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DEBT OR EQUITY? FINANCIAL IMPACTS OF R&D SUPPORT ACROSS FIRM DEMOGRAPHICS

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Abstract. This study utilizes data from Korea's Research and Development (R&D) grant program to examine the impact of receiving an R&D grant on a firm's ability to obtain external financing, taking into account the heterogeneous effects based on firm size and characteristics. By employing the propensity score matching method, we establish the causal effect of R&D support on financing and discover that R&D grants have differential effects on debt and equity financing. Our findings indicate that larger firms are more likely to acquire subsequent debt financing, whereas small firms that receive R&D grants exhibit an increased likelihood of securing equity financing, particularly among young firms. Furthermore, we identify a certification effect of R&D grants, implying that such grants may serve as indicators of the potential success of small, young firms in the market. Collectively, this study illuminates the role of R&D grants in firms' financing decisions, providing valuable insights for policymakers and firms seeking to secure external financing.

Keywords: debt financing, equity financing, public support.

JEL Classification: G18, H00, H3, L00, O32.

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1. Introduction

Numerous studies have highlighted the crucial role of government support in promoting firms' research and development (R&D) activities. Nelson (1959) and Arrow (1962) demonstrate that the non-rival nature of R&D investments leads to underinvestment in this sector. Consequently, many countries invest substantial resources to encourage R&D activities, and all OECD countries offer subsidies or grants for this purpose (Storey & Tether, 1998).

Empirical studies have been conducted to investigate the impact of government support on firms' innovation development, scientific productivity, public finances, and the behavioral additionality of these interventions in the private sector (Lach, 2002; Czarnitzki et al., 2011; Cappelen et al., 2012; Bronzini & Iachini, 2014; Jacob & Lefgren, 2016; Bertoni et al., 2019). These studies have estimated the effectiveness of various countries' R&D support policies by observing an increase in patent applications, grants, or additionality, such as enhanced product and process innovation. Some studies have analyzed firms' strategic choices in R&D activities (Moon, 2021) and the interconnectivity of the financial and industrial sectors (Buisseret et al., 1995). Harhoff and Körting (1998) note that obstacles to R&D investments include financial constraints and difficulties obtaining external financing, leading to an increased interest in the effect of government investments in R&D on both internal and external private financing of R&D activities. There are also studies that present proposals for research methods based on literature analysis on government support and corporate innovation. Beck et al. (2017), through a literature analysis on the relationship between public support and corporate innovation, confirms that an important point in the study is the identification of the causal effect. Petrin (2018) conducts a literature analysis on the relationship between government support and innovation performance in EU and OECD countries, China and Taiwan from 1960 till 2017 and confirms that the research results are quite heterogeneous. Also, later studies suggest a greater focus on macroeconomic and qualitative aspects. Ziesemer (2021) proposes the development of a dynamic model that takes into account factors such as sample size, industry characteristics, and economic scale for future research studies. By incorporating these considerations, researchers can enhance the robustness and applicability of their investigations into the relationship between government support and corporate innovation.

One area of literature focuses on the financial effects of R&D investments and, in particular, whether these R&D grants crowd in or crowd out firms' internal R&D expenditures (David et al., 2000; García-Quevedo, 2004). Wallsten (2000) and Busom (2000) found in their studies of the Small Business Innovation Research (SBIR) program in the United States and of firms in Spain that government grants reduce firms' internal R&D expenditures. However, Klette et al. (2000) showed that R&D grants targeted at specific industries increase firms' internal R&D expenditures in Norway. Becker (2015) conducted a survey of existing literature and reported that the crowding-out effect of government grants on private sector R&D remains unclear. Boeing et al. (2021) found that despite diminishing private R&D investments, R&D subsidies lead to an overall increase in R&D resources.

Other studies have focused on the relationship between R&D grants and firm characteristics, the types of investments made by financial institutions, or geographical factors. Dimos and Pugh (2016) argued that unobserved firm characteristics play a vital role in receiving R&D grants. Brown et al. (2009) found that while cash flow and public funds played an essential role in R&D investment by startups between 1990 and 2004, these factors did not affect R&D investments by mature firms. Moon (2021) suggested that the size of a firm and the conditions of grant approval affect firms' innovative behaviors. Hottenrott et al. (2017) identified research grants and development grants to analyze the effects of grants on R&D investments. They found that research grants increase internal investments in research, while development grants do not have a significant impact on developmental activities. Therefore, grants specifically targeting research may be more favorable.

Moreover, the effect of government R&D grants on private investment can be explained by the "resource effect" and "certification effect". Czarnitzki (2006) and Takalo and Tanayama (2010) argued that R&D grants provide the much-needed liquidity for firms, resulting in a resource effect that reduces external R&D investment. Lerner (2002) showed that a certification effect arises because the receipt of a government R&D grant by a firm signals the health of the firm's financial standing and its innovative skills, leading to an increase in external R&D investment. Feldman and Kelley (2003, 2006) and Meuleman and De Maeseneire (2012) claimed that R&D grants increase external financing of R&D activities. Furthermore, Kleer (2010), Li et al. (2019), Wu (2017), Martí and Quas (2018), and Xu et al. (2022) have empirically analyzed the positive signals that government support has on the market. Moon (2022) confirms that the government's R&D support for companies reduces subsequent financial funding, and based on this, it empirically proves the crowding out effect. A study closely relevant to the present research is conducted by Guo et al. (2022), who utilizes Chinese data to examine the influence of government R&D support on firms' external financing. They investigated the effects of direct funding and certification on company performance. The study revealed that both direct funding and certification have a more pronounced effect on companies that receive government support. Furthermore, the research confirmed that government support has a positive impact on innovation performance, although it did not significantly affect the financial returns of the companies. Additionally, the study found that supported businesses generate positive signals for subsequent government support and political funding, indicating the potential for continued support in the future.

Li et al. (2020) employed a signaling model to explain that R&D grants alleviate the problem of informational asymmetry in R&D investments. They argued that government entities can gather more information about firms than private investors can. Private investors have limited information about firms, usually only based on their financial statements. In contrast, government experts may have more information and understanding of particular products or the potential of firms. Furthermore, because R&D investments are risky, the receipt of grants by firms after going through strict evaluation signals to private investors that the firm may be profitable.

