportion of capital from equity investors who assign escalated valuation to innovative projects, it is likely to encourage the firm to be more innovative, resulting in higher valuation of innovation.

In this study, I begin by examining how equity financing affects the valuation of R&D investments using a sample of firms from 33 countries for 22 years, from 1997 to 2018. The impact of debt financing on R&D investment valuation is also considered for the sake of comparison. The results show that equity financing is a more effective means of enhancing the value of R&D investments compared to debt financing. I also find that both one-year and two-year lagged equity issuances have a positive impact on the valuation of R&D investments. In contrast, I show that debt financing does not affect R&D investment valuation. My findings also signify that one-year and two-year lagged debt issuances have no bearing on the valuation of R&D investments, in line with the results for the contemporaneous debt issuance. Next, I explore how the R&D valuation effect of equity financing varies with the financial market conditions. I provide evidence that during the financial crisis, the effect of equity financing on R&D investment valuation lessens. Finally, I check the robustness of my baseline regression results. The baseline results are robust to the use of various fixed effects and clustering dimensions for standard errors.

This paper is organized as follows. Section 2 describes the data and presents summary statistics of the variables used for the analysis in this study. Section 3 outlines the research design and reports the results of the main analysis. Section 4 presents the results of robustness checks. Section 5 concludes the paper.

II. Data and Summary Statistics

Firm-level annual accounting data are collected from Compustat. Specifically, CRSP/Compustat merged database for U.S. firms, Compustat North America for Canadian firms, and Compustat Global for firms from the other countries are used. I complement the Compustat data with the firm-level market capitalization data from Worldscope (available via Datastream). If a firm's domestic currency is not used, I omit it from the sample. A firm must have a standard industrial classification (SIC) code to be eligible for inclusion. In line with many empirical studies on corporate decision making at the firm level, I exclude firms in the utility (SICs 4900-4999) or financial (SICs 6000-6999) industries. A CRSP share code of either 10 or 11, indicative of ordinary common shares, is required for U.S. firms. I restrict the sample to firms with legitimate values for total assets, common equity, sales, income before extraordinary items, market capitalization, long-term debt, debt in current liabilities, retained earnings, sales, and net operating cash flow. Negative retained earnings disqualify a firm from being included in the sample. The calendar year is determined by the end of a firm's fiscal year; if it ends after July, the calendar year is the same as the fiscal year, otherwise, it is the fiscal year minus one. The collection of country-level data (real GDP growth and GDP per capita) from the World Bank serves to complement the firm-level data.

I further require the variables in the baseline regression equation (equation (1)) to have non-missing values both at the time indicated by the time subscript and currently. Next, I remove countries with fewer than 50 unique firms during the time period of 1996 to 2019.

To reduce the impact of outliers, all time-varying firm-level variables are winsorized at the 1% and 99% levels. Local currency values of firm-level variables are converted into US dollars using the exchange rate (sourced from Compustat) at the end of the fiscal year-end of each firm-year. My final sample consists of 169,357 firm-year observations and 22,652 unique firms from 33 countries for 22 years (from 1997 to 2018).

〈Table 1〉 presents firm-years, unique firms, and years for each country in the sample. The number of firm-year observations spans from 258 for Greece to 49,771 for the United States.

Table 1. Sample Countries

Country	Number of Observations	Number of Unique Firms	Number of Years
Australia	3,543	554	22
Austria	355	57	22
Belgium	350	59	20
Brazil	940	153	20
Canada	9,141	1,475	22
China	16,307	2,722	21
Denmark	781	113	22
Finland	1,142	131	22
France	856	256	22
Germany	2,884	423	22
Greece	258	79	18
Hong Kong	789	85	22
India	10,453	1,471	22
Indonesia	282	98	16
Israel	406	100	19
Italy	675	138	22
Japan	40,419	3,426	22
Korea	6,651	942	22
Malaysia	4,592	723	22
Netherlands	876	144	22
New Zealand	407	70	22
Norway	685	127	22
Pakistan	823	137	22
Philippines	283	52	22
Singapore	2,356	388	22
South Africa	678	142	22
Spain	287	64	18
Sri Lanka	614	103	22
Sweden	2,518	341	22
Switzerland	1,330	168	22
Thailand	891	251	22
United Kingdom	7,014	1,151	22
United States	49,771	6,509	22
Total	169,357	22,652	

Notes: This table presents sample countries with the number of observations (i.e., firm-years), number of unique firms, and number of years.

