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# Leverage, performance and capital adequacy ratio in Taiwan's banking industry

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ABSTRACT

We examine the relation between firms' financial structures and their risky investment strategies in Taiwan's banking industry. Regressions cover two subperiods: before the first financial reform (1996–2000) and after the first financial reform (2001–2006), to address the impacts of the first financial reform on banking firms' financial structures. Our first result demonstrates that the restrictions on CAR have indeed affected firms' risky investment strategies, as market share and leverage are positively related. Second, the firm performance is significantly and positively related to firm size, leverage and financial cost. Finally, the regression results show that financial structures for banking firms are positively related to the states of business cycle (i.e., cyclical). The positive signs coincide with Proposition 4 in our analytical model.



## 1. Introduction

The existing literature such as Brander and Lewis (1986) has examined the impact of oligopolistic firms' financial structures on their competition in the product market. It is concluded that a firm can use "debt" to commit to an aggressive output level and induce a favorable output reduction from its rival. However, as pointed by Doherty (1989), this line of research addressed the financial structure issue under the assumption that the firms' financing decisions are predetermined and separable from its operating decisions. "This convenient separating of financing and operating decisions is inappropriate for financial intermediaries". For example, debts in banks usually consist of deposits with various maturities; new depositors can join in or early withdrawal can occur when depositors remove their money for better returns elsewhere (see Diamond and Dybvig, 1983). Sealey (1983) also pointed out that similar issues arise for insurance firms. The sale of insurance policies generates the operating revenues of the insurance firms. Although these debt like instruments are sold in the insurance product market (rather than in the capital market), these afford the firm as a source of capital. The insurance "debt" issued by the insurers is used to construct a portfolio consisting of mostly of financial assets. These suggest that unlike other industries, debt levels in the banking industry will actually change with firms' current revenues and hence cannot be predetermined before competition.

Our paper will incorporate these observations in an imperfectly competition framework similar to Brander and Lewis (1986); two firms simultaneously choose their equity levels (rather than debts) in the first stage, and then decide how to allocate their capital between cash flow reserve and risky investment which is subject to the rival's competition. We assume instead that debt level is an increasing function of current revenue and will be determined endogenously with the operating decision. We will consider the possibility that too many early withdrawal might cause the firms go bankruptcy, and the impacts from the capital adequacy ratio (henceforth, CAR) requirement by Basel I and Basel II Accords (1988, 2004). We ask the same questions as in the existing literature but focus on the banking industry: How will banking firms' financial structures affect their risky investment decisions? How will firms' financial decisions change with the business status? What is the impact from the CAR requirement?

Assuming debt to vary with firms' current revenues and taking equity as the control variable for financial structure give us a different aspect to examine the impact of firms' financial decisions. In Brander and Lewis (1986), increasing debt has two impacts on firm value: to decrease the critical value of shock (representing the uncertain demand) and to increase the debt repayment. Since debt is predetermined before competition, the repayment will not affect firms' output levels. The only impact on

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the critical value of shock is to lift up the expected demand, increase marginal revenue, and increase output and profit. Hence, debt financing can commit a firm to an aggressive output stance. In our model, the equity level will be set prior to the risky competition. Equity issuing has three impacts on firm value. First, higher equity level can increase a firm's cash flow reserve, which also decreases the critical value of shock. The former increases the firm value directly and the latter will lift up the expected demand and marginal revenue, and also increase risky investments and returns. Second, higher equity level means more dividends to give away to equityholders, and this will decrease the marginal revenue, their investments and returns. The third impact is on the debt repayment, indirectly through its impacts on the return and the debt level.

For the combination of the three effects, Proposition 3 concludes that equity issuing will decrease firms' equilibrium risky investments, showing the domination of the latter two impacts. Proposition 4 also demonstrates that the equilibrium equity level is higher in a better business status. Finally, Basel I and Basel II Accords (1988, 2004) suggested that banking firms should follow a minimum risk-based capital requirement that the CAR be at least greater than 8%. Proposition 5 shows that if the CAR requirement is binding, then the result from Proposition 3 will be overturned and the equilibrium risky investment will be positively related to equity level. This gives us an alternative interpretation for the empirical tests on banking industry: if the risky investment or return is negatively related to equity level, then the CAR requirement is not effectively binding; otherwise, the CAR requirement is binding and firms' risk managements are affected.

We then test our theoretical results using panel data from Taiwan's banking industry. Our research is the first attempt to cover Taiwan's four core financial businesses:[1] banks, securities firms, property insurance firms and life insurance firms. We present the regression results for before the first financial reform (1996–2000) and after the first financial reform (2001–2006), to examine the impacts of the first financial reform on banking firms' financial structure. Our results first justify our theoretical assumption that debts are increasing function of firms' returns. Next, as described by Proposition 5, the restrictions on CAR have indeed affected firms' management strategies, as market share and leverage are positively related. The firm values are significantly and positively related to firm size, leverage and financial cost. Finally, the regression results show that financial structures for banking firms are positively related to the states of business cycle (i.e., cyclical). The positive signs coincide with Proposition 4 in our analytical model.

Section 2 describes a two stage game where two firms simultaneously choose their equity levels first, and then allocate their capital between cash flow reserves and risky investments, which are subject to the rival's competition. Section 3 provides the empirical tests of our theoretical results using data from Taiwan's banking industry. Section 4 concludes the paper.

## 2. The analytical model

We consider a two stage game between firm 1 and 2. In the first stage, the two firms simultaneously choose the levels of equity $e_i$ (with a face value $v_i$), which together with an initial debt level $D_i^0$ determined by, say, firm $i$'s last period revenue, compose firm $i$'s initial capital stock $(e_i v_i + D_i^0)$ in the first stage.[2] Each firm acts like a portfolio manager who allocates the received capital between cash flow reserve and risky investment, which is subject to the rival's competition. That is, in the second stage the two firms simultaneously choose their levels of risky investment which is characterized by a differentiated market with uncertain demand. This investment is assumed irreversible and the return will be realized at the end of stage 2.

Denote $r_i$ as firm $i$'s risky investment, and the remaining capital $e_i v_i + D_i^0 - r_i$ is hence the initial cash flow reserve. The risky investment is characterized by a differentiated market with uncertain demand. Denote $\pi_i(r_i, r_2, \varepsilon_i)$ as the return for this risky investment, which is the difference between revenue and variable cost: $\pi_i(r_1, r_2, \varepsilon_i) = P_i(r_1, r_2, \varepsilon_i)r_i - c_i(r_i)$. The random variable $\varepsilon_i$ represents firm $i$'s state of demand, which is identically and independently distributed on the interval $[\underline{\varepsilon}, \bar{\varepsilon}]$ according to a distribution function $G(\varepsilon_i)$ with density $g(\varepsilon_i)$.