Another area of literature analyzes the different types of financing methods related to R&D. Mann (2018) found that firms focused on innovation tend to use debt financing with patents as collateral to fund their projects. Meuleman and Maeseneire (2012) analyzed the effect of government's R&D support for Small and Medium Enterprises (SMEs) on their future accessibility to external equity, short-term and long-term financing and found that R&D grants yield positive results on long-term debt. Bellucci et al. (2019) found that R&D subsidies modify firms' debt structure, especially for young firms, in favor of long-term financing and help firms limit the average cost of debt. Robb and Robinson (2014) showed that external bank financing was an important source of funds for startups that lack collateral. Lee and Lee (2019) used Korean data to show that while R&D subsidies decrease subsequent debt financing except for in the bio sector, R&D subsidies increase subsequent debt financing.

Lastly, some studies have explored the effect of government R&D support on subsequent investment by venture capitalists (VCs). Howell (2017) analyzed the relationship between energy related firms supported by the SBIR program and venture capital investments. She found that firms that received SBIR support had double the probability of receiving investment from venture capital firms than those that did not receive any SBIR support. Guo and Jiang (2022) found that firms with venture capital support surpass those without it in areas such as patent registrations, sales from new products, and exports. This superior performance can be credited to the preliminary selection and subsequent value enhancement associated with venture capital investments.

In summary, the existing literature suggests that government support plays a crucial role in promoting innovation and mitigating financial constraints in R&D activities. However, the effectiveness of government R&D support policies varies depending on several factors, such as firm characteristics, industry specificity, and types of financing methods. Based on this literature review, we propose the following hypotheses to guide our study.

H1. *Government R&D funding reduces the demand for debt financing among firms, with variations in effect based on firm characteristics*.

Compared to specialized venture capital firms in the R&D sector, banks generally exhibit lower competitiveness and impose more stringent requirements, such as extensive paperwork and warranties, when providing debt financing. Previous studies (Giudici & Paleari, 2000; Storey & Tether, 1998; Berger & Udell, 1998; Carpenter & Petersen, 2002) have emphasized the difficulties faced by smaller firms in securing bank financing for R&D projects. Smaller firms and startups, with a limited operating history and absence of a proven track record, are seen as risky borrowers due to their high failure rate (Stinchcombe & March, 1965). Therefore, these firms may depend more heavily on government R&D grants, reducing their need for external debt financing. In contrast, larger firms or those with established R&D experience could use these grants as an affirmation of their creditworthiness (Hall, 2002).

The hypothesis is grounded in the observation that the banking sector, compared to venture capital firms specializing in R&D investments, presents greater obstacles to firms seeking debt financing. This obstacle is particularly pronounced for smaller firms lacking extensive R&D experience. Previous research underscores the challenges faced by smaller firms in obtaining bank financing for their R&D initiatives. Consequently, the hypothesis posits that government R&D grants, providing liquidity to smaller firms, can diminish their reliance on external debt financing. However, the impact of these grants on larger firms or those with a successful R&D track record may differ, as they may function as a positive signal of creditworthiness to banks.

H2. *Government R&D grants serve as a positive signal for firms seeking external equity financing, subject to variations based on firm characteristics*.

According to the pecking order theory by Myers and Majluf (1984), firms, especially smaller ones, tend to finance their projects with internal funds first, then debt, and finally, new equity due to the perception of market undervaluation. R&D-intensive young firms often struggle to attract external equity due to higher information asymmetry and perceived risk (Hsu, 2007). However, securing a government R&D grant can help alleviate this information asymmetry (Lerner, 1999). The grant acts as a signal to potential investors that the firm has undergone a stringent evaluation process and shows high potential for future returns (Hoenig & Henkel, 2015). For small or younger firms, these signals can be particularly important to boost investor confidence and facilitate external equity financing (Czarnitzki & Hottenrott, 2011).

The hypothesis is based on Myers and Majluf's pecking order theory, which posits that firms finance their projects with the understanding that the market undervalues their worth. Within this theoretical framework, the receipt of a government R&D grant can signal to investors that the firm has successfully passed a rigorous evaluation process, indicating its potential for generating future returns. This increased investor confidence, in turn, facilitates external equity financing for the firm. The hypothesis acknowledges that the impact of government R&D grants on equity financing may vary depending on firm characteristics, as the weight assigned to the grant's signal may differ across different types of firms.

Our study seeks to make a significant academic contribution by addressing critical gaps in the existing literature through a rigorous analysis of the effects of R&D grants on subsequent debt and equity financing in the unique context of Korea. We emphasize the novelty and contribution of our study by employing a comprehensive counterfactual case approach to identify and analyze these effects. This approach allows us to compare the financing patterns of firms that receive R&D grants with those that do not, enabling us to draw robust conclusions.

One key aspect that sets our study apart is the focus on Korea's R&D grant policy and innovation related policies. This perspective provides a distinctive and valuable insight due to Korea's position as one of the top global spenders on R&D. In 2018, the Korean government allocated a remarkable 5% of its annual budget to support private sector R&D activities, surpassing per capita investments in any other OECD country (OECD, 2018). Moreover, the Korean Constitution explicitly underscores the government's substantial role in promoting R&D for technological development. By examining data from a comprehensive R&D support program, rather than one targeting specific industries or firms, we are able to approach the issue from multiple angles, expanding the breadth of our analysis.

Additionally, our study encompasses data from diverse sectors in Korea, providing a holistic view of the overall impact of R&D grants on the private sector. This broader perspective is crucial for informing policy design and decision-making. Furthermore, the rigorous regulations and robust systems governing the Korean data address the issue of missing observations that has plagued previous studies. By leveraging this high-quality data, we can uncover insights into the influence of government grants on firms of various sizes and ages, surpassing the limitations of prior research that predominantly focused on specific firm categories, such as SMEs (Meuleman & De Maeseneire, 2012).

In the following sections, we describe our empirical strategy and data in Section 2, present our empirical findings and results in Section 3, and conclude with a summary of our findings and their policy implications in Section 4.

2. Empirical strategy and data

This section scrutinizes the impact of Korean government R&D grants on subsequent financing opportunities, using internal government data. We leverage propensity score matching (PSM) to differentiate the financing prospects between grant-receiving and non-grant-receiving firms.