The United States and Japan represent about half of the firm-year observations. The United States has the highest count of unique firms at 6,509, while the Philippines has the lowest at 52. With the exception of Indonesia (16 years), Spain (18 years), Greece (18 years), Israel (19 years), Belgium (20 years), Brazil (20 years), and China (21 years), each country has observations for 22 years.

〈Table 2〉 presents summary statistics of the variables used for the empirical analysis performed in this study. *V* is firm value defined as the sum of market capitalization, long-term debt, and short-term debt. *E* is earnings calculated as the sum of income before extraordinary items, interest expense, deferred income taxes, and investment tax credit. *A* is total assets. *RD* is research and development (R&D) expense. When R&D is missing, *RD* is assigned a value of zero. *D* is common dividends. *I* is interest expense. *Equity issuance* is net equity issuance (defined as annual change in common equity net of retained earnings). *Debt issuance* is net debt issuance (defined as annual change in long-term & short-term debts). *Equity dummy* (*Debt dummy*) is equal to one if *Equity issuance* (*Debt issuance*) is greater than zero and zero otherwise. *Cash flow* is net operating cash flow. Following McLean (2011), *Other funding* is the sum of other funding sources (= sale of property, plant, and equipment + sale of investments + sources of funds (other)). *GDP growth* is annual real GDP (gross domestic product) growth. *GDP per capita* is GDP per capita (is constant 2010 US dollars). In 〈Table 2〉, for each variable, observations (N), mean, standard deviation, minimum, 25th percentile (P25), median, 75th percentile (P75), and maximum are reported. With respect to the key variables in this study, the average market-to-book ratio (*V/A*) is 1.3237, R&D relative to total assets (*RD/A*), on average, is 2.11%, the average value for net equity issuance divided by total assets (*Equity issuance/A*) is 2.82%, and net debt issuance scaled by total assets (*Debt issuance/A*) has an average of 1.19%. *Equity dummy* has an average of 0.6256, indicating that about 62.56% of the firms are net equity issuers. The average value of *Debt dummy* is 0.4683, signifying that net debt issuances of about 46.83% of the firms are positive.

Table 2. Summary Statistics

Variable	N	Mean	Standard Deviation	P25	Median	P75
V_t / A_t	169,357	1.3237	1.1799	0.6341	0.9385	1.5391
Equity issuance$_t$ / A_t	169,357	0.0282	0.1107	-0.0081	0.0050	0.0282
Equity dummy$_t$	169,357	0.6256	0.4840	0.0000	1.0000	1.0000
Debt issuance$_t$ / A_t	169,357	0.0119	0.0819	-0.0212	0.0000	0.0385
Debt dummy$_t$	169,357	0.4683	0.4990	0.0000	0.0000	1.0000
Cash flow$_t$ / A_t	169,357	0.0667	0.1024	0.0288	0.0710	0.1181
Other funding$_t$ / A_t	169,357	0.0158	0.0565	0.0000	0.0000	0.0045
E_t / A_t	169,357	0.0358	0.1147	0.0205	0.0495	0.0841
dE_t / A_t	169,357	0.0034	0.0801	-0.0145	0.0046	0.0242
dE_{t+1} / A_t	169,357	0.0062	0.0833	-0.0164	0.0040	0.0262
dA_t / A_t	169,357	0.0579	0.1913	-0.0341	0.0566	0.1507
dA_{t+1} / A_t	169,357	0.0995	0.2658	-0.0343	0.0540	0.1647
RD_t / A_t	169,357	0.0211	0.0521	0.0000	0.0000	0.0163
dRD_t / A_t	169,357	0.0015	0.0120	0.0000	0.0000	0.0003
dRD_{t+1} / A_t	169,357	0.0016	0.0128	0.0000	0.0000	0.0004

D_t / A_t	169,357	0.0148	0.0230	0.0000	0.0071	0.0184
dD_t / A_t	169,357	0.0011	0.0091	0.0000	0.0000	0.0018
dD_{t+1} / A_t	169,357	0.0013	0.0098	0.0000	0.0000	0.0018
I_t / A_t	169,357	0.0112	0.0125	0.0018	0.0069	0.0163
dI_t / A_t	169,357	0.0004	0.0057	-0.0011	0.0000	0.0017
dI_{t+1} / A_t	169,357	0.0010	0.0065	-0.0009	0.0000	0.0019
dV_{t+1} / A_t	169,357	0.1501	0.8617	-0.1320	0.0294	0.2645
GDP $growth_t$	169,357	0.0320	0.0307	0.0153	0.0278	0.0448
GDP per $capita_t$	169,357	10.1593	1.1080	10.2261	10.7034	10.7887

Notes: This table presents summary statistics of the variables used for the empirical analysis in this study. Summary statistics include N (number of observations), mean, standard deviation, P25 (25th percentile), median, and P75 (75th percentile).

