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Status-quo vs new strategy in intangibles

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Abstract

Purpose – This study explores company strategies for intangibles. The authors investigate whether it is reasonable for companies to intensify intangibles when the current strategy is not intangible-intensive. The purpose of this paper is to elaborate a theoretical model to describe the strategic decision making in companies.
Design/methodology/approach – The authors use the Bellman-equation framework to find the conditions under which a change in strategy for intangibles is reasonable.
Findings – The results determine the parameters of returns on intangibles in different strategies, the optimal intangible stock and the influence of external economic shocks. The findings of the study demonstrate that many requirements have to be met to make intangible-intensive strategy beneficial for a company. Moreover negative shocks of crises force a company to postpone a new strategy on intangibles.
Practical implications – This research provides an insight into strategic behavior of companies under uncertainty. The theoretical findings demonstrate under which conditions companies should decide to switch to a strategy more intangible-intensive. This model can be used to empirically test parameters of different investment strategies of companies using structural estimation techniques.
Originality/value – This work contributes to the theory of managerial economics giving closed form solutions for the dynamic optimization of company behavior. The findings also show how this behavior might change when economic crises are faced or expected.

Keywords Intangible-intensive strategy, Bellman equation, Dynamic optimization

Paper type Research paper

Introduction

Managerial economic has always looked for a validated model for investment decisions, which is considered a great challenge both to scholars while investigating companies' behavior as well as to policy makers in companies. In searching for a better theoretical foundation for investment decisions, academics elaborated different frameworks, namely: resource-based view (Barney, 1991; Grant, 1991; Kristandl and Bontis, 2007) and value-based concept (Rappaport, 1986; Stern, 2001; Ottoson and Weissenrieder, 1996). Firms follow their strategy and decide on investments that are aligned with the strategy. That was discovered in studies by Miles *et al.* (1978), Porter (1985), Maidique (1982) and Insch and Steensma (2006).

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Meanwhile, new economy requires company strategies to focus specifically on intangibles. This issue is considered as one of the most relevant since highlights the pivotal resources of a contemporary company (Lev, 2001; Kristandl and Bontis, 2007). Shakina and Barajas (2014) discover two intangible-intensive strategies in companies (conservative and innovative). They suggest that most of the companies, consciously or unconsciously, follow investment strategy for intangibles by intensifying their particular intangible resources. However, some firms allocate resources still having no clear intangible-intensive strategy. Furthermore, the outperforming of intangible-intensity strategy was established. This fact comes to demonstrate that the investigation on companies' investment strategies regarding intangibles is of particular interest.

This research questions whether companies should intensify or not their investment in intangibles. This dichotomy arises since both intangible-intensive and non-intangible-intensive companies are observed on the market. Such fact indicates that, despite the significant role of intangibles in new economy, some companies consider this intangible-intensive profile as a non-optimal strategy for them which lead us to the supposition that it might be not beneficial or affordable for those companies to switch to the intangible-intensive strategy. This supposition is theoretically studied in this paper.

The objective of this study is to introduce a conceptual model that explains companies' investment strategies for intangibles.

The model is elaborated to solve the following problem:

> What is the optimal decision for a company – to intensify intangibles or to stay in a strategy that is not based on the employment of intangibles? And, under which conditions this decision can change?

The proposed conceptual model outlines a theoretical reasoning using the Bellman equation for dynamic optimization of companies' investment strategy.

This research aims to find out the main features, outcomes and conditions of investments strategies for intangibles in companies.

The paper is organized as follows: first, we provide a brief overview of the literature about intangible-intensive strategies. Following, The model 'status-quo vs new strategy in intangibles', the methodology and the development theoretical model are presented and finally, the paper concludes by briefly summarizing the main findings obtained.

Literature review

Firm theory and companies' strategic profiles in intangibles

According to the neoclassical theory of a firm, companies have common patterns of behavior under similar conditions (Holstrom and Tirole, 1989; Conner, 1991). This theory appeared to be relevant for reasoning about the strategic orientation of companies. But still, it did not explain the diversity of companies inside one industry or market. This theory was followed by Cyert and March's (1963) behavioral framework, the evolutionary theory of the firm by Nelson and Sidney (1982), and Grant's (1996) knowledge-based theory. The latest firm theories challenge the idiosyncratic features of companies' strategic profiles and provide the insight into incentives that bring firms to certain decisions.