PSM, a method often employed to mitigate the confounding variables' influence in estimating the treatment effect via observational data, helps in curtailing bias from these variables by aligning treatment groups based on control variables. This technique separates groups by presupposing that potential outcomes are irrelevant to treatment allocations, given an observable covariate, X, for a non-treated individual cohort. Thus, assignments are predicated entirely on observable traits, ensuring that all variables influencing both treatment allocations and potential outcomes are observable to the investigator. This approach aligns with the propensity score methodology developed by Rosenbaum and Rubin (1983). They show that when the potential outcome is unrelated to the conditional treatment on covariate, *X*, then the potential outcome is also unrelated to the conditional treatment on balance score $b(X)$. Given the balance score $P(D = 1|X) = P(X)$, that is, given an observed covariate, *X*, the probability that an individual will participate in the treatment is one of the possible balance scores. The conditional independence assumption (CIA) underlying the propensity score (PS) can be written as follows:

$$Y(0), Y(1) \perp D|P(X), \forall X. \quad (1)$$

Heckman et al. (1997) demonstrated that significant bias may occur in estimates when critical variables are excluded. The model should include only variables that impact participation decisions and outcomes. Consequently, the model's foundation must be based on economic theory, an understanding of relevant literature, and familiarity with the policy environment (see Smith & Todd, 2005; Sianesi, 2004). Therefore, in applying the propensity score matching (PSM) method, we need to scrutinize policies and procedures potentially linked to variables impacting treatment and incorporate as many covariates into the model as feasible.

While PSM cannot wholly resolve these issues, it can practically alleviate some challenges. The initial step involves identifying the propensity score, representing a firm's likelihood of receiving government grants based on its characteristics. We then use these scores to match the treated and untreated groups. Following this, the average treatment effect is estimated based on the results' weighted average between these two groups. The data utilized in this study, detailing every firm that applied for a government grant, facilitates the segregation of treated and untreated groups.

We combine three types of data to create a new data set. The first data set is the data used in Moon (2021), government classification data on a list of all companies applying for R&D grants from the Ministry of Trade, Industry and Energy of Korea. This data is from 2009 to 2013 and contains information on the firm name, identifier, number of employees, industry, size of firms that applied for government R&D grants[1]. In Korea, whether a firm is large or small is determined by the number of employees. Specifically, if a firm employs more than 300 people, it is classified as a large firm, and a small firm otherwise. Based on this classification, firm receives different treatment with respect to support and taxes on revenue and wages. Because of this, we include average treatment effects not only on the entire sample but also based on the size of a firm.

Next, we use the Korean government's internal survey data to extract information on subsequent external finances. This information is used to determine how a government R&D grant affects subsequent financing in the private sector. Once a firm receives a government R&D grant, the government inquires whether they received debt or equity financing for the next three years[2]. Financial debt is debt financing by banks for business and innovative ac-

[1] The Korean government's R&D grant application approval process is similar to that of other governments. First, based on the proposal submitted by the firm, the project's excellence, feasibility, and future development potential are evaluated, and a score is awarded based on this. Any company that has subsequently passed the common minimum qualifications similarly applied in other country programs (i.e. very high risk of default, criminal activity, noncompliance with government contracts) can apply for and receive R&D grants if selected. Evaluation is performed by an evaluator among the expert pool.

[2] In order to analyze the effect of government grants, every firm has agreed to provide related information and to provide supporting documents. However, the actual amount financed is kept confidential for firm privacy. In order to obtain accurate information, the government records financing related to the firm's projects or business. This is to reduce the possibility of the owner's personal debt.

tivities no related to the firm's owner, and equity financing is determined by whether a firm raised the net equity from existing or new shareholders.[3] The record only indicates whether or not a firm received financing as a binary input.

Finally, a firm's financial and regular information is obtained by combining data collected when the firm applies for a R&D grant and from information provided by KIS VALUE, one Korea's largest credit agency. When a firm applies a grant, it provides information on the number of employees, liquidity, and age, and any information not provided at the time of the application could be found in KIS VALUE by using the employer identification number. We then match this data with the information from KIS VALUE on revenue, debt ratio, credit rating, and R&D investment intensity (the ratio of revenue to internal investment on R&D). Furthermore, in order to obtain an accurate information on the firms' geographical locations, we utilize the employer identification number to extract the address of the firm's headquarters or use the most recent address.

The budget for R&D in Korea as of 2017 was about US$19 billion and the amount of grants provided to firms by the Ministry of Trade, Industry, and Energy was about US$5 billion which accounts for over 30% of its total budget. The fact that much of the grants provided for firms is provided by the Ministry of Trade, Industry, and Energy shows that this data set has strength for analyzing the effect of R&D grants on the behavior of industry. Furthermore, the data has an additional benefit of being organized systematically. The government has a legal obligation to collect data on firms that received grants and those that did not, and firms have agreed at the time of application to provide further data collection for the purpose of analyzing various effects of government R&D policies. Because of this, the probability that there will be missing data is significantly lower than if the data were to be collected manually. Furthermore, we overcome the limitations of the existing literature which focused on particular industries by the fact that our data includes information on R&D grants provided to six different industries.

The variables used in our estimation have been chosen as follows. We aim to reduce confounding bias by using the propensity score matching method. Because of this, we also take into consideration the variables that may affect a firm's ability to receive both R&D grants from the government and subsequent debt or equity financing. While the evaluation of R&D grant applications are based on the project and business reports, it also takes into consideration the firm's financial health and other relevant factors. This is to minimize the probability of a firm going bankrupt or experiencing extreme difficulty in running its business after receiving a grant. Furthermore, when a firm applies for debt financing through a bank of the financial market or raises funds through equity financing, its ability to obtain financing is determined by its financial health. Based on surveys and interviews on specialists, we find out that institutions like banks place great importance on a firm's debt ratio, assets, and liquidity. Because of this, we collected as many covariates as possible for estimation using the PSM method.

Table 1 shows the summary statistics of the main variables. The data set includes information on 21,314 projects from 19,234 firms that applied for a government R&D grant between 2009 and 2013. The firm's industry is classified as IT (Information Technology), BT

[3] The definitions of Debt and Equity financing are similar to those of Meuleman and Maeseneire (2012).

(Bio Technology), NT (Nano Technology), ST (Space Technology), ET (Environment Technology), CT (Culture Technology).