〈Table 3〉 presents a correlation matrix that demonstrates the relationships among the key variables used in this study's empirical tests. The market-to-book ratio (V_t/A_t) is significantly positively related to all R&D investment variables (dRD_t/A_t, RD_t/A_t, and dRD_{t+1}/A_t). This suggests that firm value increases with current R&D investments and changes in past and future R&D investments, on a univariate basis. It is observed that the market-to-book ratio (V_t/A_t) is positively (negatively) associated with the equity (debt) dummy variable. It indicates that net equity (debt) issuers exhibit higher (lower) firm valuation in a univariate setting. As correlation only captures a univariate relationship between two variables, 〈Table 3〉 does not offer any insights into how financing choices impact the valuation of R&D investments, which is examined in a multivariate setting in Section 3.

Table 3. Correlations

	V_t / A_t	Equity $dummy_t$	Debt $dummy_t$	RD_t / A_t	dRD_t / A_t	dRD_{t+1} / A_t
V_t / A_t	1					
Equity $dummy_t$	0.0792***	1				
Debt $dummy_t$	−0.0415***	0.0701***	1			
RD_t / A_t	0.3095***	0.1035***	−0.0953***	1		
dRD_t / A_t	0.1822***	0.0537***	0.0195***	0.3189***	1	
dRD_{t+1} / A_t	0.2103***	0.0406***	-0.0121***	0.1021***	0.1311***	1

Notes: This table presents a correlation matrix that demonstrates the relationships among the key variables used in this study's empirical tests. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

Ⅲ. Research Design and Empirical Results

This section describes the methodology adopted for the primary empirical analysis in this research. I explore how firms' financing decisions affect the valuation of their innovative investments by measuring the sensitivity of firm value to additional innovative investments depending on financing choices. Specifically, to examine the impact of financing on the valuation of innovative investments, I use a modified version of the valuation regression widely used in the literature (e.g., Fama and French, 1998; Pinkowitz, Stulz and Williamson, 2006). The subsequent model specification serves as the foundation for my baseline regression:

$$\frac{V_{i,t}}{A_{i,t}} = \beta_1 \frac{RD_{i,t}}{A_{i,t}} + \beta_2 Finance\,dummy_{i,t} + \beta_3 \left(\frac{RD_{i,t}}{A_{i,t}} \times Finance\,dummy_{i,t} \right) + \varphi CONTROL + \delta_k + \theta_t + \varepsilon_{i,t} \quad (1)$$

where the subscripts i, t, and k correspond to firm, time (measured in years), and industry (as determined by SIC codes) in that order. The dependent variable ($V_{i,t}/A_{i,t}$) is measured on a firm-year basis, indicating that equation (1) is a firm-level (unbalanced) panel regression model. Since the central independent variable being examined is the interaction of $RD_{i,t}/A_{i,t}$ and $Finance\,dummy_{i,t}$, I include their interaction term $(RD_{i,t}/A_{i,t}) \times Finance\,dummy_{i,t}$, along with both individual terms ($RD_{i,t}/A_{i,t}$ and $Finance\,dummy_{i,t}$) as independent variables. $Finance\,dummy_{i,t}$ represents either $Equity\,dummy_{i,t}$ or $Debt\,dummy_{i,t}$. Note that I also examine the effect of debt financing on R&D investment valuation for the purpose of comparison. $CONTROL$ is a column vector that contains the control variables. The coefficients of the control variables are included in a row vector φ. Industry fixed effects, denoted by δ_k, are employed to eliminate the impact of time-invariant industry-level variables. The influence of variables that remain constant across firms in a given year is controlled for through the employment of year fixed effects, denoted as θ_t. $\varepsilon_{i,t}$ is the disturbance term that captures variables apart from the independent variables that affect the dependent variable in the regression. The method of ordinary least squares (OLS) is employed in estimating the baseline regression model. Standard errors are clustered at the firm level to accommodate correlations over time for a given firm.