We will make the conventional assumptions on demand and cost functions: $\partial P_i/\partial r_i < 0$, $\partial P_i/\partial r_j < 0$, $\partial^2 P_i/\partial r_i r_j < 0$, $\partial c_i/\partial r_i > 0$ and $\partial^2 c_i/\partial r_i^2 \geq 0$. This assumption describes that firm $i$'s inverse demand function is decreasing in both $r_i$ and $r_j$, and the cost is increasing and convex in its investment. In addition, we assume that higher values of $\varepsilon_i$ will lead to higher demand and the marginal demand is higher in better states of the world, that is, $\partial P_i/\partial \varepsilon_i > 0$ and $\partial^2 P_i/\partial r_i \varepsilon_i > 0$. As an illustrative example for this differentiated competition, consider the following linear demand and quadratic cost functions: $P_i(r_1, r_2, \varepsilon_i)r_i = \alpha - \beta r_i - \gamma r_i + \varepsilon_i$ and $c_i(r_i) = r_i^2/2$. Under these assumptions, the return on risky investment has the conventional properties: $\partial^2 \pi_i/\partial r_i^2 < 0$, $\partial^2 \pi_i/\partial r_i \partial e_i = 0$ and $\partial^2 \pi_i/\partial r_i \partial r_j < 0$.

Two specific issues will be discussed: the impact of the CAR requirement and the possibility of early deposit withdrawal. First, Basel I and Basel II Accords[3] (1988, 2004) suggested that firms should follow a minimum risk-based capital requirement that the CAR, a ratio of capital over risky credit exposures, be at least greater than 8%:

$$\frac{e_i v_i}{\pi_i(r_1, r_2, \varepsilon_i)} \geq 0.08, \quad \text{that is,} \quad \pi_i(r_1, r_2, \varepsilon_i) \leq 12.5(e_i v_i) \tag{1}$$

Given $e_i$ and that $\pi_i(r_1, r_2, \varepsilon_i)$ is concave, if the requirement is binding, there will be a lower and upper bounds on $r_i$. Since only the upper bound can affect the determination of equilibrium, we will focus on this case and denote this upper bound by $\bar{r}_i(r_j, e_i)$.

**Proposition 1.** *The upper bound from the CAR requirement $\bar{r}_i(r_j, e_i)$ is increasing in $e_i$ and decreasing in $r_j$.*[4]

According to Diamond and Dybvig (1983), the withdrawal decision will depend on the firm's current revenue, demand uncertainty and other depositors' withdrawal decisions. Under the first-come-first-serve rule, early withdrawers can fully retrieve their money until the firm's cash flow reserve is used up, then the firm declares bankruptcy and the debtholders get the remaining value. To simplify, we will eschew the detailed discussion on depositors' withdrawal decisions, and assume directly that the remaining debt is $D_i(\pi_i(r_1, r_2, \varepsilon_i))$. Since the amount of withdrawal will depend on firm's current revenue, the remaining debt is therefore a function of current revenue. For simplification, we assume that $D_i' > 0$ and $D_i'' < 0$, meaning that higher return can attract more deposits but in a decreasing rate.

Recall that firm $i$'s initial cash flow reserve is $e_i v_i + D_i^0 - r_i$. Notice that the amount of early withdrawal $[D_i^0 - D_i(\pi_i(r_1, r_2, \varepsilon_i))]$ can also be negative and be interpreted as deposit increase. The current cash flow reserve becomes $e_i v_i + D_i^0 - r_i - [D_i^0 - D_i(\pi_i(r_1, r_2, \varepsilon_i))]$ or in short, $e_i v_i + D_i(\pi_i(r_1, r_2, \varepsilon_i)) - r_i$. There is a

[1] See the Act of Financial Holdings Companies, Article 4, Term 1–3.

[2] It is assumed that there is no other internal capital.

[3] See http://en.wikipedia.org/wiki/Capital_adequacy_ratio#cite_note-investopedia-0.

[4] The detailed characterization for the analytical results is referred to Ho and Hsu (2010).

level of debt associated with each value of $\pi_i(r_1, r_2, \varepsilon_i)$, until $\varepsilon_i$ drops down to $\varepsilon^1(e_i, r_1, r_2)$, when the amount of early debt withdrawal exceeds the cash flow reserve. $\varepsilon^1(e_i, r_1, r_2)$ is the critical value of random shock for the breakeven condition, given by

$$e_i v_i + D_i(\pi_i(r_1, r_2, \varepsilon_i)) - r_i = 0 \tag{2}$$

The firm will announce bankruptcy when $\varepsilon_i < \varepsilon^1(e_i, r_1, r_2)$ and we will assume that $\underline{\varepsilon} < \varepsilon^1(e_i, r_1, r_2) < \bar{\varepsilon}$.

**Proposition 2.** *$\varepsilon^1(e_i, r_1, r_2)$ is decreasing in $e_i$, and decreasing and convex in $r_i$.*

The bankruptcy probability $G(\varepsilon^1(e_i, r_1, r_2))$ will be decreasing in $e_i$, and decreasing and convex in $r_i$. However, we need to compare $\varepsilon^1(e_i, r_1, r_2)$ with the critical value defined in Brander and Lewis' (1986) Eq. (2), which describes the breakeven condition for firm value. In our portfolio choice framework, the firm value consists of the return from risky investment and cash flow reserve. In addition, there are two kinds of capital costs: the dividends paid to equityholders and the repayment to debtholders. For simplification, these capital prices are assumed to be competitive and exogenously given. That is, let $\theta_i$ be the share of return given to equityholders as dividends and $\phi_i$ be the interest rate paid to debtholders.[5] In good states (to be defined shortly), the total amount of repayment paid to debtholders is $(1 + \phi_i)D_i(\pi_i)$, and equityholders get dividends from what is left after debtholders' claims, i.e., $e_i\theta_i[\pi_i(r_1, r_2, \varepsilon_i) - (1 + \phi_i)D_i(\pi_i)]$. Overall, firm $i$'s value is:

$$\{[\pi_i(r_1, r_2, \varepsilon_i) + e_i v_i + D_i(\pi_i(r_1, r_2, \varepsilon_i)) - r_i] - e_i\theta_i[\pi_i(r_1, r_2, \varepsilon_i) - (1 + \phi_i)D_i(\pi_i(r_1, r_2, \varepsilon_i))] - [(1 + \phi_i)D_i(\pi_i(r_1, r_2, \varepsilon_i))]\}.$$

The first square bracket denotes the sum of the return on risky investment and cash flow reserve. The second square bracket contains the total dividends, and the third bracket contains the repayment to debtholders.