The Debt and Equity Financing variable indicate whether a firm received funding as a form of debt and equity financing during three years after they apply R&D grant. The SELECT variable indicates whether a firm received a R&D grant from the government. This shows that about 30% of all the firms that applied for a R&D grant is approved. The GRANT variable indicates the total amount of R&D grant received by the firm. The EMP variable shows the number of employees the firm had at the time of applying for the grant. The SALES variable indicates the profit earned by the firm in the year prior to receiving the R&D grant or funding for innovation. The ASSET variable shows the total assets owned by the firm 1 year before receiving the R&D grant or funding for innovation, and the LIQUIDITY variable shows the firm's liquid assets at the same time. The CREDIT variable is a value between 1 and 10 which indicates the firm's credit rating. The DEBT and RDINVEST variables are the firm's debt ratio

Table 1. Summary statistics

		All		Selected		Not Selected	
		mean	sd	mean	sd	mean	sd
DEBT FINANCING	Debt Financing Recipient (1=Receive Debt financing, 0=otherwise)	0.103		0.018		0.144	
EQUITY FINANCING	Equity Financing Recipient (1=Receive Equity financing, 0=otherwise)	0.074		0.087		0.067	
SELECT	Grant Recipient (1=Receive Grant, 0=otherwise)	0.329		1.000		0.000	
GRANT	Grant amount	138.219	346.014	420.121	495.467	0.000	0.000
EMP	Number Of Employees	128.004	615.616	275.319	982.024	55.774	275.925
SALES	Revenues	131817.348	1498415.428	332071.140	2451679.356	33630.674	608181.647
PROFIT	Net profit	1949.703	40576.405	10882.337	94727.469	2246.203	44591.023
ASSET	Total assets held by the firm	20976.094	301981.317	122308.248	714455.918	20158.292	307420.731
LIQUIDITY	Liquidity assets	2947.818	65594.879	17141.220	161384.490	3833.681	67793.891
CREDIT	Credit score of the firm (AAA to D that are converted to 1-10)	0.768	2.037	2.654	2.999	2.109	2.970
DEBT	Debt Ratio(%)	298.592	10193.070	170.129	407.352	361.579	12439.871
RDINVEST	R&D Intensity (Internal R&D Investment/ Revenue)(%)	95.360	5284.373	22.406	152.938	148.645	6949.681
AGE	AGE of firms	16.546	8.985	18.745	10.854	15.465	7.679
N		21,314		7,012		14,302	
R&D grant sample is comprised of 5 years (2009 to 2013). Debt and Equity Financing recipient sample is comprised of 3 years after receiving R&D grant.							
Monetary units are in 1,000,000 Korean won, which is approximately equivalent to 1 thousand US dollars							

and the internal R&D investment ratio, respectively. From these variables, we see that about 32% of all the projects that applied for a government grant were approved and that about 10% of the firms that received the grant also subsequently received debt financing while about 7% received equity financing.

3. Empirical findings

Displaying the outcome according to the presence or absence of policy by O_1 and O_0, where O is the outcome status (O = 1: received external debt or equity financing; O = 0: otherwise), respectively, and with *SELECT* the treatment status (*SELECT* = 1: treated (got government grant); *SELECT* = 0: untreated), the average treatment effects for the treated (*ATT*) can be defined as

$$ATT = E(O_1 - O_0 | SELECT = 1) = E(O_1 | SELECT = 1) - E(O_0 | SELECT = 1). \quad (2)$$

In Equation (1), $E(O_1|SELECT = 1)$ can be estimated with a simple mean of the outcome (O) in the group of firms that are subsidized, but $E(O_0|SELECT = 1)$ is by definition non-observable. In order to overcome this problem, $E(O_0|SELECT = 1)$ needs to be substituted by referring to a suitable "counterfactual" of untreated firms. To control for selection bias on observable, the difference in outcomes between the two groups must be solely due to policy intervention. One way to solve this is to match treated and untreated firms based on propensity scores., $Pr(SELECT = 1|X(orP(X))$. In other words, an untreated firm should have an equal chance of being funded than a treated firm given the set of pre-treatment characteristics., X, which are supposed to affect both the treatment and the outcome. The PSM estimate of the ATT is given by

$$ATT_{PSM} = E_{P(X)|SELECT=}1\{E[O_1|SELECT = 1, P(X)] - E[O_0|SELECT = 0, P(X)\}. \quad (3)$$

We draw a set of control firms with replacement and assumes that the treated and untreated firms are sufficiently similar after matching based on propensity scores. We use the Kernel matching and the Caliper matching method using bandwidths of 0.01. The bandwidths represent the difference that can be tolerated in the matching process. The lower the bandwidth, the more conservative the matching between treated and untreated firms. The Kernel approach is to generate a synthetic counterfactual using a kernel-weighted average of the characteristics of all matched untreated firms and closer the propensity score of the untreated firm to that of the treated firm, the higher the weight assigned. The Caliper method matches the treated firm with a maximum of n-nearest untreated firms and applies the same weighting. We apply n = 5 and estimate by matching firms based on industry and year.[4] Furthermore, our study distinguishes large and small firms and firms whose age are greater than 10 years and less than 10 years to estimate the impact that firm size and age has on a firm's ability to receive external funding after receiving a R&D grant. Furthermore, by comparing both size and age, we identify different effects based on firm characteristics.

[4] Our sample consists of 21,314 projects of 19,234 firms that have applied for R&D grants. As a result, some firms may be observed multiple times at different points in time and serve as a treated firm at one point and as a control at another point. These cases make up about 3.7% of our data. However, we estimate by matching industry and year, thereby reducing any potential error related to this issue.

Appendix shows the quality of the balance based on the matching methodology and the group using the unbalanced covariate test with Rosenbaum and Rubin's (1985) suggested matching weighting methodology. U represents the difference of each covariates between the control group and the treatment group before matching, while M represents the difference after matching. This method applies the t-test related to the average equivalence of the treated and untreated groups before and after matching. To be considered a good product, the t-test must not be important after matching (Largoza et al., 2015). As shown in Tables 10 and 11 in Appendix, none of the covariates in the case of the whole sample have a statistically significant t score, and in the case of large and large & old groups, while the covariates for the internal R&D investment shows a statistically significant t score but show a higher similarity than before matching. Therefore, this matching method satisfies the balance property required by the algorithm suggested by Becker and Ichino (2002). We see that after matching, firm characteristics become similar which indicates a positive environment for assuming the treatment effect.

3.1. Estimation results on debt financing

Table 2 shows the effect of receiving R&D grant on debt financing for the total sample. Under every specification, we see that firms that receive the R&D grant receive less debt financing compared to firms that do not receive the grant. This negative relationship shows that as stated in Hypothesis 1, a R&D grant provides liquidity to firms and reduces demand for subsequent external financing through a resource effect. Furthermore, it also shows the effectiveness of the government policy that provides funds to firms that would have no access to external financing if there was no government intervention.