The partial derivative of $V_{i,t}/A_{i,t}$ with respect to $RD_{i,t}/A_{i,t}$ (i.e., partial effect of $RD_{i,t}/A_{i,t}$ on $V_{i,t}/A_{i,t}$) is $\beta_1 + \beta_3 Finance\,dummy_{i,t}$, which measures the change in firm value as a result of one unit change in R&D investment, holding all other factors constant. In other words, $\partial V_{i,t}/\partial A_{i,t}$ (= $\beta_1 + \beta_3 Finance\,dummy_{i,t}$) represents the marginal value of one extra dollar of R&D investment. This indicates that the value of R&D investment depends on a firm's financing choices. The partial derivative of the value of R&D investment (= $\beta_1 + \beta_3 Finance\,dummy_{i,t}$) with respect to $Finance\,dummy_{i,t}$ is β_3. This means that β_3 captures the impact of $Finance\,dummy_{i,t}$ on R&D investment valuation. Specifically, one dollar of R&D investment is valued at $\beta_1 + \beta_3$ when $Finance\,dummy_{i,t}$ equals one and β_1 otherwise. The difference (= β_3) represents the difference between the value of one additional dollar of R&D investment when $Finance\,dummy_{i,t}$ is equal to one and when it is equal to zero. When examining equity financing, β_3 picks up the valuation differential between R&D investments of equity issuers and those of non-equity issuers. With respect to the use of debt financing, β_3 reflects the difference in valuation between debt financed R&D investments and non-debt financed R&D investments. Hence, a statistically significant β_3 indicates that financing has a significant impact on how R&D investments are valued by investors in the market.

My analysis controls for a number of firm-level and country-level variables that are likely to have a relationship with the market-to-book ratio. I include various firm-level control variables used in the prior studies using the valuation regression (e.g., Fama and French, 1998; Pinkowitz, Stulz and Williamson, 2006). Those firm-level control variables are $E_{i,t}/A_{i,t}$, $dE_{i,t}/A_{i,t}$, $dE_{i,t+1}/A_{i,t}$, $dA_{i,t}/A_{i,t}$, $dA_{i,t+1}/A_{i,t}$, $dRD_{i,t}/A_{i,t}$, $dRD_{i,t+1}/A_{i,t}$, $D_{i,t}/A_{i,t}$, $dD_{i,t}/A_{i,t}$, $dD_{i,t+1}/A_{i,t}$, $I_{i,t}/A_{i,t}$, $dI_{i,t}/A_{i,t}$, $dI_{i,t+1}/A_{i,t}$, and $dV_{i,t+1}/A_{i,t}$. The change in variable X from time $t-1$ to t is represented by dX_t, while the change from time t to $t+1$ is represented by dX_{t+1}. Fama and French (1998) identify the following fundamental drivers of firm value for their valuation regression specification: profitability, investment, leverage, and dividends. $E_{i,t}/A_{i,t}$, $dE_{i,t}/A_{i,t}$, $dE_{i,t+1}/A_{i,t}$ capture profitability of a firm. $dA_{i,t}/A_{i,t}$ and $dA_{i,t+1}/A_{i,t}$ proxy for a firm's investment excluding R&D. $dRD_{i,t}/A_{i,t}$, $RD_{i,t}/A_{i,t}$, and $dRD_{i,t+1}/A_{i,t}$ reflect a firm's R&D investments. Note that $RD_{i,t}/A_{i,t}$, being one of the main independent variables in this study, is not regarded as a control variable. $D_{i,t}/A_{i,t}$, $dD_{i,t}/A_{i,t}$, and $dD_{i,t+1}/A_{i,t}$, pick up information about a firm's dividend policy. A firm's leverage policy is reflected in $I_{i,t}/A_{i,t}$, $dI_{i,t}/A_{i,t}$, and $dI_{i,t+1}/A_{i,t}$. In addition, I control for other possible funding sources for R&D investments. In studying the influence of $Equity\,dummy_{i,t}$, I include $Debt\,issuance_{i,t}/A_{i,t}$, $Cash\,flow_{i,t}/A_{i,t}$, and $Other\,funding_{i,t}/A_{i,t}$. When analyzing the impact of $Debt\,dummy_{i,t}$, I employ $Equity\,issuance_{i,t}/A_{i,t}$, $Cash\,flow_{i,t}/A_{i,t}$, and $Other\,funding_{i,t}/A_{i,t}$. Finally, I incorporate $GDP\,growth_{c,t}$ and $GDP\,per\,capita_{c,t}$, with c representing the country, in order to control for the effects of economic conditions and development at the country-level.