Firm theories are popular in empirical studies. In the recent paper by Arato and Yamada (2012), the authors apply neoclassical framework to evaluate the ratio between tangible and intangible capital stock. Other scholars are searching for evidence that could explain theoretically the companies' strategic profiles. Miles *et al.* (1978) propose three strategic positions (defenders, analyzers and prospectors) together with what they consider as a strategic failure (reactors). Porter (1985) proposes three broad generic strategic positions for companies: cost leadership, differentiation and focus or niche strategy. For him, these clear strategies offer the company an ability to outperform the competitors. Companies "get stuck in the middle," what means that do not have a clear profile, are not able to perform at the same level of their competitors. Insch and Steensma (2006) follow the typology of

Maidique (1982) and point out four profiles in business strategy: first mover, imitator, low-cost producer and niche.

Meanwhile, Osborne and Cowen (2002), drawing the profile of high-performance companies, assert that high-performance companies usually have solid strategies and a superb execution of their strategy.

Nevertheless, there is a literature that underlines the additional risk brought by strategy that is specifically focused on the intensification of intangibles. Jinnai (2015) states that innovation and R&D causes long-run uncertainties for the growth.

Shakina and Barajas (2014) identify profiles considering the use of intangibles in companies. They conclude that companies with a defined strategic related to the use of intangibles are better off than those firms that present a moderate investment in each one of the intangibles components. That paper remarks that some intensiveness in the employment of intangibles will be recommendable.

Value-based view on companies' strategies

The evolution of the firm theory resulted in the current prevailing managerial concept – value-based view on companies' strategy. Apparently, value-based concept argues that value is a comprehensive outcome of companies' activities and is a key incentive for investments. Value arises only as a result of efficient investment decisions. It is driven by profit and is under the pressure of investment costs. If the profitability of a particular strategy is not sufficient to cover all investment associated to it, there is not creation of value in a company. This concept requires a dynamic consideration because investment costs are not supposed to be paid back immediately.

Value-based concept, being supported by scholars such as Rappaport (1986) and Stern (2001), refers to a simple formula: on one hand, investment gives an opportunity for a future growth in profits, on the other hand, each unit of this investment has to be covered with the increment in the future profits considering opportunity costs (cost of capital). Thus, the value-based analysis provides investment process with a clear and convenient decision tool. The greater the increment in value brought by investments, the better the investment decision is.

There is a specific approach in value-based concept that focuses on employment of intangibles. Intangibles being unique resources for a firm are likely to produce extra profits. These abnormal profits are called economic profit, residual income or economic value-added in the literature. All these indicators are widely recognized as a good metrics for the possession of unique resources which enable to create an abnormal profit (Stewart, 1999; Bontis, 2001; Stern, 2001). Several researchers of stakeholders' theory as Meek and Sidney (1988) and Donaldson and Preston (1995) agree that economic profit reflects the efficiency of intangible capital employment. This concept implies that the company succeeds when returns on invested capital exceed the industry's average level. In a situation where tangible resources do not provide competitive advantages for a company, another source of growth has to be found. Intangible resources created by a unique knowledge inside a particular company represent a competitive advantage in the new economy. This reasoning underlies the assumption that a positive economic profit reveals an intangible-driven outperformance (Zaratiegui, 2002; Stegmann, 2007). Opportunity costs are the major distinction of economic profit. Opportunity costs are those associated with the normal profit that might be gained by a common representative firm on the market. In this sense, additional profit is provided by a company's competitive advantages and mostly by its intangibles. This framework is commonly accepted by scholars in corporate finance as well as by resource-based theory followers like Barney (1991), Bontis (2001) and Stewart (1999).

There are several estimation approaches in the frame of value-based concept: discounted economic profits, capitalized profit and market value-added are the most widespread (Damodaran, 2005). Each of them reflects the dynamic nature of the value creation. That makes dynamic consideration of investment strategies reasonable. The next paragraphs give a short overview of the recent research agenda in dynamic optimization for investment analysis.

Dynamic optimization for investment decisions
Nowadays, decision-making studies often focus on dynamic issues. The pioneering work of Lintner (1956) indicates the importance of the dynamic foundations of the investment decisions. It has become clear that static models often fail to explain simple stylized facts. On the contrary, dynamic models allow to explore a set of new questions which cannot be addressed in a set of traditional paradigm problems – Strebulaev and Whited (2012). Today, recent progress in stochastic dynamic optimization techniques and dynamic investment modeling make possible more pervasive studies of dynamic corporate finance.