Analyzing these effects based on firm characteristics also carries an important meaning. Many studies have focused on the effects of R&D grants for SME, and analyzing the policy effect for different firm sizes and age may provide meaningful contribution to the literature. Table 3 shows the policy effect for small and large firms, defined by fewer than or more than 300 employees, respectively. The interesting fact here is that the effect of the R&D grant is different based on firm size. For small firms, receiving a R&D grant leads to less subsequent debt financing, but for large firms, it leads to more debt financing. These results explain that in the case of small firms, R&D grants have "resource effects" that reduce the demand for subsequent financing by supplying liquidity. On the other hand, in the case of a large firm, the fact that the private financial market has received an R&D grant can be explained as creating a favorable environment for financing by strengthening confidence in the firm's ability or stability. As discussed above, this may be because for large firms, a R&D grant sends a positive signal and helps create a favorable environment for receiving debt financing.

How long a firm has been active in business is also an important factor to consider. We have two standards to determine whether a firm is young or old. First, the government consider firms to be young for the first 10 years after it is registered. During this time, the government provides support and information for submitting paperwork and filing taxes. In our data, companies that have been in business for 10 years represents the lower 25% of the sample. Because of this, using 10 years as a benchmark to determine whether a firm is young or old is justifiable. The estimation results in Table 4 show that R&D grants lead to less debt financing for firms of all age. However, the magnitude of this effect is higher for

Table 2. Estimation using PSM- Effects of R&D grant receipt on debt financing receipt (same industry-year match sample)

		(1)	(2)
Specification		Kernel, bandwidth 0.01	Caliper, bandwidth 0.01
Debt Financing	Mean of control	0.1512	0.1231
	Treatment effect	–0.0226** (0.00888)	–0.0203** (0.00677)

Note: Standard errors in parentheses, Standard errors are bootstrapped with 100 replications.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3. Estimation using PSM- Effects of R&D grant receipt on debt financing receipt (small and large firms)

		(1)	(2)	(3)	(4)
Specification		Small		Large	
		Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01
Debt Financing	Mean of control	0.1711	0.1711	0.0156	0.0156
	Treatment effect	–0.134*** (0.00461)	–0.131*** (0.00592)	0.0383*** (0.0121)	0.0385*** (0.0106)

Note: Standard errors in parentheses, Standard errors are bootstrapped with 100 replications.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4. Estimation using PSM- effects of R&D grant receipt on debt financing receipt (young/old firms)

		(1)	(2)	(3)	(4)
Specification		Young (age <10)		Old (age >=10)	
		Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01
Debt Financing	Mean of control	0.2129	0.2130	0.1588	0.1588
	Treatment effect	–0.182*** (0.0112)	–0.185*** (0.0110)	–0.0871*** (0.00551)	–0.0831*** (0.00763)

Note: Standard errors in parentheses, Standard errors are bootstrapped with 100 replications.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

young firms. This shows that when a firm has less experience, R&D grants play an especially important role in providing liquidity to the firm.

Considering both the size and age of the firm allows us to compare the policy effect on groups with complex characteristics. We divide the firms into 4 groups and use the PSM method to analyze the effect of the R&D grant. As shown in Columns (1) and (2) of Table 5, age does not make a difference on the direction of the effect for small firms, though the magnitude is greater than young firms. Furthermore, as shown in Columns (3) and (4), R&D grants allow old and large firms to secure more subsequent debt financing, possibly because for firms that have more experience and are larger, the signaling effect of the R&D grant is very strong. However, for young and large firms, age and size affect the firm in different directions, so the effect is not statistically significant.

Table 5. Estimation using PSM- effects of R&D grant receipt on debt financing receipt (young/old firms)

	(1)		(2)		(3)		(4)	
	Young & Small		Old & Small		Young & Large		Old &Large	
Specification	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01
Mean of control	0.1597	0.1612	0.2132	0.2133	0.0152	0.0153	0.0163	0.0166
Debt Financing Treatment effect	–0.144*** (0.0118)	–0.154*** (0.0126)	–0.122*** (0.00560)	–0.123*** (0.00660)	0.0690 (0.580)	0.0712 (0.682)	0.0364** (0.0147)	0.0370** (0.0168)

Note: Standard errors in parentheses, Standard errors are bootstrapped with 100 replications.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

3.2. Estimation results on equity financing

As discussed above, debt financing and equity financing have different characteristics. In the equity market, the role of information asymmetry stands out, and therefore a significant amount of lemon premium may be charged to new external shareholders. Because of this, comparing the effect of the receipt of R&D grant on subsequent equity financing and debt financing may be meaningful. Table 6 shows the estimation results using the total sample. Unlike debt financing, we see that receiving a R&D grant facilitates receiving subsequent equity financing. The fact that a firm received support for their project sends a clear signal about a firm's value and its R&D potential to investors in the equity market where there is a significant amount of information asymmetry, leading to higher confidence to provide equity financing.

Next, we consider the effect of R&D grants on equity financing based on firm size. Firm size is also an important information for investors after controlling for other variables. As Table 7 indicates, the receipt of R&D grant increases subsequent equity financing for small firms but has the opposite effect for large firms. This implies that the signaling effect for small firms is large and also shows that for large firms, receiving R&D grant makes debt financing through banks more accessible through the R&D grant effect seen in Table 3, which is consistent with the pecking order theory.

As Table 8 shows, the effect based on age is positive for both young and old firms. This shows that in the equity market, a firm's experience, record of performance, and selection by the government for support all play an important role in equity financing.

Table 9 shows the estimation results that takes into consideration for both age and size. The effect is very different for each type of firm. For young and small firms, the grant has a positive effect on equity financing. However, for old and large firms, those that receive the grant has reduced equity financing compared to those that do not receive the grant. The estimation results for the other groups are not statistically significant, but we see that the direction is negative for large firms.