〈Table 4〉 presents the results from the estimation of the baseline regression (equation (1)) for equity and debt issuances separately. Column 1 of 〈Table 4〉 shows the coefficient estimates with the corresponding *t*-statistics in parentheses from the baseline regression for equity issuance where $Finance\,dummy_{i,t}$ represents $Equity\,dummy_{i,t}$. The R&D investment coefficient (β_1) is 4.4552 and it is statistically significant (*t*-statistic = 15.5381), indicating that the marginal value of one additional dollar of R&D investment is $4.4552 for non-equity issuers. With the coefficient of the interaction between R&D investment and equity dummy (β_3) being 1.5749, one extra dollar of R&D investment is valued at $6.0301 (= 4.4552 + 1.5749). The R&D investment-equity dummy interaction coefficient is 1.5749 and statistically significant with a *t*-statistic of 6.0120, suggesting that there is a significant difference in R&D investment valuation between equity-issuing firms and non-equity issuing firms. Given that the other sources of funding ($Debt\,issuance_{i,t}/A_{i,t}$, $Cash\,flow_{i,t}/A_{i,t}$, and $Other\,funding_{i,t}/A_{i,t}$) are controlled for, R&D investments appear to be valued more highly when financed with equity. The value of a firm increases by $5.0301 (= 6.0301 - 1.0000) for every dollar invested in R&D if it is equity financed, while it increases by $3.4552 (= 4.4552 - 1.0000) if financed through other methods. It follows that equity financing is more advantageous for enhancing the value of R&D investments compared to other financing methods.

Table 4. Baseline Regression

	Equity		Debt	
	1		2	
	Coefficient	t-statistic	Coefficient	t-statistic
RD_t / A_t	4.4552***	15.5381	5.4761***	26.1705
Equity $dummy_t$	-0.0440***	-6.7188		
RD_t / A_t × Equity $dummy_t$	1.5749***	6.0120		
Debt $dummy_t$			-0.0403***	-5.8076
RD_t / A_t × Debt $dummy_t$			-0.0719	-0.3523
Equity $issuance_t$ / A_t			1.6188***	33.2760
Debt $issuance_t$ / A_t	-0.7094***	-14.7962		
Cash $flow_t$ / A_t	0.4455***	7.5242	0.6432***	11.1447
Other $funding_t$ / A_t	0.5587***	5.3365	0.5767***	5.6216
E_t / A_t	-0.5151***	-4.8729	0.3546***	3.5289
dE_t / A_t	0.6293***	11.3815	0.5426***	10.0415
dE_{t+1} / A_t	0.4575***	6.8378	0.5828***	8.8683
dA_t / A_t	0.9963***	32.9614	0.3311***	12.6220
dA_{t+1} / A_t	0.9557***	49.5472	0.8944***	46.8792
dRD_t / A_t	4.3746***	11.7176	4.3103***	11.8904
dRD_{t+1} / A_t	10.2186***	28.4809	10.1939***	28.6615
D_t / A_t	17.0201***	35.5240	15.8915***	33.9063
dD_t / A_t	-5.0966***	-12.2746	-4.7524***	-11.6931
dD_{t+1} / A_t	7.8164***	18.8647	7.5958***	18.4777
I_t / A_t	-5.0376***	-10.1104	-5.7125***	-11.8277
dI_t / A_t	-2.1560***	-4.1328	-0.8645*	-1.6922
dI_{t+1} / A_t	-8.5843***	-15.7310	-6.2926***	-11.7431
dV_{t+1} / A_t	-0.1950***	-26.3229	-0.1876***	-25.5003
GDP $growth_t$	2.4110***	11.7097	2.1934***	10.6896
GDP per $capita_t$	0.4704***	14.3562	0.4651***	14.3785
Fixed effects	Country, industry, and year		Country, industry, and year	
R-squared (adjusted)	0.4111		0.4223	
Observations	169,357		169,357	

Notes: This table presents the baseline regression results for equity and debt issuances separately. Standard errors allow for clustering at the firm level. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