Let $\varepsilon^2(e_i, r_1, r_2)$ denote the critical value of shock for Eq. (3) to be zero. The difference between Eqs. (2) and (3), i.e., $\pi_i(r_1, r_2, \varepsilon_i) - e_i\theta_i[\pi_i(r_1, r_2, \varepsilon_i) - (1 + \phi_i)D_i(\pi_i(r_1, r_2, \varepsilon_i))] - (1 + \phi_i)D_i(\pi_i(r_1, r_2, \varepsilon_i))$, can be either positively or negatively related to $\varepsilon_i$, depending on the relative sizes of $e_i\ \theta_i\ \pi_i'$ and $D_i'$. Hence we will define $\underline{\varepsilon}(e_i, r_1, r_2) \equiv \max\{\varepsilon^1(e_i, r_1, r_2),\ \varepsilon^1(e_i, r_1, r_2)\}$. It can be checked that $\underline{\varepsilon}(e_i, r_1, r_2)$ is decreasing in $e_i$, and decreasing and convex in $r_i$.

Overall, in good states when $\varepsilon_i \geq \underline{\varepsilon}(e_i, r_1, r_2)$, the firm value is as given by Eq. (3); in bad states when $\varepsilon_i < \underline{\varepsilon}(e_i, r_1, r_2)$, the firm will declare bankruptcy, so the firm value will be zero. The expected firm value is hence

$$W_i = \int_{\underline{\varepsilon}(e_i, r_1, r_2)}^{\bar{\varepsilon}} \{[\pi_i(r_1, r_2, \varepsilon_i) + e_i v_i + D_i(\pi_i(r_1, r_2, \varepsilon_i)) - r_i] - e_i\theta_i[\pi_i(r_1, r_2, \varepsilon_i) - (1 + \phi_i)D_i(\pi_i(r_1, r_2, \varepsilon_i))] - [(1 + \phi_i)D_i(\pi_i(r_1, r_2, \varepsilon_i))]\} dG(\varepsilon_i)$$

Alternatively, the value function can be rewritten as:

$$W_i = \int_{\underline{\varepsilon}(e_i, r_1, r_2)}^{\bar{\varepsilon}} \{(1\text{-}e_i\theta_i)[\pi_i(r_1, r_2, \varepsilon_i) - (1 + \phi_i)D_i(\pi_i(r_1, r_2, \varepsilon_i))] + e_i v_i + D_i(\pi_i(r_1, r_2, \varepsilon_i)) - r_i\} dG(\varepsilon_i). \tag{4}$$

We have treated firms like portfolio managers, so the firm value contains both the return from risky investment and the cash flow reserve. The integration in the expected value is taken from $\underline{\varepsilon}(e_i, r_1, r_2)$ till $\bar{\varepsilon}$. Brander and Lewis (1986) called this part of value as the equity value. They have distinguished between equityholders and debtholders; due to limited liability, equityholders are residual claimants in good states and debtholders become residual claimants in bad states. Brander and Lewis compared the maximizing results for both equity value (integrated from $\underline{\varepsilon}(e_i, r_1, r_2)$ to $\bar{\varepsilon}$) and debt value (integrated from $\underline{\varepsilon}$ to $\underline{\varepsilon}(e_i, r_1, r_2)$). They concluded that the output level in debt value is obviously below that in equity value. Differently, Showalter (1995) and Wanzenried (2003) assumed that firms act on behalf of equityholders in the second stage, so the output level is chosen to maximize the equity value. However, in the first stage, firms choose the debt level to maximize the full value, where the integration is taken from $\underline{\varepsilon}$ to $\bar{\varepsilon}$. Showalter (1995) explained that this is so because debtholders can anticipate the output decisions by firms, and change accordingly the cost of funds. So firms should internalize the competing interests between debtholders and equityholders, and choose debt to maximize the full value of the firm. Instead, Wanzenried (2003) explained that, since the potential debtholders are foresighted, the firms need to present the overall value including the possibility of bankruptcy when selling bonds to raise funds.

By backward induction, we first derive the equilibrium risky investments, and then determine the first stage equity levels using the second stage results.

### 2.1. Analytical results

Given the financial decision $e_i$, firm $i$'s maximization conditions are given by $\partial W_i/\partial r_i = 0$ and $\partial^2 W_i/\partial r_i^2 < 0$, the latter of which is satisfied under our assumptions. Let $r_i(r_j, e_i)$ be firm $i$'s best response function and Proposition 3 describes the properties of $r_i(r_j, e_i)$.

**Proposition 3.** *$r_i(r_j, e_i)$ is negatively related to $r_j$ and $e_i$.*

That is, we have the conventional downward slopping reaction function, and $e_i$ increases, $r_i(r_j, e_i)$ shifts toward the left. The equilibrium risky investment $(r_1^*, r_2^*)$ is given by $r_i^* \in r_j(r_i^*, e_j)$ for $i, j = 1, 2$. Notice that Proposition 3 also describes that the equilibrium risky investment is negatively related to $e_i$. Recall that in Brander and Lewis (1986), firms choose debt levels prior to product competition. Since the debt level is predetermined and constant, the only impact of debt is to lift up the expected demand, and increase output and profit. Hence, firm's outputs or profits will increase with financial leverage, which is measured by a debt to equity or value ratio. In our model, firms choose the level of $e_i$ prior to competition in risky investment. $e_i$ has three impacts on firm value: to increase the cash flow reserve which also decreases critical value of shock, to increase the dividends to equityholders, and to increase debt level indirectly through its impact on the return. Our result shows the domination of the latter two negative effects. However, since the debt to equity ratio is negatively related to $e_i$, our result coincides with Brander and Lewis (1986) that firms' outputs or profits in risky investment are positively related to financial leverage.

Despite that increasing $e_i$ is dominated for the risky investment market, there are still positive impacts on the cash flow reserve and indirectly on debt. Given the equilibrium risky investment $(r_1^*, r_2^*)$, the equilibrium equity level is determined by $\partial W_i(e_i, r_1^*, r_2^*)/e_i = 0$.

Next, we show that the equilibrium equity level is higher in a better business status. To examine the effect of different business status, we consider a distribution $\hat{G}$ which stochastically dominates $G$ in the sense that $\hat{G}(\varepsilon_i) < G(\varepsilon_i)$, for $\varepsilon_i \leq \underline{\varepsilon}(e_i, r_1, r_2)$ and we will demonstrate that the equilibrium $e_i$ is greater under $\hat{G}$.

**Proposition 4.** *The equilibrium equity level is higher in a better business status.*

[5] We have not considered the effect of big equity holders, which is believed to cause the managers to choose risky assets.

Finally we examine how the CAR requirement from the Basel I and II Accord affects the relation between risky investment and financial structure. Recall from Eq. (1) that the CAR requirement puts an upper bound on the level of risky investment: $\bar{r}_i(r_j, e_i)$, which is increasing in $e_i$ and decreasing in $r_j$. Together with Proposition 3 that $r_i(r_j,e_i)$ is negatively related to $e_i$, this indicates that the response function is kinked at the level $\bar{r}_i(r_j, e_i)$. Since $\bar{r}_i(r_j, e_i)$ will decrease with $r_j$, the restricted part is not constant. Proposition 5 describes the relation between risky investment and $e_i$, if the CAR requirement is binding.

