

Long-Period Employment, Service Innovation, and Profit

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1. Introduction

Firms face obsolescence risks in various areas such as technology, sales methods, design, services, and products. We posit that employees' firm-specific experience increases labor productivity and therefore counteracts obsolescence. Employees acquire firm-specific skills and develop relationships of trust with their colleagues through experience. As an example, employees who regularly interact with customers understand the changes in demand and learn to recognize customers' requirements. Furthermore, skilled technical personnel sustain business innovation, which also contributes toward preventing obsolescence. This indicates that firms should develop human resource strategies that drive business innovation to remain competitive. The longer the employment period, the greater are the beneficial effects of firm-specific job experience. Firm-specific experience increases the long-term return on investment, which is shared by the employee and employer. To our knowledge, no study has yet investigated whether human resource development with a long-term vision drives business innovation, enabling the firm to remain competitive and avoid obsolescence.

Firms should be able to fine-tune their employment strategies when the economy worsens. However, employment protection legislation makes it difficult to do so. Therefore, firms with a large number of regular employees face high bankruptcy risk, which we call the risk of employment adjustment. Conversely, firms with a large number of low-productivity employees may be unable to remain competitive in the face of future changes in the business environment. We call this the risk of obsolescence. We use this risk to analyze the relationship between firm-specific experience and employment period. The purpose of this paper is to determine whether human resource development with a long-term vision generates an increase in profits for a firm.

There are many existing empirical studies on human resource development. Previous studies have determined that according to the analysis of firm-specific human capital, the cost of and returns on investment in skills development are shared by both the employee and employer. This argument was originally proposed by Becker (1962, pp.10-15). Hashimoto (1981) considered the Becker hypothesis to be a direct application of the Coase theorem. Mincer (1974) demonstrated what is known today as the Mincer earnings function, and Flamholtz (1985) listed three conditions necessary for human capital to be recorded as an asset: (1) the firm can acquire the benefit for as long as the employee remains with the firm; (2) the firm can control the benefit; and (3) the benefit can be measured in monetary terms. Bouillon et al. (1996) demonstrated that two measures of firm investment in human-specific capital are significantly and positively correlated with the long-term return on investment. Both Willis (1986) and Heckman et al. (2003) surveyed the Mincer earnings functions. Lastly, Heckman et al. (1999) surveyed existing empirical research concerning the effects of job training.

Section 2 develops the basic model. Sections 3 and 4 analyze long- and short-period employment, respectively, and Section 5 compares the two. Section 6 concludes with a discussion on the relationship between business innovation and firm-specific skills.

2. Long-Period Employment

In this section, we propose a model consisting of two consecutive periods, specified by three points in time. At the start of the first period, each firm is assumed to employ workers to maximize its expected long-period profit.

We assume that the prices of the products of the first and second periods are given and one.

The second period is called the “in-fashion” or “out-of-fashion” period, depending on whether the product is in fashion or not. The notations are as follows: $(1-q)$ is the probability that the product is in fashion, and q the probability that the product is out of fashion, in the second period. We suppose that productivity decrease when the product is out of fashion. The rate of decrease in productivity, the obsolescence rate is denoted by m .

We denote by w_L the wage for long period employment, and we assume that w_L is given and constant.

For simplicity, we assume that the productivity of workers is homogeneous at the beginning of the period, and marginal product of workers is constant. With L denoting the number of workers for long period employment, the production function is written as follows:

$$f(L) = aL, \quad a > w_L \quad (1)$$

Workers acquire firm-specific skills and skilled technical personnel sustain service innovation. We assume that job experience increases labor productivity in the second period and that the effect of service innovation is given. The rate of increase in productivity when firms reward job experience is denoted by r for the second period. For simplicity, we suppose that firms are identical in all respects other than employment period and that firms and workers know how much returns on job experience firms yield in the first and second periods.

The firm must pay training cost for workers, the expenses of production facility. With C_L denoting the cost of production for long-period employment, C is an increasing convex function of the number of labor, For simplicity, we specify the rate of increase in cost due to worker as $C_L = c_L L^2$.