Next, in comparison to equity issuance, I estimate the baseline regression for debt issuance where $Finance\,dummy_{i,t}$ denotes $Debt\,dummy_{i,t}$. The results are presented in Column 2 of ⟨Table 4⟩. The coefficient associated with R&D investment is positive (= 5.4761) and statistically significant (*t*-statistic = 26.1705). This implies that the marginal value of one extra dollar of R&D investment is $5.4761 for non-debt issuers. A dollar invested in R&D investment activities by debt-issuers has a value of $5.4042 (= 5.4761 - 0.0719), based on the R&D investment coefficient of 5.4761 and the interaction coefficient of -0.0719 between R&D investment and debt dummy. The insignificance (*t*-statistic = -0.3523) of the coefficient for the R&D investment-debt dummy interaction term indicates that no significant difference exists in the R&D investment valuation of debt issuers compared to non-debt issuers. Given that the other major sources of funding are controlled for, the results indicate that the use of debt financing does not affect investors with respect to R&D investment valuation. This implies that firms do not experience an increase in value when they finance their R&D investments with debt.

With the baseline results for the contemporaneous relationship between financing and R&D

investment valuation established, I also examine if there are delayed effects of financing on R&D investment valuation. The results are reported in 〈Table 5〉. The results derived from the use of one-year (two-year) lagged equity issuance are illustrated in Column 1 (2) of 〈Table 5〉. I find that lagged equity issuances, both one-year and two-year, positively influence the valuation of R&D investments. The findings from the use of one-year (two-year) lagged debt issuance are exhibited in Column 3 (4) of 〈Table 5〉. I observe that the valuation of R&D investments does not depend on one-year and two-year lagged debt issuances, consistent with the results for the contemporaneous debt issuance.

Table 5. Delayed Effects of Financing

	Equity		Debt	
	Lag 1	Lag 2	Lag 1	Lag 2
	1	2	3	4
RD_t / A_t	5.0169***	4.9911***	5.6819***	5.7497***
	(15.4163)	(13.4378)	(24.0965)	(21.9512)
Equity dummy$_{t-1}$	0.0380***			
	(5.8162)			
RD_t / A_t × *Equity dummy*$_{t-1}$	1.1381***			
	(3.7978)			
Equity dummy$_{t-2}$		0.0624***		
		(8.7803)		
RD_t / A_t × *Equity dummy*$_{t-2}$		1.4060***		
		(4.0236)		
Debt dummy$_{t-1}$			-0.0118*	
			(-1.9194)	
RD_t / A_t × *Debt dummy*$_{t-1}$			-0.0989	
			(-0.4251)	
Debt dummy$_{t-2}$				-0.0044
				(-0.7070)
RD_t / A_t × *Debt dummy*$_{t-2}$				0.2444
				(0.9659)
Baseline regression controls	Yes	Yes	Yes	Yes
Fixed effects	Country, industry, and year	Country, industry, and year	Country, industry, and year	Country, industry, and year
R-squared (adjusted)	0.4164	0.4296	0.4290	0.4415
Observations	142,342	120,526	142,342	120,526

Notes: This table presents the results from the use of one and two-year lagged equity and debt dummy variables. Standard errors allow for clustering at the firm level. *t*-statistics, enclosed in parentheses, are located below the estimates of the coefficients. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

The final part of my study focuses on how the valuation effect of financing changes with respect to the financial market conditions. I add the following variables to the baseline regression model: $Crisis$ and $(RD_{i,t}/A_{i,t})\times Finance\,dummy_{i,t}\times Crisis$. $Crisis$ is a dummy variable that is equal to one if the year is 2008 or 2009 and zero otherwise. 〈Table 6〉 displays the findings. The coefficient on $(RD_{i,t}/A_{i,t})\times Finance\,dummy_{i,t}\times Crisis$ is negative and statistically significant (*t*-statistic for equity dummy = -4.7386 and -4.4438 for debt dummy). This indicates that the R&D valuation effect of financing is diminished during the financial crisis.