**Proposition 5.** *If the CAR requirement is binding, then the equilibrium risky investment will be positively related to* $e_i$.

With CAR binding, each firm increases equity issuing and its risky investment. Together with Proposition 3, this result gives us an interesting implication for empirical tests on banking industry: if the firm's risky investment or return is negatively related to equity level, then the CAR requirement is not effectively binding; otherwise, the CAR requirement is binding and the firm's risk management is affected by this constraint.

## 3. Regressions and results

Due to high leverages, the banking industry is often treated as a special case by literature and receives little attention. Nevertheless, its highly correlation with other industries and large contribution to GDP[6] have motivated us to reexamine the feasibility of the existing models in Section 2. In this section we will provide empirical supports by testing the theoretical results using data from Taiwan's banking industry for the period 1996–2006. Our data cover two subperiods: 1996–2000 and 2001–2006, and the cutting point is the year of "*the first financial reform*". After the 1997 South Asia financial crisis, the Executive Yuan of Taiwan approved of "the Act of Financial Reform Fund" in 2001 to improve the healthiness of the banking industry.[7] Sequential activities include: to reach the so called"258 targets", namely, to reduce overdue loans ratio to 5% and to increase capital adequacy ratio to 8% in 2 years. More importantly, the government promoted the establishment of financial holdings companies to encourage mergers and acquisitions among the existing firms, which greatly changed the risky investment strategies in this industry. In order to examine the impacts of the first financial reform on banking firms' financial structure and investment strategies, we test for the subperiods before the first reform (1996–2000) and after the first reform (2001–2006).

### 3.1. Data and variables

Our research is the first attempt to cover four core financial businesses: *banks, securities firms, property insurance firms* and *life insurance firms* in Taiwan. We extract the data of banks and securities companies from the *Taiwan Economic Journal Data Bank* (*TEJ*), and the data of life and property insurance companies from the *Insurance Year Book*, issued by Taiwan Insurance Research Center. There are overall 44 banks, 31 securities companies, 17 property insurance companies and 15 life insurance companies. Notice that we have used panel data which, according to Hsiao (1986), can increase sample numbers, trace the intertemporal variation of individual firms and increase the estimation efficiency.

[6] The banking industries contributed over 10.04% of GDP in Taiwan. Data source: 2008 National Income Statistics by the Census Bureau.

[7] Related laws and regulations include the Financial Holding Company Act, the Financial Institutions Merger Law, the Company Law, the Securities Exchange Law.

The definitions of variables are given as follows. A summary of sample firms and statistics is presented in Appendix (Tables A.1–A.5). The currency used for these variables is one thousand new Taiwan dollars (NTDS).

*Asset*: *Total Asset* is used to measure firm size (see Smith and Watts, 1992; Campello, 2003).

*Cost*1: *Financial expense*. For banks, financial expense refers to interest expenses or bad debts write-off; for securities companies, it refers to total expenditure minus operational expense and non-operating expense; for insurance companies, it refers to the allowance for liability reserve.

*Cost*2: *Operating expenses* include selling expenses, administrative expenses and other expenses such as research and development expense, salaries, rents, taxes, depreciations/amortization, uncollectible accounts and other miscellaneous expenses.

*Debt*: *Total debt* represents firms' total external debt.

*MS*: *Market share* is the ratio of each firm's net operating revenue over the industrial sum of net revenues. Greenhalgh and Rogers (2006) reported that companies with large market shares have more monopoly power and hence may not need to cost down when it faces challengers.

*Rev*: *Net operating revenues* are firms' revenues minus sales returns and allowances.

*RevR*: *State of business* is the growth rate of net operating revenues (*Rev*). Campello (2003) used $-\log \Delta\text{GDP}$ to indicate the state of business, but this industry wise index cannot identify the difference across firms. For our aim, we use *RevR*, each firm's revenue growth rates, to indicate the business state faced by individual firms.

*ROE*: *Return on equity* is the per share pretax net profit. This term measures banking firms' management efficiency.

*Stock*: *Value of common stock*. In Taiwan, the minimum required capital is 10 billions NTDs for commercial banks, 2 billions NTDs for insurance companies, and 60 billions NTDs for financial holdings companies.

### 3.2. Regression models

Proposition 3 in Section 2 describes that if CAR is not binding, output and equity level are negatively related; while Proposition 5 says that when CAR is binding, output and equity level are positively related. Hence, Eq. (5) tests if the risky investment strategies for Taiwan's banking firms are affected by CAR:

$$MS = \beta_0 + \beta_1 \log(Stock) + \varepsilon_0. \tag{5}$$

If $\beta_1$ is negative, then we can conclude as Brander and Lewis (1986) that leverage is negatively related to market share, indicating that the risky investment is not affected by CAR. Otherwise, if $\beta_1$ is positive, then as stated by Proposition 5, the leverage is positively related to market share, indicating that CAR is actually influencing the risky investment strategy.

Second, we use Eq. (6) to examine the relationship between firm's performance, firm size, state of business, financial structure, costs and management efficiency.

$$\log(Rev) = \gamma_0 + \gamma_1 \log(Asset) + \gamma_2 Re + \gamma_3 \log(Stock) + \gamma_4 \log(Cost1) + \gamma_5 \log(Cost2) + \gamma_6 ROE + \varepsilon_0. \tag{6}$$

First of all, bigger firm size indicates higher monopoly power, and hence $\gamma_1$ is expected to be positive. Similarly, when a banking firm is in a better state, there is less chance for bankruptcy and hence the public is more willing to deposit or purchase insurance. These activities either directly increase performance or increase transactions with banks, and hence $\gamma_2$ is expected to be positive.

As described, more deposits or higher insurance premiums not only increase debt levels, but also increase firms' revenues. This explains our assumption about the positive relationship between debt level and revenue. To understand the overall relationship between banking firms' revenue and financial structure, we need to examine the sign of $\gamma_3$. Moreover, since market share is positively related to a firm's revenue, the sign of $\gamma_3$ is also related to $\beta_1$ in Eq. (5); namely, if $\gamma_3$ is positive, then as stated by our Proposition 5, the leverage is positively related to market share (hence revenue), indicating that CAR is actually influencing the risky investment in Taiwan's banking industry.

Next, *Cost*1 measures the financial expense such as interest expenses or debts write-off. Since the interest rates are often publicly announced, the average financial expenses are not too different across firms, and therefore the total financial expense will be positively related to firm's output and revenues, indicating a positive sign for $\gamma_4$. Similarly, *Cost*2 contains total operational expenditures such as salaries and advertisement fees. The average operational costs are not too different across firms, and hence *Cost*2 is positively related to revenues, indicating a positive sign for $\gamma_5$. Finally, ROE is included to measure management efficiency, which is expected to have positive contribution to firm values.