Our empirical findings reveal several intriguing facts. Firstly, the impact of R&D grants on subsequent financing varies depending on the type of financing. Holding all other factors constant, firms that receive R&D grants experience a decrease in subsequent debt financing

Table 6. Estimation using PSM- effects of R&D grant receipt on equity financing receipt (same industry-year match sample)

		(1)	(2)
Specification		Kernel, bandwidth 0.01	Caliper, bandwidth 0.01
	Mean of control	0.0582	0.0608
Equity Financing Receipt	Treatment effect	0.0104*** (0.00524)	0.0156*** (0.00687)

Note: Standard errors in parentheses, Standard errors are bootstrapped with 100 replications.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7. Estimation using PSM- effects of R&D grant receipt on equity financing receipt (small and large firms)

		(1)	(2)	(3)	(4)
Specification		Small		Large	
		Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01
Equity Financing Receipt	Mean of control	0.0184	0.0214	0.1524	0.1667
	Treatment effect	0.0163** (0.00627)	0.0179** (0.00721)	–0.0347* (0.0181)	–0.0449* (0.0241)

Note: Standard errors in parentheses, Standard errors are bootstrapped with 100 replications.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 8. Estimation using PSM- effects of R&D grant receipt on equity financing receipt (young/old firms)

		(1)	(2)	(3)	(4)
Specification		Young (age <10)		Old (age >=10)	
		Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01
Equity Financing Receipt	Mean of control	0.0174	0.0191	0.1574	0.1738
	Treatment effect	0.0217*** (0.00680)	0.0223*** (0.00750)	0.0794*** (0.0125)	0.0804*** (0.0149)

Note: Standard errors in parentheses, Standard errors are bootstrapped with 100 replications.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

but an increase in subsequent equity financing. This finding aligns with previous studies, which indicate that R&D grants have both a resource effect and a signal effect, and highlights the significance of considering the type of financing.

Moreover, our results suggest that the impact of R&D grants on financing also varies depending on the characteristics of the firms. When comparing firms based on factors such as size and age, we find that R&D grant receipt has a positive impact on equity financing but a negative impact on debt financing for small and young firms. Conversely, for large and established firms, the grant has the opposite effect on both types of financing.

Table 9. Estimation using PSM- effects of R&D grant receipt on equity financing receipt (young/old firms)

	(1)		(2)		(3)		(4)	
Specification	Young & Small		Old & Small		Young & Large		Old &Large	
	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01	Kernel, bandwidth 0.01	Caliper, bandwidth 0.01
Mean of control	0.0192	0.0214	0.0877	0.0923	0.1801	0.1825	0.1278	0.1641
Equity Financing Receipt Treatment effect	0.0162** (0.007623)	0.0176** (0.00725)	0.0121 (0.00837)	0.0141 (0.00927)	–0.0217 (0.0853)	–0.0199 (0.0702)	–0.0412* (0.0180)	–0.0475* (0.0260)

Note: Standard errors in parentheses, Standard errors are bootstrapped with 100 replications. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4. Conclusions and policy implication

Government support for research and development (R&D) activities plays a pivotal role in society by providing essential funding for innovative endeavors. Moreover, such support can help mitigate issues related to information asymmetry, enabling companies to communicate their value and project potential to financial markets for subsequent funding, thereby sustaining their R&D initiatives through debt and equity financing. This study focuses on examining the aforementioned aspects of government support for R&D, utilizing the Korean R&D grant program as a case study to analyze the impact of R&D grant receipt on subsequent debt and equity financing. To mitigate potential confounding bias, we employ the propensity score matching method.

This research contributes to the existing literature in several notable ways. Unlike prior studies that have concentrated on firms of similar sizes or industries, our utilization of data from the extensive R&D support program in Korea allows for an analysis of the effects of R&D grants across firms of varying sizes and industries. Additionally, the systematically compiled data reduces the likelihood of missing observations. Furthermore, we extend the current literature on the effects of R&D grants on subsequent financing by investigating both debt financing and equity financing as outcomes. Lastly, we demonstrate that the impact of the policy varies based on firm characteristics, such as size and age.

Our study presents several intriguing findings with significant policy implications. Firstly, R&D grants lead to a reduction in subsequent debt financing but an increase in equity financing for the overall sample, although the effects may differ depending on firm characteristics. For small and young firms, the grant has a negative effect on debt financing, whereas for large and old firms, it has a positive effect. These observations align with the resource effect and certification effect posited in the existing literature, and they highlight the influence of firm size and age on the effects. However, R&D grants are shown to increase equity financing, indicating a strong certification effect for small and young firms and a negative effect for large and old firms. In summary, R&D grants impact debt financing and equity financing differently, reflecting the disparities suggested by the pecking order theory as well as the differences in firm size and age.

Our findings hold crucial policy implications. Firstly, policy evaluations should consider the specific type of financing involved. Although debt financing and equity financing are similar as external financing methods, a differentiated approach may be necessary when considering them as policy outcomes. Moreover, policies must be tailored to accommodate firm characteristics, as the effects of government policies may vary based on size and age. Particularly, when designing policies, the ability of R&D grants to provide liquidity while simultaneously addressing asymmetry issues for small and medium-sized enterprises (SMEs) should be taken into account. Lastly, establishing sustainable linkages with the private market and conducting business through it should be prioritized, as evidenced by the empirical contribution of this study. Future research could explore the potential differences that may arise when considering the type of financial institution, geographical area, or other firm characteristics, such as CEO background, in estimating the effects of R&D grant receipt.