The profits that the firm earns in the in-fashion period are as follows:

$$\Pi_L^G = (1+r)aL - w_L L - c_L L^2 \quad (2)$$

The profits that the firm earns in the out-of-fashion period are as follows:

$$\Pi_L^B = (1+r-m)aL - w_L L - c_L L^2 \quad (3)$$

The profit function in the first period is specified as follows:

$$\Pi_L^I = aL - w_L L - c_L L^2 \quad (4)$$

We assume that the profit in the in-fashion period is larger than that in the first period. Therefore, $\Pi_L^G > \Pi_L^I$. We assume that Π_L^B becomes positive (negative) when when the products go out of fashion in the second period and the rate of service innovation (r) is large (small).

The maximization problems that each firm faces at the start of the first period are as follows:

$$\begin{aligned} \max_L E\Pi_L &= \Pi_L^I + (1-q)\Pi_L^G + q\Pi_L^B \\ &= [aL - w_L - c_L L^2] + (1-q)[(1+r)aL - w_L L - c_L L^2] \\ &\quad + q[(1+r-m)aL - w_L L - c_L L^2] \end{aligned} \quad (5)$$

For simplicity, defined $q(2+r) \equiv q(1+s_m)$, $(1-q)(2+r-m) \equiv (1-q)(1+s_n)$, (5) is rewritten as follows:

$$\max_L E\Pi_L = q[(1+s_m)aL - 2w_L L - 2c_L L^2] + (1-q)[(1+s_n)aL - 2w_L L - 2c_L L^2] \quad (6)$$

Let L_L^* denote the equilibrium number of long-term workers. From the first-order condition for maximization, L_L^* is as follows.

$$L_L^* = \frac{a[q(1+s_m) + (1-q)(1+s_n)] - 2w_L}{4c_L} \quad (7)$$

Upon defining $q(1+s_m) + (1-q)(1+s_n) \equiv K$, K represents net expected returns on service innovation. Let $E\Pi_L^*$ denote the equilibrium expected profit. $E\Pi_L^*$ is as follows.

$$E\Pi_L^* = \frac{(aK - 2w_L)^2}{8c_L} \quad (8)$$

From (7) and (8), we obtain the following:

$$\frac{\partial L_L^*}{\partial K} = \frac{a}{4c_L} > 0 \quad (9)$$

$$\frac{\partial E\Pi_L^*}{\partial K} = \frac{a(K - 2w_L)}{4c_L} \quad (10)$$

Proposition 1 (The obsolescence risk and the equilibrium number of long-term workers)

The equilibrium number of long-term workers increases (decreases) when the rate of service innovation increases (decreases) or the obsolescence risk decreases (increases).

Proposition 2 (The obsolescence risk and the equilibrium profit for long-period employment)

The equilibrium expected profit for long-period employment increases (decreases) when $K > 2w_L$ and the rate of service innovation increases (decreases) or the obsolescence risk decreases (increases). The equilibrium expected profit for long-period employment decreases (increases) when $K < 2w_L$ and the rate of service innovation increases (decreases) or the obsolescence risk decreases (increases).

3. Short-Period Employment

In this section, we assume workers are employed for a short period. We suppose that firms employ short-term workers so as to maximize their profit in every period. We assume that firms can increase the number of workers if the products are in fashion in the second period. In addition, we assume workers' job experience does not increase their productivity in a short term. For analytical convenience, we assume that the productivity of short-term workers is the same in both the first and second periods, even if the workers were employed at the same company in both periods. We also suppose, for simplicity, that firms are identical in all respects other than employment period, that the sales amount decreases when the products are out of fashion in the second period.

We assume that each firm, at the beginning of the first period, employs workers so as to maximize its profit for one period. The employment of all workers is terminated at the end of the first period. At the beginning of the second period, firms employ workers again after assessing the economic conditions.

L_1 indicates the number of workers in the first period. L_G and L_B denote the numbers of workers in the in-fashion and out-of-fashion periods, respectively.