Finally, Eq. (7) examines whether banking firms' financial structures are affected by firm size and the business state.

$$\log(Stock) = \theta_0 + \theta_1 \log(Asset) + \theta_2 Re + \varepsilon_0 \tag{7}$$

Since bigger firm sizes indicate higher monopoly power and cheaper average costs due to economy of scale, firms could preempt the market by extending their capital and hence $\theta_1$ is expected to be positive. We also use each firm's revenue growth rates to indicate the business state faced by individual firm. In bad states, firms will reduce loans and the public will reduce stock transactions or willingness to purchase insurance, which then suggests a positive sign for $\theta_2$.

### 3.3. Results

As described, we have used panel data to increase sample numbers, to trace the intertemporal variation of individual firms, and to increase the estimation efficiency. However, due to the emergence of 14 financial holdings companies since 2001, the sample lengths for firms are not exactly the same and hence the panel data are unbalanced. The software used to run regressions for Eqs. (5)–(7) is *Eviews*.

The literature has provided three approaches[8] to handle panel data: *pooled data regression*, *fixed effect model* and *random effect model*. Following Greene (2003), we first examine the *F*-values for Eqs. (5)–(7), which significantly reject the null hypotheses that the firm specific dummy variables are identical across firms. Next, the Hausman tests significantly suggest that the data are best fit in the fixed effect model. Since our main concern is on the impact of financial structure, we will eschew the detailed econometric discussion to avoid distraction and to save space. We will present "*the fixed effect*" ordinary least squared (OLS) results in Tables 1–3. Notice that Tables A.2–A.5 show that the correlations between Debt and Rev for banks, securities firms, life insurance firms and property insurance firms are 0.8775, 0.8345, 0.9424 and 0.9571, respectively, which hence justifies our assumption that debt is positively related to revenue.

[8] See Waldfogel (1997) and Greene (2003).

**Table 1**
Capital structure and market share (OLS fixed effect).

| | *MS* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1996–2000 | | | | 2001–2006 | | | | | |
| | Banks | Securities | Life insurance | Property insurance | Banks | Securities | Life insurance | Property insurance | | |
| C | −0.039065* (−1.585201) | 0.037331 (0.999297) | 0.080303 (1.294085) | 0.117344*** (2.788879) | −0.165105*** (−3.856054) | −0.183211*** (−3.693341) | −0.016750 (−0.143058) | −0.131364* (−1.516185) | | |
| log (*Stock*) | 0.004000*** (2.658128) | 0.000379 (0.154574) | −0.001063 (−0.260506) | −0.004106 (−1.396752) | 0.011482*** (4.439376) | 0.013990*** (4.449621) | 0.005257 (0.699510) | 0.013194** (2.258427) | | |
| Adj. $R^2$ | 0.978502 | 0.909464 | 0.991336 | 0.962830 | 0.929400 | 0.937765 | 0.982245 | 0.971288 | | |
| *F*-statistic | 200.0014*** | 39.50692*** | 565.4651*** | 128.9918*** | 72.50585*** | 78.28447*** | 329.2392*** | 184.0741*** | | |
| Obs. | 189 | 116 | 75 | 85 | 240 | 160 | 90 | 93 | | |

Numbers in parentheses indicate the *t*-values.
* Significance level 10%.
** Significance level 5%.
*** Significance level 1%.

**Table 2**
Firm value, leverage and other variables (OLS fixed effect).

| | log (*Rev*) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1996–2000 | | | | 2001–2006 | | | |
| | Banks | Securities | Life insurance | Property insurance | Banks | Securities | Life insurance | Property insurance |
| C | 1.224072** (2.199697) | −1.041137 (−1.347804) | 0.775220* (1.595234) | −1.085429 (−1.286633) | 6.398643*** (4.683181) | −1.572893** (−2.221610) | −0.179686 (−0.988163) | 0.820488* (1.570679) |
| log (*Asset*) | 0.096188*** (2.697794) | 0.076392* (1.478833) | 0.170306*** (3.608257) | 0.158758** (2.083030) | 0.030025 (0.975445) | 0.027456 (0.591584) | 0.021590 (1.264930) | 0.038586* (1.514695) |
| *RevR* | 0.076820*** (6.550538) | −0.004569 (−0.618490) | 0.105506*** (3.600036) | −0.010832*** (−2.565268) | 0.289383*** (5.353928) | 0.023445*** (2.859412) | 0.006708 (0.803483) | 0.050286* (1.593330) |
| log (*Stock*) | 0.169341*** (4.813069) | 0.244151*** (4.863010) | −0.030024 (−1.256812) | −0.006761 (−0.213268) | −0.157202* (−1.764470) | 0.143764** (2.144235) | −0.006619 (−0.454385) | 0.020835 (0.741104) |
| log (*Cost*1) | 0.365247*** (29.18049) | 0.215698*** (9.865457) | 0.721327*** (15.89881) | 0.772409*** (19.35464) | 0.394377*** (12.76780) | 0.188115*** (11.93068) | 0.947693*** (48.27325) | 0.768646*** (22.28338) |
| log (*Cost*2) | 0.321662*** (9.617355) | 0.551683*** (14.26035) | 0.096392*** (2.981488) | 0.176668*** (3.526550) | 0.380750*** (5.386598) | 0.768199*** (13.51201) | 0.057975*** (7.060449) | 0.153959*** (6.019474) |
| *ROE* | 0.025274*** (4.914365) | 0.092833*** (13.38813) | 0.007426*** (3.366926) | 0.023977*** (4.132608) | 0.038198*** (5.442209) | 0.217914*** (13.53819) | 0.010029*** (9.855373) | 0.017098*** (5.616848) |
| Adj.$R^2$ | 0.998569 | 0.995240 | 0.999237 | 0.997329 | 0.976385 | 0.991057 | 0.999794 | 0.996227 |
| *F*-statistic | 2215.581*** | 523.7028*** | 3864.714*** | 1138.021*** | 200.9803*** | 487.3662*** | 21622.18*** | 1105.146*** |
| Obs. | 147 | 86 | 60 | 68 | 238 | 159 | 90 | 93 |

Numbers in parentheses indicate the *t*-values.
* Significance level 10%.
** Significance level 5%.
*** Significance level 1%.