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APPENDIX

Table 10. Test of balancing of covariates–Kernel Matched Sample

Variable	Unmatched	All				Small				Large			
		Mean		t-test		Mean		t-test		Mean		t-test	
	Matched	Treated	Control	t	*p* > t	Treated	Control	t	*p* > t	Treated	Control	t	*p* > t
lnemp	U	5.5417	4.5822	16.85	0	4.7024	4.5077	5.96	0	7.022	5.967	5.54	0
	M	5.0085	4.965	1.42	0.155	4.6904	4.6916	–0.04	0.968	6.0696	6.1051	–1.32	0.188
lnsales	U	11.324	10.127	15.52	0	10.285	10.069	4.64	0	13.158	11.203	6.38	0
	M	10.604	10.525	2	0.046	10.25	10.246	0.11	0.91	11.711	11.583	2.08	0.038
lndebt	U	4.4711	4.562	–1.99	0.047	4.47	4.5584	–1.67	0.095	4.4727	4.6298	–1.06	0.288
	M	4.4583	4.4718	–0.34	0.733	4.4821	4.466	0.34	0.735	4.4579	4.6716	–3.06	0.002
lninvest	U	1.1274	0.8913	3.87	0	1.3611	0.89842	7.07	0	0.7112	0.75908	–0.21	0.835
	M	1.1883	1.2682	–1.63	0.103	1.3429	1.3127	0.56	0.576	0.78342	0.98267	–1.91	0.057
lnlig	U	8.509	7.3638	13.24	0	7.5238	7.3067	3.3	0.001	10.248	8.4245	5.2	0
	M	7.8032	7.7375	1.24	0.217	7.4783	7.4976	–0.34	0.734	8.7873	8.7356	0.52	0.606
lnorofit	U	8.0954	6.8368	14.47	0	7.1006	6.78	4.8	0	9.8495	7.8922	5.65	0
	M	7.3971	7.3253	1.33	0.183	7.06	7.0465	0.24	0.814	8.4766	8.2272	2.56	0.011
lnpreasset	U	10.332	9.0249	15.95	0	9.2684	8.956	5.53	0	12.208	10.306	6.2	0
	M	9.603	9.5153	1.88	0.061	9.2209	9.2182	0.06	0.954	10.784	10.623	2.51	0.013
age	U	27.332	23.578	6.2	0	23.676	23.198	0.89	0.374	33.785	30.647	1.08	0.278
	M	25.017	24.816	0.48	0.634	23.316	23.529	–0.49	0.624	30.48	29.04	1.4	0.163
lnemp	U	5.4996	4.3033	6.66	0	5.5553	4.6045	15.42	0	4.5497	4.2791	2.46	0.015
	M	4.8236	4.7116	0.84	0.404	5.0252	5.005	0.62	0.532	4.541	4.5151	0.25	0.806
lnsales	U	11.481	9.7887	5.69	0	11.313	10.152	14.35	0	10.198	9.7957	2.52	0.013
	M	10.258	10.254	0.03	0.976	10.615	10.59	0.58	0.564	10.182	10.173	0.07	0.946
lndebt	U	4.5252	4.8391	–2.25	0.026	4.4612	4.5157	–1.1	0.27	4.7552	4.8354	–0.53	0.595
	M	4.7192	5.1446	–2.99	0.003	4.4307	4.439	–0.2	0.842	4.7633	5.0552	–2.26	0.025
lninvest	U	1.257	0.8171	2.25	0.025	1.1079	0.88512	3.39	0.001	1.4111	0.80851	2.87	0.005
	M	1.4079	1.2971	0.55	0.582	1.1796	1.2317	–1.01	0.314	1.3772	1.2275	0.82	0.413
lnlig	U	8.4937	6.8284	4.68	0	8.5186	7.4178	12.3	0	7.13	6.8192	1.25	0.215
	M	7.1252	7.3635	–0.95	0.345	7.85	7.8323	0.32	0.751	7.0915	7.2849	–0.85	0.394
lnorofit	U	8.1872	6.3084	5.67	0	8.0983	6.8829	13.31	0	6.8751	6.3025	2.66	0.009
	M	6.7125	6.8208	–0.47	0.636	7.4369	7.421	0.28	0.781	6.8378	6.8229	0.08	0.938
lnpreasset	U	10.222	8.211	6.02	0	10.368	9.1347	14.62	0	8.6135	8.1911	2.25	0.026
	M	8.9259	8.6122	1.77	0.078	9.6808	9.6717	0.19	0.853	8.5854	8.557	0.18	0.859
age	U	11.533	11.443	0.3	0.761	29.543	25.277	6.75	0	12.146	11.5	1.9	0.059
	M	11.663	12.242	–1.79	0.075	26.723	26.498	0.51	0.609	12.108	12.195	–0.31	0.761
lnemp	U	4.7024	4.5077	5.96	0	6.7514	5.9798	2.7	0.007	7.0662	5.9733	5.48	0
	M	4.6904	4.6916	–0.04	0.968	5.9692	6.0054	–0.62	0.537	6.0388	6.0732	–1.25	0.212
lnsales	U	10.285	10.069	4.64	0	12.785	11.033	2.82	0.005	13.15	11.258	6.42	0
	M	10.25	10.246	0.11	0.91	11.198	11.058	0.76	0.449	11.677	11.567	1.83	0.068
lndebt	U	4.47	4.5584	–1.67	0.095	4.438	4.8442	–1.37	0.172	4.5104	4.6167	–0.72	0.473
	M	4.4821	4.466	0.34	0.735	4.6287	4.653	–0.17	0.866	4.4641	4.5919	–1.61	0.108

End of Table 10

Variable	Unmatched	All				Small				Large			
		Mean		t–test		Mean		t–test		Mean		t–test	
	Matched	Treated	Control	t	*p* > t	Treated	Control	t	*p* > t	Treated	Control	t	*p* > t
lninvest	U	1.3611	0.89842	7.07	0	1.0203	0.53275	1.17	0.244	0.66547	0.74171	–0.33	0.741
	M	1.3429	1.3127	0.56	0.576	1.1654	1.334	–0.79	0.43	0.86798	0.99389	–1.15	0.252
lnlig	U	7.5238	7.3067	3.3	0.001	9.99	8.3048	2.35	0.02	10.233	8.4562	5.29	0
	M	7.4783	7.4976	–0.34	0.734	8.494	8.3373	0.68	0.5	8.8471	8.7683	0.81	0.419
lnorofit	U	7.1006	6.78	4.8	0	9.5796	7.9016	2.56	0.011	9.8367	7.9294	5.69	0
	M	7.06	7.0465	0.24	0.814	8.1927	8.164	0.13	0.898	8.4376	8.2892	1.53	0.126
lnpreasset	U	9.2684	8.956	5.53	0	11.856	10.11	2.93	0.004	12.187	10.334	6.23	0
	M	9.2209	9.2182	0.06	0.954	10.392	10.351	0.26	0.798	10.763	10.614	2.24	0.026
age	U	23.676	23.198	0.89	0.374	15.94	19.1	–2.23	0.027	37.536	31.333	2.34	0.019
	M	23.316	23.529	–0.49	0.624	18.538	17.841	0.82	0.412	32.53	30.629	1.79	0.074

Table 11. Test of balancing of covariates–Calipermatching with (*n* = 5)