In this study, a discrete-time model of investment decision is considered. Such kind of models is widespread supported in the field of corporate finance. The "classic" models of this field include those by Lucas and Prescott (1971) and Hayashi (1982). Modern studies have been carried out by Abel and Eberly (1994), Hennessy (2004) and Hennessy *et al.* (2007).

A typical discrete-time investment model contains three parts: an objective function, exogenous stochastic state variables and a set of endogenous control variables (Strebulaev and Whited, 2012). A set of the state variables typically contains shocks to firm productivity which can be measured in different ways. There are models with additional shocks: for example, the model of Riddick and Whited (2009) with production costs shocks or the model of Jermann and Quadrini (2012) with financing costs shocks.

Discrete-time model forces us to use the Bellman-equation approach. It breaks a complex optimization problem into simpler steps at different points in time according to the Bellman's Principle of Optimality. This problem in discrete time can be formulated in a step-by-step form by writing down the relationship between the value function in one period and the value function in the next period. This approach is well-suited for the problem presented here. A firm is considered by means of its current economic profit and a sum of all discounted future economic profits. According to the Bellman's Principle of Optimality, it is reasonable to optimize an investment decision of such firm in a discrete time.

To conclude, the literature on investment strategies has numerous links to the value-based concept. Most of the studies introduce that those companies with clear investment strategies are better off. Meanwhile, companies evolve. Each of them has an opportunity to change the strategy and to turn into a new profile. Despite the sum of studies that examine companies' static and dynamic strategies by applying value-based concept, there is a lack of research about the motivation of switching from one strategy to another. When will it be worth for a company changing its strategy on intangibles increasing it investment on them? Next section introduces a conceptual model to define the parameters in order to take the decision on the intensification or not on the use of intangibles. The elaborated model implies value maximization.

The model "status-quo vs new strategy in intangibles"

This section introduces the conceptual model that describes the process of investment decisions with regard to intangibles. The core idea of the model is that a particular company decides either to keep its current strategy on intangibles or to switch to a new one. This study considers the current strategy of a hypothesized company as non-intangible-intensive. It means that the alternative strategy implies intensification on the use of intangibles. The model is elaborated on the value-based framework and is solved with dynamic optimization. Bellman's equation might be an appropriate technique to approach the research's issue.

As stated in the previous section, Bellman equation has to be identified for three groups of elements:

(1) an objective function;

(2) state variables; and

(3) control variables.

The objective function in the frame of Bellman equation in this study is a value function. Value-added associated with intangible stock is introduced in the objective function with regard to value of intangibles. The value function is a discrete function where each of the periods introduces an economic profit generated by a current intangible stock and investment in the future intangible stock. The evidence on discontinuity of investment in intangibles is discussed in the paper by Corrado *et al.* (2009). Thus, all future flows of economic profit are provided by an investment decision made in the current period.

The Bellman-equation framework suggests a universal tool for the dynamic optimization. Still, the theoretical reasoning applied to solve the model in our paper has a number of specific features. The special nature of investment in intangibles requires a separation of the value function into different equations. This technique is very important to demonstrate that investment in intangibles is not continued. Following a certain intangible-intensive strategy, a company is bounded with a level of intangibles to maintain this profile. However, the switching to the "higher" more intangible-intensive strategy demands reallocation and significant raise of investment in certain type of intangibles. For instance, switching to the innovative strategy refers to investments in R&D that do not exist when company does not follow an innovative strategy. The same can be attributed to the strategy in HR development or strong marketing orientation. Meanwhile, switching to the new strategy a company might have virtually higher return on intangibles bounded with higher investment and risks. One more detail is that normally it is not reasonable for a company to switch back to the basic strategy in intangibles because this step back brings significant sunk costs. All above-mentioned arguments lead to the Bellman-equation framework constituted as a system of two or more value function and allows achieving the close-form solution applying recursive way of model transformation.

Moreover, we choose the methodology of dynamic optimization taking into account the feature of the economic process that we are modeling: a company may decide to switch once at any time on an infinite planning horizon. Therefore, at any given time, firm while considering the decision to switch, compares the expected discounted payments in the case of switching to the innovative strategy and the case of not switching. It is important, that future payments depend on the time of the switching. The above refers to "recursively" pattern of decision making, which should take into account the future. In particular, the company may refuse to switch to an innovative strategy in the current year, waiting for better conditions in the future.

The value function is determined by a set of parameters:

- intangible stock;
- investment in intangibles;
- return on intangibles;
- depreciation rate of intangibles;
- discount factor (risk-free rate); and
- risk factor (exogenous shock of a profit).