Table 6. Financial Market Conditions

	Equity	Debt
	1	2
RD_t / A_t	4.4089***	5.5210***
	(15.3941)	(26.2880)
Crisis	-0.1544***	-0.1700***
	(-15.3795)	(-16.7350)
Equity dummy$_t$	-0.0737***	
	(-11.6874)	
RD_t / A_t × Equity dummy$_t$	1.8427***	
	(6.9367)	
RD_t / A_t × Equity dummy$_t$ × Crisis	-1.4378***	
	(-4.7386)	
Debt dummy$_t$		-0.0461***
		(-6.6298)
RD_t / A_t × Debt dummy$_t$		0.1427
		(0.6903)
RD_t / A_t × Debt dummy$_t$ × Crisis		-2.1296***
		(-4.4438)
Baseline regression controls	Yes	Yes
Fixed effects	Country and industry	Country and industry
R-squared (adjusted)	0.4034	0.4146
Observations	169,357	169,357

Notes: This table presents the results from estimating the impact of the financial market conditions on the valuation effect of financing. Standard errors allow for clustering at the firm level. *t*-statistics, enclosed in parentheses, are located below the estimates of the coefficients. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

Ⅳ. Robustness Checks

This section is dedicated to testing the robustness of my baseline results. First, I examine if the baseline results are robust against alternative fixed effects. The results are reported in 〈Table 7〉. I employ the following fixed effects: (1) industry-year and year (Columns 1 and 2), (2) country-year and year (Columns 3 and 4), (3) industry-year, country-year, and year (Columns 5 and 6). As demonstrated in 〈Table 7〉, the findings resulting from the use of all of the above alternative fixed effects are qualitatively akin to the baseline results.

Table 7. Robustness Check - Fixed Effects

	Equity	Debt	Equity	Debt	Equity	Debt
	1	2	3	4	5	6
RD_t / A_t	5.3490***	6.4447***	5.0380***	5.7822***	4.3949***	5.3568***
	(17.7882)	(30.3623)	(18.5641)	(29.9596)	(15.4395)	(25.7070)
Equity dummy$_{t-1}$	-0.0221***		-0.0042		-0.0119*	
	(-3.1984)		(-0.5892)		(-1.7194)	
RD_t / A_t	1.6953***		1.2117***		1.4470***	
× *Equity dummy*$_{t-1}$	(6.1598)		(4.5711)		(5.5529)	
Debt dummy$_{t-1}$		-0.0653***		-0.0300***		-0.0278***
		(-8.8065)		(-4.2388)		(-4.0282)
RD_t / A_t		-0.0773		-0.1251		-0.1019
× *Debt dummy*$_{t-1}$		(-0.3736)		(-0.6116)		(-0.5021)
Baseline regression controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Industry × year and year	Industry × year and year	Country × year and year	Country × year and year	Industry × year, country × year, and year	Industry × year, country × year, and year
R-squared (adjusted)	0.3738	0.3851	0.4131	0.4240	0.4396	0.4491
Observations	169,357	169,357	169,357	169,357	169,357	169,357

Notes: This table presents the results from estimating the baseline regression with alternative fixed effects. Standard errors allow for clustering at the firm level. *t*-statistics, enclosed in parentheses, are located below the estimates of the coefficients. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

Next, I scrutinize whether my baseline results hold up when subjected to alternative standard errors. I report the findings in ⟨Table 8⟩. Specifically, I use the following alternative clustering dimensions for standard errors: (1) industry-year (Columns 1 and 2), (2) country-year (Columns 3 and 4), (3) firm and industry-year (Columns 5 and 6), (4) firm and country-year (Columns 7 and 8), and (5) firm, industry-year, and country-year (Columns 9 and 10). The results of using these alternative clustering dimensions are qualitatively indifferent from the baseline results.