Variable	Unmatched	All				Small				Large			
		Mean		t–test		Mean		t–test		Mean		t–test	
	Matched	Treated	Control	t	*p* > t	Treated	Control	t	*p* > t	Treated	Control	t	*p* > t
lnemp	U	5.5417	4.5822	16.85	0	4.7024	4.5077	5.96	0	7.022	5.967	5.54	0
	M	5.0109	4.9817	0.95	0.34	4.6915	4.7017	–0.37	0.713	6.0804	6.1243	–1.36	0.175
lnsales	U	11.324	10.127	15.52	0	10.285	10.069	4.64	0	13.158	11.203	6.38	0
	M	10.606	10.59	0.41	0.683	10.251	10.259	–0.2	0.839	11.794	11.647	2.23	0.027
lndebt	U	4.4711	4.562	–1.99	0.047	4.47	4.5584	–1.67	0.095	4.4727	4.6298	–1.06	0.288
	M	4.4604	4.4636	–0.08	0.933	4.4855	4.4547	0.65	0.516	4.4286	4.6952	–3.47	0.001
lninvest	U	1.1274	0.8913	3.87	0	1.3611	0.89842	7.07	0	0.7112	0.75908	–0.21	0.835
	M	1.1976	1.2504	–1.09	0.275	1.3526	1.3506	0.04	0.969	0.65514	1.0649	–3.35	0.001
lnlig	U	8.509	7.3638	13.24	0	7.5238	7.3067	3.3	0.001	10.248	8.4245	5.2	0
	M	7.8037	7.8092	–0.1	0.919	7.4818	7.4937	–0.21	0.833	8.8705	8.7615	1.03	0.305
lnorofit	U	8.0954	6.8368	14.47	0	7.1006	6.78	4.8	0	9.8495	7.8922	5.65	0
	M	7.4007	7.4238	–0.43	0.67	7.0659	7.0624	0.06	0.951	8.5503	8.2273	3.01	0.003
lnpreasset	U	10.332	9.0249	15.95	0	9.2684	8.956	5.53	0	12.208	10.306	6.2	0
	M	9.6094	9.6014	0.17	0.868	9.2232	9.2178	0.11	0.911	10.843	10.71	1.9	0.058
age	U	27.332	23.578	6.2	0	23.676	23.198	0.89	0.374	33.785	30.647	1.08	0.278
	M	25.02	24.687	0.77	0.439	23.311	23.06	0.58	0.561	31.876	29.068	2.37	0.018
lnemp	U	5.4996	4.3033	6.66	0	5.5553	4.6045	15.42	0	4.5497	4.2791	2.46	0.015
	M	4.8236	4.7362	0.66	0.513	5.0252	5.0026	0.7	0.481	4.4071	4.4347	–0.24	0.808
lnsales	U	11.481	9.7887	5.69	0	11.313	10.152	14.35	0	10.198	9.7957	2.52	0.013
	M	10.258	10.279	–0.15	0.882	10.615	10.587	0.66	0.508	10.026	10.109	–0.53	0.595
lndebt	U	4.5252	4.8391	–2.25	0.026	4.4612	4.5157	–1.1	0.27	4.7552	4.8354	–0.53	0.595
	M	4.7192	5.1291	–2.86	0.005	4.4307	4.4595	–0.7	0.485	4.9263	5.0193	–0.63	0.531

End of Table 11

Variable	Unmatched	All				Small				Large			
		Mean		t–test		Mean		t–test		Mean		t–test	
	Matched	Treated	Control	t	*p* > t	Treated	Control	t	*p* > t	Treated	Control	t	*p* > t
Ininvest	U	1.257	0.8171	2.25	0.025	1.1079	0.88512	3.39	0.001	1.4111	0.80851	2.87	0.005
	M	1.4079	1.2368	0.86	0.39	1.1796	1.2355	–1.08	0.282	1.2041	1.0505	0.82	0.411
Inlig	U	8.4937	6.8284	4.68	0	8.5186	7.4178	12.3	0	7.13	6.8192	1.25	0.215
	M	7.1252	7.3951	–1.07	0.285	7.85	7.8158	0.61	0.541	6.7928	7.223	–1.58	0.116
Inorofit	U	8.1872	6.3084	5.67	0	8.0983	6.8829	13.31	0	6.8751	6.3025	2.66	0.009
	M	6.7125	6.8651	–0.67	0.507	7.4369	7.4168	0.35	0.728	6.6045	6.671	–0.31	0.754
Inpreasset	U	10.222	8.211	6.02	0	10.368	9.1347	14.62	0	8.6135	8.1911	2.25	0.026
	M	8.9259	8.649	1.56	0.12	9.6808	9.6657	0.31	0.76	8.3401	8.3589	–0.09	0.927
age	U	11.533	11.443	0.3	0.761	29.543	25.277	6.75	0	12.146	11.5	1.9	0.059
	M	11.663	12.192	–1.64	0.104	26.723	26.414	0.71	0.481	11.633	11.826	–0.51	0.612
Inemp	U	4.7024	4.5077	5.96	0	6.7514	5.9798	2.7	0.007	7.0662	5.9733	5.48	0
	M	4.6915	4.7017	–0.37	0.713	5.9385	5.9641	–0.38	0.702	6.0391	6.0971	–1.75	0.081
Insales	U	10.285	10.069	4.64	0	12.785	11.033	2.82	0.005	13.15	11.258	6.42	0
	M	10.251	10.259	–0.2	0.839	11.299	11.174	0.49	0.625	11.65	11.551	1.49	0.137
Indebt	U	4.47	4.5584	–1.67	0.095	4.438	4.8442	–1.37	0.172	4.5104	4.6167	–0.72	0.473
	M	4.4855	4.4547	0.65	0.516	4.4056	4.5045	–0.49	0.627	4.5095	4.6154	–1.23	0.218
Ininvest	U	1.3611	0.89842	7.07	0	1.0203	0.53275	1.17	0.244	0.66547	0.74171	–0.33	0.741
	M	1.3526	1.3506	0.04	0.969	1.0141	1.3346	–1	0.321	0.76921	0.99311	–1.79	0.075
Inlig	U	7.5238	7.3067	3.3	0.001	9.99	8.3048	2.35	0.02	10.233	8.4562	5.29	0
	M	7.4818	7.4937	–0.21	0.833	8.7859	8.3692	1.52	0.134	8.8496	8.7243	1.14	0.257
Inorofit	U	7.1006	6.78	4.8	0	9.5796	7.9016	2.56	0.011	9.8367	7.9294	5.69	0
	M	7.0659	7.0624	0.06	0.951	8.3446	8.3269	0.06	0.955	8.3772	8.2924	0.83	0.405
Inpreasset	U	9.2684	8.956	5.53	0	11.856	10.11	2.93	0.004	12.187	10.334	6.23	0
	M	9.2232	9.2178	0.11	0.911	10.535	10.32	1.09	0.281	10.668	10.631	0.53	0.594
age	U	23.676	23.198	0.89	0.374	15.94	19.1	–2.23	0.027	37.536	31.333	2.34	0.019
	M	23.311	23.06	0.58	0.561	17.793	17.629	0.15	0.881	32.534	30.2	1.92	0.055