**Table 3**
Capital structure, firm size and business state (OLS fixed effect).

| | log (*Stock*) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1996–2000 | | | | | 2001–2006 | | | |
| | Banks | Securities | Life insurance | Property insurance | Banks | Securities | Life insurance | Property insurance |
| C | 3.945341** (2.471725) | 3.485510*** (2.922911) | 9.775536*** (4.448777) | −9.843195*** (−3.079411) | 14.83508*** (27.99260) | 7.606362*** (8.007508) | 11.95521*** (17.46457) | 11.00254*** (7.705996) |
| log (*Asset*) | 0.657646*** (7.865125) | 0.691907*** (9.399773) | 0.322740** (2.528063) | 1.525920*** (7.587557) | 0.089474*** (3.252236) | 0.479068*** (8.264222) | 0.195915*** (5.316006) | 0.237708*** (2.677695) |
| *RevR* | 0.008998 (0.245682) | 7.43E−08*** (4.195364) | −0.005509 (−0.033650) | 0.044483*** (2.699550) | 0.124731*** (2.774586) | 1.61E−08 (0.977079) | 0.037886 (0.642949) | 0.078883 (0.648674) |
| Adj. $R^2$ | 0.953513 | 0.890851 | 0.896584 | 0.935315 | 0.959192 | 0.959420 | 0.967741 | 0.948179 |
| *F*-statistic | 72.30077*** | 31.27768*** | 32.96957*** | 54.82149*** | 124.7937*** | 118.4744*** | 167.8695*** | 94.51932*** |
| Obs. | 147 | 116 | 60 | 68 | 238 | 160 | 90 | 93 |

Numbers in parentheses indicate the *t*-values.
*Significance level 10%.
** Significance level 5%.
*** Significance level 1%.

First, Table 1 presents the fixed effect OLS results for Eq. (5) for four businesses in two subperiods. By examining the sign of $\beta_1$ (*Stock*), we can conclude whether banking firms' risky investment strategies are affected by the regulations of CAR; if CAR regulation is binding, then as described by Proposition 5, market share is positively related to stock ($\beta_1 > 0$); otherwise, as described by Proposition 3 in this paper and by Brander and Lewis (1986), market share is negatively related to stock ($\beta_1 < 0$). The *F*-values are significant for all four businesses in two subperiods. The values of adjusted *R*-squared are all above 0.9.

Before the reform, $\beta_1$ is only significantly positive for banks and it is even slightly negative for property insurance firms but not significantly; after the reform, the magnitude of $\beta_1$ has increased for all four businesses, and it is significantly positive for banks, securities and property insurance firms. The positive sign of $\beta_1$ after the financial reform suggests that banking firms' risk investment strategies are affected by the regulations on CAR. The establishment of financial holdings companies has strengthened the regulation impacts; The Act of Financial Holdings Company requires that the CAR for the holdings companies be at least 100%, within which the CAR must be at least 10% for bank subordinates, 200% for securities subordinates and 300% for insurance subordinates. These rules are much stricter than those for each individual business,[9] and hence cause more distortion to investment after the reform.

Second, Eq. (6) examines the relationship between performance, asset size, business state, financial structure, costs, and management efficiency. Table 2 presents the fixed effect OLS results for the two subperiods. The *F*-values are all significant and the adjusted *R*-squared values are all above 0.97.

Before the reform, $\gamma_1$ (*Asset*) is positive and significant for all four businesses; after the reform, the magnitude of $\gamma_1$ all decreases, and it is only significantly positive for property insurance firms. A positive sign of $\gamma_1$ shows that bigger firm size indicates higher monopoly power, which can also be explained as the economy of scale effect. After the establishment of many financial holding firms in 2001, firms tend to compete in diversification by providing more customized and bundled services. In other words, the economy of scope effect becomes more important, and this could be part of reasons why the scale effects are weaker after the reform. Next, for both before and after the reform, $\gamma_2$ (*RevR*) is positive for banks and life insurance firms, indicating that in better states the public is more willing to deposit or purchase insurance, which either directly increases firm value or increases transactions with banks. For securities and property insurance firms, $\gamma_2$ is negative before the reform and turns significantly positive after the reform. A possible explanation is that, before the reform, firms kept part of revenues as retained capital to meet the CAR requirement, so in better states, more money was retained. After the reform when the requirement was met, we have the expected results like banks and life insurance firms.

Recall that we have assumed debt to be positively related to revenue. The coefficient of $\gamma_3$ (*Stock*) will show the overall impact of leverage on firm value. $\gamma_3$ is significantly positive for banks and securities firms before the reform, and it turns significantly negative after the reform for banks. However, for property insurance firms, the opposite results occur. According to Proposition 3, when CAR is binding, market share (hence firm value) is positively related to stock, and it is negative for otherwise. It is interesting to understand why insurance firms are not affected by the CAR requirement before the reform, while banks are not affected after the reform. For insurance firms, a possible reason could be that, in the subperiod before the reform the capital requirement is only 2 billions NTDs, while after the reform, the CAR requirement increases to 200%, which greatly restricts firms' risky investment levels, and hence it becomes binding after the reform. On the other hand, since a large number of banks are merged into financial holding companies after the reform, the CAR requirement for the whole financial holding companies can be shared by other subsidiaries, and hence it is not binding for banks alone after the reform. Next, as expected, the cost terms $\gamma_4$ (*Cost*1) and $\gamma_5$ (*Cost*2) are significantly positive for all business before and after the reform. Finally, $\gamma_6$ (*ROE*) is positive for all business for both subperiods, supporting the positive contribution of management efficiency.

Eq. (7) examines the relationship between firms' financial structure, firm size and business state. Table 3 presents the fixed effect OLS results for the two subperiods. The *F*-values are significant for all four businesses in two subperiods. The adjusted R-squared values are all above 0.89.

For both subperiods, $\theta_1$ (*Asset*) is significantly positive within 1% confidence level for all four businesses. This supports the idea that firms could preempt the market by extending their capital, to take advantage of the benefit from economy of scale. Next, $\theta_2$ (*business state*) is positive for banks, securities firms and property insurance firms before and after the reform. For life insurance firms, it is negative but not significant before the reform, and it is also positive after the reform. The positive signs coincide with Proposition 4 in our analytical model.

## 4. Concluding remarks

This paper incorporates the observation that in the banking industry, debts are usually affected by current revenues and cannot be predetermined before competition. In a portfolio choice model, we have analyzed how two firms sequentially decide their financial structures through choosing equity level, and then the level of risky investment which is subject to the rival's competition. Taking equity as a control variable gives us a different aspect to examine the impact from firms' financial decisions; in addition to the impact on the critical value of shock from uncertain demand, the firms' financial decisions also affect firms' cash flow reserve, as well as the costs paid to equityholders and debtholders. Our main results show that leverage is positively related to a firm's revenue; however, when the CAR requirement is binding, this result will be overturned. This gives us a convenient approach to check if the firm's risky investment strategy is restricted by the CAR requirement, by testing the relationship between firm's financial structure and risky investment.

Our theoretical results are tested using panel data from Taiwan's banking industry. Our research is the first attempt to cover Taiwan's four core financial businesses: banks, securities firms, life insurance firms and property insurance firms. The first result agrees with Proposition 5 that the restrictions on CAR have indeed affected firms' management strategies, as market share and leverage are positively related. Second, firm values are significantly and positively related to firm size, leverage and financial cost. Finally, the regression results show that financial structures for banking firms are positively related to the states of business cycle (i.e., cyclical). The positive signs coincide with Proposition 4 in our analytical model.