Table 8. Robustness Check - Standard Errors

	Equity	Debt	Equity	Debt	Equity	Debt	Equity	Debt	Equity	Debt
	1	2	3	4	5	6	7	8	9	10
RD_t / A_t	4.4552***	5.4761***	4.4552***	5.4761***	4.4552***	5.4761***	4.4552***	5.4761***	4.4552***	5.4761***
	(13.4049)	(25.3618)	(15.3970)	(33.3796)	(11.1902)	(19.7277)	(12.2714)	(22.8632)	(10.4643)	(20.3678)
Equity dummy$_{t-1}$	−0.0440***		−0.0440***		−0.0440***		−0.0440***		−0.0440***	
	(−5.2686)		(−3.2177)		(−4.8154)		(−3.1055)		(−2.9652)	
RD_t / A_t	1.5749***		1.5749***		1.5749***		1.5749***		1.5749***	
× *Equity dummy*$_{t-1}$	(6.0656)		(5.2481)		(5.0708)		(4.5631)		(4.3079)	
Debt dummy$_{t-1}$		−0.0403***		−0.0403***		−0.0403***		−0.0403***		−0.0403***
		(−5.8942)		(−4.4190)		(−5.0908)		(−4.0483)		(−3.9455)
RD_t / A_t		−0.0719		−0.0719		−0.0719		−0.0719		−0.0719
× *Debt dummy*$_{t-1}$		(−0.4232)		(−0.2988)		(−0.3396)		(−0.2645)		(−0.2700)
Baseline regression controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Country, industry, and year	Country, industry, and year	Country, industry, and year	Country, industry, and year	Country, industry, and year	Country, industry, and year	Country, industry, and year	Country, industry, and year	Country, industry, and year	Country, industry, and year
Clustering dimensions	Industry × year	Industry × year	Country × year	Country × year	Industry × year and firm	Industry × year and firm	Country × year and firm	Country × year and firm	Industry × year, country × year, and firm	Industry × year, country × year, and firm
R-squared (adjusted)	0.4111	0.4223	0.4111	0.4223	0.4111	0.4223	0.4111	0.4223	0.4111	0.4223
Observations	169,357	169,357	169,357	169,357	169,357	169,357	169,357	169,357	169,357	169,357

Notes: This table presents the results from estimating the baseline regression with alternative standard errors. t-statistics, enclosed in parentheses, are located below the estimates of the coefficients. ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

V. Conclusion

The main objective of this study is to explore the influence of equity financing on the value attributed to R&D investments using a sample of firms from 33 countries for 22 years, from 1997 to 2018. I uncover evidence that equity financing is more advantageous in escalating the value of R&D investments than other financing methods. My results also show that the valuation of R&D investments benefits from both one-year and two-year lagged equity issuances. As a contrast, I establish that debt financing doesn't influence R&D investment valuation. My findings also suggest that one-year and two-year lagged debt issuances do not alter the valuation of R&D investments. Additionally, I investigate the variation in R&D valuation based on the condition of the financial markets. I demonstrate that during the financial crisis, equity financing's impact on R&D investment valuation is reduced. Lastly, I scrutinize the robustness of my baseline regression results. The baseline results hold up against the use of various fixed effects and clustering dimensions for standard errors.

References

Chemmanur, T. J. and Y. Jiao (2011), "Institutional Trading, Information Production, and the SEO Discount: A Model of Seasoned Equity Offerings", *Journal of Economics & Management Strategy*, 20(1), 299-338.

Easley, D. and M. O'hara (2004), "Information and the Cost of Capital", *Journal of Finance*, 59(4), 1553-1583.

Fama, E. F. and K. R. French (1998), "Taxes, Financing Decisions, and Firm Value", *Journal of Finance*, 53(3), 819-843.

Fulghieri, P., D. García and D. Hackbarth (2020), "Asymmetric Information and the Pecking (Dis) Order", *Review of Finance*, 24(5), 961-996.

Fulghieri, P. and D. Lukin (2001), "Information Production, Dilution Costs, and Optimal Security Design", *Journal of Financial Economics*, 61(1), 3-42.

Hsu, P., X. Tian and Y. Xu (2014), "Financial Development and Innovation: Cross-country Evidence" , *Journal of Financial Economics*, 112(1), 116-135.

Kerr, W. R. and R. Nanda (2015), "Financing Innovation", *Annual Review of Financial Economics*, 7, 445-462.

Knight, F. H. (1921), *Risk, Uncertainty, and Profit*, Boston, MA: Houghton Mifflin.

McLean, R. D. (2011), "Share Issuance and Cash Savings", *Journal of Financial Economics*, 99(3), 693-715.

Pástor, Ľ. and P. Veronesi (2009), "Technological Revolutions and Stock Prices", *American Economic Review*, 99(4), 1451-1483.

Pinkowitz, L., R. Stulz and R. Williamson (2006), "Does the Contribution of Corporate Cash Holdings and Dividends to Firm Value Depend on Governance? A Cross-country Analysis", *Journal of Finance* 61(6), 2725-2751.

Scherer, F. M. and D. Harhoff (2000), "Technology Policy for a World of Skew-distributed Outcomes", *Research policy*, 29(4-5), 559-566.

Yang, M. and Y. Zeng (2019), "Financing Entrepreneurial Production: Security Design with Flexible Information Acquisition", *Review of Financial Studies*, 32(3), 819-863.