We denote by w_1 the wage of short-term workers in the first period. We denote by w_G and w_B the wages of short-term workers in the in-fashion and out-of-fashion periods, respectively. We assume $w_G > w_1 > w_B$. With C_s denoting the cost of production for long-period employment, C_s is an increasing convex function of the number of labor, For simplicity, we specify the rate of increase in cost due to worker as $C_s = c_s L^2$

The profit function in the first period, Π_s^1 , is specified as follows:

$$\Pi_s^1 = aL_1 - w_1 L_1 - c_s L_1^2 \quad (11)$$

Let L_1^* denote the equilibrium number of workers in the first period. From the first-order condition,

$$L_1^* = \frac{a - w_1}{2c_s}. \quad (12)$$

The profits that the firm earns in the in-fashion period are as follows:

$$\Pi_s^G = aL_G - w_G L_G - c_s L_G^2 \quad (13)$$

Let L_G^* denote the equilibrium number of workers in the in-fashion period. From the first-order condition,

$$L_G^* = \frac{a - w_G}{2c_s} \quad (14)$$

The profit that each firm earns in the out-of-fashion period is as follows:

$$\Pi_s^B = (1 - m)aL_B - w_B L_B - c_s L_B^2 \quad (15)$$

Let L_B^* denote the equilibrium number of workers in the out-of-fashion period. From the first-order condition,

$$L_B^* = \frac{(1 - m)a - w_B}{2c_s} \quad (16)$$

$$\frac{\partial L_B^*}{\partial m} = -\frac{a}{2c_s} < 0 \quad (17)$$

From $(w_B < w_1 < w_G)$ and $m > 0$, we obtain the following:

$$L_B^* < L_1^* < L_G^* \quad (18)$$

Let $E\Pi_s^*$ denote the equilibrium expected profit for short period employment. $E\Pi_s^*$ is as follows.

$$E\Pi_S^* = \frac{(a-w_l)^2 + q[(1-m)a-w_B]^2 + (1-q)(a-w_c)^2}{4c_S} \quad (19)$$

$$\frac{\partial E\Pi_S^*}{\partial m} = \frac{qa(w_B-am)}{2c_S} \quad (20)$$

$$\frac{w_B}{a} > m \Rightarrow \frac{\partial E\Pi_S^*}{\partial m} > 0 \quad (21)$$

$$\frac{w_B}{a} < m \Rightarrow \frac{\partial E\Pi_S^*}{\partial m} < 0 \quad (22)$$

Proposition 3 (The obsolescence risk and equilibrium number of short-term workers in out-of-fashion)

The equilibrium number of short-term workers in out-of-fashion decreases (increases) when the obsolescence risk increases (decreases).

Proposition 4 (The obsolescence risk and the equilibrium profit for short-period employment)

An increase (decrease) in the obsolescence risk increases (decreases) the equilibrium expected profit for short period employment when the obsolescence risk is smaller than (w_B/a) . An increase (decrease) in the obsolescence risk decreases (increases) the equilibrium expected profit for short period employment when the obsolescence risk is larger than (w_B/a) .

4. Comparison of Short- and Long-Period Employment

First, we compare the equilibrium number of short-term workers in the first period with that of long-term workers.

From (7) and (16), we obtain the following:

$$L_L^* - L_B^* = \frac{c_S(aK - 2w_l) - 2c_L[(1-m)a - w_B]}{4c_S c_L}$$

$$K > \frac{c_L}{c_S}(1-m) + \frac{2}{a}(w_l - \frac{c_L}{c_S}w_B) \Rightarrow L_L^* > L_B^*$$

$$K \leq \frac{c_L}{c_S}(1-m) + \frac{2}{a}(w_l - \frac{c_L}{c_S}w_B) \Rightarrow L_L^* \leq L_B^*$$

Proposition 5 (Short-term workers in the out-of-fashion period and long-term workers)

The equilibrium number of short-term workers in out-of-fashion decreases (increases) when the obsolescence risk increases (decreases). The rate of increase in productivity due to service innovation in long-period employment decreases the risk of obsolescence. Therefore, short-term workers in out-of-fashion is less than long-term workers when net expected returns on service innovation is large or the risk of obsolescence is large.

Next, we compare the expected profit for long-period employment with that of short-term workers.