## Appendix A. Appendix

See Tables A.1–A.5.

[9] For individual firms, the CAR must be at least 8% for banks, 150% for securities companies and 200% for insurance companies.

**Table A.1**
Sample companies.

| Bank | Securities | Life insurance | Property insurance |
|---|---|---|---|
| Chang Hwa Com. Bank, First Com. Bank, Hua Nan Com. Bank, China Dev. Ind. Bank, Mega Int. Com. Bank, Chinatrust Com. Bank, Taichung Com. Bank, Yuanta Secur. Finance, Bank of Communication, Cathay United Bank, Agricultural Bank of Taiwan, Taiwan Bus. Bank, | Polaris, President, MasterLink, Capital, KGI, Taiwan Int., Horizon, Concord, | Bank of Taiwan, Taiwan, PCA., China, Nan Shan, Global, Mass Mutual | First, Taiwan Fire Marine, Walsum, Tacomar, Zurich (Taiwan), |
| Grand Bills Com. Bank, Dah An Com. Bank, Taipei Fubon Com. Bank, Cathay Com. Bank, Bank SinoPac, E. Sun Com. Bank, Fubon Com. Bank, Yuanta Com. Bank, Taishin Int. Bank, Shin Kong Com. Bank, Jih Sun Int. Bank, King's Town Bank, Taichung Com. Bank, Bank of Kaohsiung, Cosmos Bank, Union Bank of Taiwan, Far Eastern Int. bank, Taipei Int. Com. Bank, Taiwan Land Dev. Corp., Ta Chong Bank, EnTie Com. Bank, Taiwan Coop. Bank, Industrial Bank of Taiwan, First Capital Com. Bank, Serventh Com. Bank, Int. Bills, China Bills, Mega Bills, E. Sun Bills, Chinatrust Bills, Taishin Bills, Hu Nan Bills. | Tachan, Ta Ching., Ta Chong, Yuanta Core Pacific, SinoPac, Grand Cathay, Fuhwa, Fubon, Hua Nan, Taishin, Jih Sun, First Taiwan, First, Chinatrust, Pali, Mega, Waterland, K-W-S, Shin Kong, E. Sun, Cathay, Ti Don., Concourse. | Mercuries, Shinung, Singfor, Far Glory, Hontai, Cathay, Shin Kong, Allianz Taiwan, Fubon. | Shinkong, Union, AIG (Taiwan), Toyko Mariane, Newa, Kuo Hua, Fubon, Chung Kuo, MSIG Mingtai, Cathay Century, Union, South China. |

**Table A.2**
Variables statistics (banks).

| | *Asset* | *Cost*1 | *Cost*2 | *Debt* | *Rev* | *RevR* | *ROE* | *MS* | *Stock* |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 394,000,000 | 14,779,930 | 4,558,998 | 365,000,000 | 20,723,722 | 0.07 | 0.81 | 0.0256 | 18,675,751 |
| Median | 204,000,000 | 8,972,994 | 2,707,811 | 188,000,000 | 12,444,786 | 0.03 | 1.12 | 0.0146 | 15,380,144 |
| Maximum | 2,370,000,000 | 79,008,305 | 28,391,058 | 2,280,000,000 | 99,459,299 | 4.76 | 11.16 | 0.1367 | 86,784,220 |
| Minimum | 5,263,160 | 75,392 | 39,183 | 100,260 | 201,373 | −0.91 | −9.97 | 0.0002 | 1,586,750 |
| Std. Dev. | 444,000,000 | 16,535,814 | 4,824,263 | 425,000,000 | 21,216,150 | 0.36 | 2.47 | 0.0259 | 13,962,402 |
| Skewness | 1.69 | 1.82 | 1.67 | 1.72 | 1.51 | 6.43 | −1.67 | 1.44 | 1.88 |
| Kurtosis | 5.35 | 6.13 | 6.08 | 5.51 | 4.70 | 79.35 | 9.15 | 4.47 | 8.15 |
| Obs. | 433 | 430 | 431 | 433 | 431 | 385 | 431 | 429 | 433 |

Variables correlations (banks)

| | *Asset* | *Cost*1 | *Cost*2 | *Debt* | *Rev* | *RevR* | *ROE* | *MS* | *Stock* |
|---|---|---|---|---|---|---|---|---|---|
| *Asset* | 1.0000 | | | | | | | | |
| *Cost*1 | 0.8268 | 1.0000 | | | | | | | |
| *Cost*2 | 0.8940 | 0.8251 | 1.0000 | | | | | | |
| *Debt* | 0.9989 | 0.8256 | 0.8912 | 1.0000 | | | | | |
| *Rev* | 0.8840 | 0.9223 | 0.9180 | 0.8775 | 1.0000 | | | | |
| *RevR* | −0.0656 | −0.0882 | −0.0249 | −0.0709 | −0.0156 | 1.0000 | | | |
| *ROE* | 0.0618 | −0.1475 | 0.0692 | 0.0526 | 0.1436 | 0.2188 | 1.0000 | | |
| *MS* | 0.9144 | 0.9047 | 0.9438 | 0.9086 | 0.9886 | −0.0261 | 0.1369 | 1.0000 | |
| *Stock* | 0.5997 | 0.5045 | 0.5842 | 0.5650 | 0.5733 | 0.0317 | 0.0215 | 0.5962 | 1.0000 |

**Table A.3**
Variables statistics (securities).

| | *Asset* | *Cost*1 | *Cost*2 | *Debt* | *Rev* | *RevR* | *ROE* | *MS* | *Stock* |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 29,488,414 | 940,718 | 1,790,251 | 18,627,671 | 3,584,968 | 0.33 | 1.18 | 0.0399 | 7,511,986 |
| Median | 22,871,826 | 608,501 | 1,705,400 | 14,332,841 | 2,930,197 | 0.05 | 1.11 | 0.0368 | 5,611,743 |
| Maximum | 143,000,000 | 8,217,645 | 5,750,926 | 82,187,239 | 18,129,963 | 13.50 | 8.14 | 0.1575 | 31,898,730 |
| Minimum | 122,969 | 6,172 | 4,273 | 690 | 16,267 | −0.55 | −2.45 | 0.0001 | 270,000 |
| Std. Dev. | 25,274,380 | 1,015,091 | 1,268,172 | 16,331,005 | 2,937,630 | 1.35 | 1.54 | 0.0313 | 5,715,924 |
| Skewness | 1.39 | 2.49 | 0.58 | 1.12 | 1.08 | 7.03 | 1.10 | 0.78 | 1.52 |
| Kurtosis | 5.67 | 13.59 | 2.71 | 4.02 | 4.59 | 60.74 | 6.08 | 3.14 | 6.07 |
| Obs. | 277 | 276 | 277 | 277 | 276 | 245 | 276 | 276 | 276 |