The key issue in the elaboration of the model and its solution is to determine which of these parameters represent state and control variable. The parameters of the model introduced above should be considered in the chain of the decision-making process. Some of the parameters such as amount of investments in intangibles are mainly influenced by a firm decision. Meanwhile, the return on these investments and the depreciation rate are brought by the intangibles and are significantly less influenced by the firm (Corrado *et al.*, 2009). In other words, a firm takes the value of these parameters and is able to influence them only through its decision on intangibles. There are several parameters that are out of a firm control, such as exogenous shock (positive or negative) and discount factor (risk-free rate in this case).

Moreover, some of the parameters cannot change significantly regardless under whose control they are. Parameters as risk-free rate and depreciation rate have a slight variation. That means that even having significant impact on companies' value, these parameters are not relevant for decision-making process.

Figure 1 represents these parameters, degree of firm control and possible variation, on two scales.

Thus, only the parameters of intangible stock and those ones associated to investment in intangibles can be considered as control variables. At the same time, two state variables: return on intangibles and exogenous shock of a profit should be examined because they introduce high degree of variation and have a significant impact on value. These parameters are analyzed in this study as critical conditions under which investment decisions are undertaken.

Considering the previous reasoning, the following should be concluded:

(1) the objective function will be a value function expressed in Bellman's equation frame;

(2) the state variables will be the exogenous shock of profit and return on intangibles; and

(3) the control variable will be Intangible stock (investment in intangibles).

In order to state the problem, the present study takes the following assumptions:

(1) intangibles bring higher return and risk to companies;

(2) each company can decide to intensify or not its investment on intangibles;

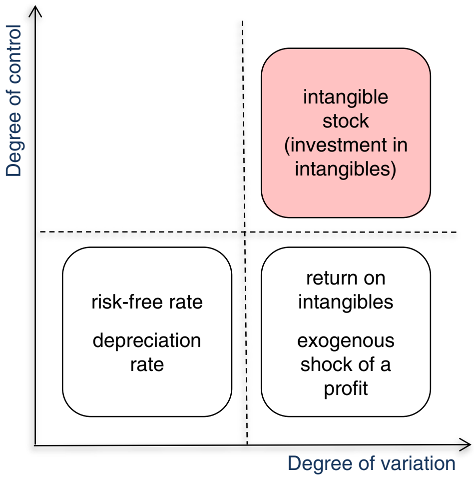

Figure 1. Degree of variation and control of the parameters in the model

(3) the depreciation of intangibles will be covered with investments in order to maintain the same production capacity; and

(4) the companies will look for maximizing the expected value (EV) of their economic profits continuously and without time limits.

Recalling the research question of this study, it is important to emphasize that two options are under a firm's decision on whether to intensify or not intangibles. Let us consider the second option as a status-quo and then, the first one reflects a switch to the new strategy. Introducing this reasoning in the model form two, Bellman equation demonstrates these options (formula (1)) EV is a maximum two optional strategic decisions: to keep status-quo or to switch to the new strategy in intangibles.

EV of a company is created by the present value of the cash flows. Meanwhile, cash flows consist of two parts. First part is an economic profit that is introduced in our model by the Cobb-Douglas function. The second part is associated with the investment in intangibles. According to the Bellman framework cash flows of a company are divided into two stages: current stage and all future flows.

It is considered that there is a basic level of investment in intangibles (*Int*) in order to keep the status-quo of the company. If a company decides to switch to a more intensive level of intangibles, then the intangible stock will be higher (Int_s). There will be two different levels of return on investment on intangibles. One is the return in the status-quo (θ) and the other will be the obtained with the new intangible stock (θ_s). θ_s is expected to be greater than θ. That recalls the first assumption of this model. The same applies for the investments that will be higher with intensification. It has been included the existence of external shocks of a profit (z). External shocks follow Markov process:

$$EV = \max\begin{cases} z_0 Int^\theta - \delta Int + \sum_{t=1}^{\infty} \dfrac{E z_t Int^\theta - \delta Int}{(1+r)^t} = z_0 Int^\theta - \delta Int + \dfrac{\bar{z} Int^\theta - \delta Int}{r} \\ z_0 Int^\theta - \delta Int - (Int_s - Int) + \sum_{t=1}^{\infty} \dfrac{E z_t Int_s^{\theta_s} - \delta Int_s}{(1+r)^t} = z_0 Int^\theta - \delta Int + \dfrac{\bar{z} Int_s^{\theta_s} - \delta Int_s}{r} - (Int_s - Int) \end{cases} \quad (1)$$

where EV, expected value of the economic profits and investments; z, external shock of the profit; *Int*, intangible stock; δ, depreciation rate of intangible stock; θ, return of intangibles in the "status-quo" strategy; θ^s, return of intangibles in the new intangible-intensive strategy; and r, discounted factor (risk-free rate).