From (8) and (19), we obtain the following:

$$E\Pi_L^* - E\Pi_S^* = \frac{c_S(aK - 2w_l)^2 - 2c_L \cdot 4c_S\Pi_S^*}{8c_L c_S}$$

$$16a^2c_S^2w_l^2 - 4a^2c_S(4w_l c_S - 8c_L c_S \Pi_S^*) = 32a^2c_L c_S^2 \Pi_S^* > 0$$

$$K < \frac{4ac_S w_l - (16a^2c_S^2c_L \Pi_S^*)^{\frac{1}{2}}}{2a^2c_S}, K > \frac{4ac_S w_l + (16a^2c_S^2c_L \Pi_S^*)^{\frac{1}{2}}}{2a^2c_S} \Rightarrow E\Pi_L^* > E\Pi_S^*$$

$$\frac{4ac_S w_l - (16a^2c_S^2c_L \Pi_S^*)^{\frac{1}{2}}}{2a^2c_S} < K < \frac{4ac_S w_l + (16a^2c_S^2c_L \Pi_S^*)^{\frac{1}{2}}}{2a^2c_S} \Rightarrow E\Pi_L^* < E\Pi_S^*$$

Proposition 6 (The expected profit for long- and short-period employment)

We assume that the expected profit for long-period employment is not larger than that for short-period employment when net expected returns on service innovation is very small. Therefore, the expected profit for long-period employment is larger (smaller) than that for short-period employment when net expected returns on service innovation is large (small).

5. Conclusion

In this paper, we consider the case of employees acquiring the ability to drive business innovation through firm-specific experience. We use obsolescence risk to analyze the relationship between the returns on long-period employment and an increase in the firm's profits. We find that when long-period employment provides sufficiently large returns and obsolescence risk is low, a firm's expected profits are greater than for short-period employment. Moreover, we find that when firms create a suitable working environment rather than decreasing the utility of the employee and long-period employment provides sufficiently large returns, long-term employment is profitable for both firms and consumers.

Japan entered a recession in the 1990s, and the protection of older regular employees — enforced by employment protection legislation — restrained youth employment. The temporary employment rate of youths is increasing due to strict employment protection for regular employment, and for most firms, temporary employees have become a buffer against business fluctuations (Piore, 1970; Doeringer and Piore, 1971; Umemura, 1971; Nakamura, 1975). This may be because human resource development for long-term employees in Japan is not considered to be an investment that promotes business innovation.

In 2016, Hitachi — Japan's largest electrical equipment manufacturer — and its rival, General Electric (GE) — the largest global electrical equipment manufacturer — reported net earnings of US\$ 2.7 and US\$ 9 billion respectively. Hitachi's net earnings were less than one third that of GE. We propose that suitable long-term human resource development explains the difference between GE's and Hitachi's net earnings. GE has cultivated a global reputation as one of the foremost companies in the world in leadership development. GE spends approximately US\$ 1 billion annually on human resource development. The GE human resource program is a typical example of implementing human resource development with a long-term vision toward increasing profits. The fact that GE has the highest earnings in the world confirms our results.

For the purposes of this paper, we assume that all employees have the same skills and abilities at the beginning of their employment period and that firm-specific job experience increases labor productivity and drives innovation. However, each employee obviously has a different set of skills. The effect of individual skills differences on returns on investment is a question that we leave for future research. We also argue that the job experience of long-term employees could lead to various innovations and therefore, in turn, decrease the risk of obsolescence. To conclude, firms that provide long-period employment as well as long-term skills development could experience a marked increase in expected profit over the long term. Lastly, another question for future research is how long-period employment affects the risk of obsolescence.

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Firms face various types of obsolescence risk. We posit that workers' firm-specific experience increases labor productivity and prevents obsolescence. The return on firm-specific experience increases with employment period. However, no study has examined whether human resource development with a long-term vision drives business innovation and enables a firm to remain competitive. We use obsolescence risk to analyze the relationship between the returns on long-period employment and profit. We find that when firm-specific experience provides sufficiently large returns and the risk of obsolescence is low, the expected profit is greater for long-period employment than short-period employment.