Variables correlation (securities)

| | *Asset* | *Cost*1 | *Cost*2 | *Debt* | *Rev* | *RevR* | *ROE* | *MS* | *Stock* |
|---|---|---|---|---|---|---|---|---|---|
| *Asset* | 1.0000 | | | | | | | | |
| *Cost*1 | 0.6349 | 1.0000 | | | | | | | |
| *Cost*2 | 0.8934 | 0.6258 | 1.0000 | | | | | | |
| *Debt* | 0.9714 | 0.6490 | 0.8337 | 1.0000 | | | | | |
| *Rev* | 0.8805 | 0.7789 | 0.9323 | 0.8345 | 1.0000 | | | | |
| *RevR* | −0.1181 | −0.0587 | −0.1297 | −0.1049 | −0.0622 | 1.0000 | | | |
| *ROE* | 0.2618 | 0.1082 | 0.3231 | 0.2647 | 0.4575 | 0.2217 | 1.0000 | | |
| *MS* | 0.8707 | 0.7330 | 0.9294 | 0.8267 | 0.9794 | −0.0743 | 0.4718 | 1.0000 | |
| *Stock* | 0.9167 | 0.5224 | 0.8578 | 0.8286 | 0.7822 | −0.1591 | 0.0902 | 0.7667 | 1.0000 |

**Table A.4**
Variables statistics (life insurance).

| | *Asset* | *Cost*1 | *Cost*2 | *Debt* | *Rev* | *RevR* | *ROE* | *MS* | *Stock* |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 205,000,000 | 65,884,995 | 4,813,383 | 218,000,000 | 72,391,339 | 0.28 | 0.42 | 0.0647 | 8,600,451 |
| Median | 48,716,389 | 19,942,669 | 1,108,573 | 47,385,191 | 20,790,432 | 0.19 | 0.06 | 0.0216 | 3,900,000 |
| Maximum | 2,140,000,000 | 561,000,000 | 47,591,477 | 2,020,000,000 | 599,000,000 | 2.21 | 18.38 | 0.4831 | 58,386,158 |
| Minimum | 1,826,394 | 860,820 | 231,583 | 545,860 | 1,114,702 | −0.27 | −19.69 | 0.0018 | 700,000 |
| Std. Dev. | 374,000,000 | 107,000,000 | 8,394,768 | 368,000,000 | 118,000,000 | 0.34 | 4.21 | 0.1047 | 12,234,350 |
| Skewness | 2.75 | 2.50 | 2.46 | 2.37 | 2.43 | 2.37 | 0.49 | 2.26 | 2.61 |
| Kurtosis | 10.89 | 9.24 | 8.95 | 8.85 | 8.72 | 11.18 | 8.67 | 7.46 | 8.95 |
| Obs. | 165 | 165 | 165 | 165 | 165 | 150 | 165 | 165 | 165 |

Variables correlation (life insurance)

| | *Asset* | *Cost*1 | *Cost*2 | *Debt* | *Rev* | *RevR* | *ROE* | *MS* | *Stock* |
|---|---|---|---|---|---|---|---|---|---|
| *Asset* | 1.0000 | | | | | | | | |
| *Cost*1 | 0.9927 | 1.0000 | | | | | | | |
| *Cost*2 | 0.8592 | 0.8643 | 1.0000 | | | | | | |
| *Debt* | 0.9439 | 0.9464 | 0.7874 | 1.0000 | | | | | |
| *Rev* | 0.9914 | 0.9988 | 0.8849 | 0.9424 | 1.0000 | | | | |
| *RevR* | −0.2284 | −0.2176 | −0.2205 | −0.1866 | −0.2192 | 1.0000 | | | |
| *ROE* | 0.3737 | 0.4106 | 0.3177 | 0.3848 | 0.4195 | −0.0670 | 1.0000 | | |
| *MS* | 0.8646 | 0.8895 | 0.9474 | 0.8069 | 0.9076 | −0.2162 | 0.4588 | 1.0000 | |
| *Stock* | 0.8945 | 0.8832 | 0.9291 | 0.8323 | 0.8974 | −0.2057 | 0.2634 | 0.8960 | 1.0000 |

**Table A.5**
Variables statistics (property insurance).

| | *Asset* | *Cost*1 | *Cost*2 | *Debt* | *Rev* | *RevR* | *ROE* | *MS* | *Stock* |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 11,686,197 | 9,859,880 | 1,064,745 | 7,349,788 | 11,869,796 | 0.18 | 0.75 | 0.0616 | 3,020,378 |
| Median | 9,062,009 | 8,471,410 | 847,004 | 6,061,975 | 9,918,059 | 0.04 | 1.05 | 0.500 | 2,000,000 |
| Maximum | 77,706,524 | 40,823,381 | 4,056,865 | 38,594,768 | 47,836,156 | 10.22 | 3.78 | 0.2200 | 20,747,765 |
| Minimum | 2,061,160 | 45,953 | 70,283 | 70,510 | 106,421 | −0.33 | −9.42 | 0.0000 | 435,000 |
| Std. Dev. | 12,837,936 | 6,976,085 | 716,416 | 6,314,782 | 8,416,738 | 1.15 | 1.61 | 0.433 | 3,763,520 |
| Skewness | 3.35 | 2.75 | 2.47 | 2.72 | 2.45 | 8.37 | −2.12 | 2.34 | 3.66 |
| Kurtosis | 14.16 | 10.93 | 9.14 | 11.11 | 9.40 | 73.27 | 12.22 | 8.57 | 16.18 |
| Obs | 178 | 178 | 178 | 178 | 178 | 161 | 178 | 178 | 178 |

Variables correlation (property insurance)

| | *Asset* | *Cost*1 | *Cost*2 | *Debt* | *Rev* | *RevR* | *ROE* | *MS* | *Stock* |
|---|---|---|---|---|---|---|---|---|---|
| *Asset* | 1.0000 | | | | | | | | |
| *Cost*1 | 0.9396 | 1.0000 | | | | | | | |
| *Cost*2 | 0.8454 | 0.9363 | 1.0000 | | | | | | |
| *Debt* | 0.9770 | 0.9362 | 0.8370 | 1.0000 | | | | | |
| *Rev* | 0.9299 | 0.9514 | 0.8762 | 0.9571 | 1.0000 | | | | |
| *RevR* | −0.0943 | −0.1501 | −0.1083 | −0.1396 | −0.1530 | 1.0000 | | | |
| *ROE* | 0.2549 | 0.2355 | 0.1632 | 0.3091 | 0.3106 | −0.1507 | 1.0000 | | |
| *MS* | 0.9304 | 0.9402 | 0.8648 | 0.9518 | 0.9902 | −0.1458 | 0.3121 | 1.0000 | |
| *Stock* | 0.9477 | 0.8947 | 0.8431 | 0.8862 | 0.8507 | −0.0338 | 0.1099 | 0.8465 | 1.0000 |

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