A theoretic analysis of key person insurance

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1. Introduction

Key person insurance, also called key man insurance, is an important form of business insurance. It is an insurance policy taken out by a business to protect from financial losses that would arise from the death or extended incapacity of a crucial member of the business. Key person insurance is necessary if the sudden loss of a key executive could have a significant negative effect on a company's operations. In recent years an increasing number of insurance companies have started to offer key person insurance policies.

Key persons have significant effects on a firm's performance in the short-term. For example, in the case of Baidu.com Inc., owner of China's most popular internet search site, the company's shares fell sharply following the death of its chief financial officer (CFO), Shawn Wang, on Dec. 27, 2008. In the two days following his death, the share price fell 4.7%. In another case, when Steve Jobs, the co-founder, chairman and chief executive officer (CEO) of Apple, resigned from the company on Aug. 24, 2011, and then passed away on Oct. 5, 2011, there was a huge shock to the company's stock (the share price fell 6% on the day after his death), which greatly affected the interests of investors. As we know, these sudden events have considerable effects on firms' profits, and key person insurance can protect firms' losses because these losses will be covered by the insurers. Therefore, key person insurance attracts attention from both firms and insurance companies because the risk for the key persons can be eliminated.

Very few papers on key person insurance have been published. However, there is a vast literature on the effects of insurance on economic activities in industries and on the economy. For example, in microeconomics, Wang et al. (2017) and Pieper et al. (2015) addressed the effects of insurance on firms’ innovation in improving environmental quality. In industrial economics, competitive relationships between insurance companies and hospitals are discussed by Wang and Nie (2016), and the factors that affect the insurance industry have been confirmed by Biener et al. (2016). In macroeconomics, existing literature focuses on economic growth under insurance (Lee et al., 2016; Courbage and Rey, 2016; Nie, 2007; Eling and Schaper, 2017; Nie et al., 2016; Wang and Nie, 2018). Lee, Chang, Aroui & Lee (2016) recently examined the negative relationship between insurance and growth. Also, Bertrand & Prigent (2016) argued that insurance significantly impacts the equilibrium in portfolios, and they showed that the equilibrium risk-neutral density is equal to the product of a factor corresponding to the total risk tolerance with exogenous insurance constraint.

Because life insurance relates to almost everyone, most of the literature highlights the effects of life insurance on human capital (Israelsen and Yonker, 2017; Nie, 2014; Dineen and Allen, 2016). Below we briefly introduce the related research about the effects of life insurance on human capital.

Many papers highlight the effects of some types of insurance on labor.
Olsson and Thoursie (2015) analyzed how health insurance affects labor supply. Dillender, Heinrich & Houseman (2016) identified the effects of health insurance on part-time employees, and argued that employer mandates on health insurance increase part-time employment among workers without a college degree. Further, Gatzert & Maegebier (2015) captured the effects of critical illness insurance on human capital supply.

As a special type of life insurance, key person insurance has attracted increasing attention in recent years, but few researchers have focused on key person insurance. Compared with general life insurance, key person insurance receives increasing attention in recent years, and many researchers have focused on key person insurance. In the key person insurance market, those who own a key person insurance claim in detail and Nicholson and Corbett (1987) examined the relationship between key man insurance and market reaction. Block, Keenan & Malone (2006) introduced the key person claim in detail and Nicholson and Corbett (1987) examined the market reaction to key person insurance. Furthermore, Owusu et al. (1986) examined the relationship between key man insurance and market reaction.

2. Model of key person insurance

We focus on key person insurance of a risk-averse firm. This firm would choose such an insurance scheme to shield itself from the uncertainties associated with the loss of services provided by its key persons.

The model of a firm with key person insurance is established. The state of the key person in the firm is a, where a is a real number. In this article, the state reflects the key person’s performance in the short-term. The price of the firm’s final product is assumed to be a = 1.

Employees: We assume that there are N identical employees in the firm, and will consider a representative employee below. The effort level of an employee is denoted by e. The production of this employee is e(1 + δ)e and the costs incurred by the employee for exerting effort e are Ce. The salary of this employee is So – τ(1 + δ)e, where So > 0 and τ > 0. So is the employee’s reservation salary. τ represents the marginal human capital cost of a unit of output, and τ(1 + δ)e is the reward for the employee’s effort. In practice, τ may be the salary incentive for the key person, which is consistent with the work situation associated with the salary (annual salary and incentives) of individuals (Joshi et al., 2006).

This type of compensation model is utilized by many firms, and is also employed in this article. Therefore, the utility of the employee is

\[ u(e, δ) = S_0 + \tau(1 + \delta)e - \frac{e^2}{2} \]

In (1), S_0 + τ(1 + δ)e is the employee’s salary, and \( \frac{e^2}{2} \) is the costs incurred by the employee for exerting effort e. It is easy to see that the optimal effort level for the employee is \( e^* = \tau(1 + \delta) \). In equation (1), the key person improves the marginal products of each employee.

Key person: We assume that other key persons in this firm are fixed, and will focus on one key person. To simplify the problem, we assume that the objective of the key person is consistent with the firm’s profits or revenues. Therefore, the key person aims to maximize the following function

\[ U(\theta, \tau) = \varphi[N(1 - \tau)(1 + \delta)e - N\tau_1 - c_2N(1 + \delta)e], \]

where \( 1 > c_2 > 0 \) is the marginal cost to sell the product, and \( c_2N(1 + \delta)e \) is the total cost to sell all outputs. The constant \( \varphi \in (0, 1) \) is the proportional gain of the key person to the firm’s revenues. Because we assume that the objective of the key person is consistent with the firm’s profits (revenues), the firm is not addressed in this article. Moreover, if the salary of the key person is proportional to the firm’s revenues, this assumption is rational.

When considering key person insurance, we assume that the probability of “good” state is a, and the probability of “bad” state is 1 – a, where \( 0 < a < 1 \) and \( a > 0.9 \). Namely, the probability of “good” state is much larger than that of “bad” state. The expected objective function of the key person is

\[ EU(\theta, \tau, a) = F(\theta, \tau, a) = \varphi[aN(1 - \tau)(1 + \delta)e + (1 - a)N(1 - \tau)e - N\tau_1]. \]

In function (3), when the key person is in “bad” state, he/she has no effect on employees. In “good” state, the key person affects both the marginal production of each employee and the profits of the firm. Before analyzing the model, we make the following assumption.

Assumption: a is close to 1, c_2 is sufficiently large, and \( \varphi \) is very small. a being close to 1 means that the probability of “good” state is much greater than that of “bad” state. This is an important condition for an insurance company. A large c_2 depicts fierce competition in this industry. A small \( \varphi \) indicates that the salary of the key person is only a small part of the firm’s revenues. In reality these assumptions are rational.

The timing of decisions is as follows. In the first stage, the insurance company determines the insurance premium. In the second stage, the firm determines whether to buy key person insurance or not. In the final stage, the key person decides the marginal salaries of employees, and the employees determine their effort levels (see Fig. 1).

3. The benchmark model

Here we address the benchmark model without key person insurance. On the basis of the formulation \( c^* = \tau(1 + \delta) \), (1) and (2), the key person can select the parameter \( \tau \) to maximize the objective function. Function (2) is restated as

\[ U(\theta, \tau) = \varphi[N(1 - \tau)(1 + \delta)e - c_2N\tau(1 + \delta)e^2]. \]

Apparenty, the function (4) is concave in \( \tau \), and a unique solution exists, which satisfies the first-order conditions. Therefore, when the key
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