The consequence of external shocks in $\{z_t\}$ is modeled by Markov process considering two states:

$$z_t = \begin{cases} z_h, \ goodyear \\ z_l, \ badyear \end{cases} \quad (2)$$

Taking that Π is a limiting transition matrix of Markov process:

$$\Pi = \begin{pmatrix} 1-p_l & p_l \\ p_h & 1-p_h, \end{pmatrix}, \quad (3)$$

and $\bar{p}$ is the limit probability of good state of economy:

$$\bar{p} = \frac{p_h}{p_h + p_l} \quad (4)$$

Apparently, according to the value-based view on a firm, the value function should be maximized. The value function that consists of two Bellman equations will have two local extremes for each strategy. Still, the solution of this problem will be found in the condition when one of the equations is sustainably higher than another one. This solution should represent the required level of Θ_S as a state variable when it is reasonable for a firm to switch from the status-quo to an intangible-intensive strategy.

Let us first consider the case when $1-p_l = p_h$. In this case, current state of economy does not have an impact on the probabilities of the future states. In other words, the probability of the onset of the good state next year is not influenced by the current state of the economy. Then Markov process $\{z_t\}$ degenerates into a sequence of independent Bernoulli trials with probability of success $\bar{p} = p_h$.

Then:

$$\bar{z} \equiv Ez_t = z_h p_h + z_l p_l.$$

According to formula (1) EV_1, the present value of cash flows if a company keeps its status-quo:

$$EV_1 = z_0 Int^\theta - \delta Int + \sum_{t=1}^{\infty} \frac{Ez_t Int^\theta - \delta Int}{(1+r)^t} = z_0 Int^\theta - \delta Int + \frac{\bar{z} Int^\theta - \delta Int}{r}. \quad (5)$$

Similarly, EV_2, which represents the present value of cash, flows if a company switches to the new strategy in intangibles at the $t=0$:

$$EV_2 = z_0 Int^\theta - \delta Int - (Int_s - Int) + \sum_{t=1}^{\infty} \frac{Ez_t Int_s^{\theta_s} - \delta Int_s}{(1+r)^t}$$

$$= z_0 Int^\theta - \delta Int + \frac{\bar{z} Int_s^{\theta_s} - \delta Int_s}{r} - (Int_s - Int). \quad (6)$$

Notably, in this case, independently from the previous history, we assume that a company is supposed to immediately switch in $t=0$.

This is the condition of the break-even point after which the switch to the new strategy is reasonable: $EV_2 - EV_1 > 0$:

$$\frac{\bar{z}\left(Int_s^{\theta_s} - Int^\theta\right) - \delta(Int_s - Int)}{r} - (Int_s - Int) > 0$$

or :

$$\bar{z}\left(Int_s^{\theta_s} - Int^\theta\right) > (\delta + r)(Int_s - Int) \quad (7)$$

The illustration of this condition is shown in the Figure 2.

Therefore, it is reasonable for a company to switch to a new strategy when $Int_s \in \left[Int, \overline{Int_s}\right]$, where $\overline{Int_s}$ is the largest of the two roots of the following equation:

$$\bar{z} Int_s^{\theta_s} - (\delta + r) Int_s = \bar{z} Int^\theta - (\delta + r) Int. \quad (8)$$

It should be noted that more intangible-intensive strategy is available only when $Int_s \geqslant \underline{Int_s}$, where $\underline{Int_s}$ is the minimum threshold of intangibles after which transition to a new strategy is possible. If we consider $\underline{Int_s} > \overline{Int_s}$ it is not reasonable for a company to switch to a more intangible-intensive strategy but only when $\underline{Int_s} < \overline{Int_s}$, instead. The condition for switching to a new strategy in intangibles is demonstrated in the following formula:

$$\bar{z}\underline{Int_s}^{\theta_s} > (\delta + r)\left(\underline{Int_s} - Int\right)\bar{z} Int^\theta. \quad (9)$$

(if the requirement (9) is met, $\underline{Int_s}$ is inside the following range $\left[Int, \overline{Int_s}\right]$ or $\underline{Int_s} < \overline{Int_s}$).

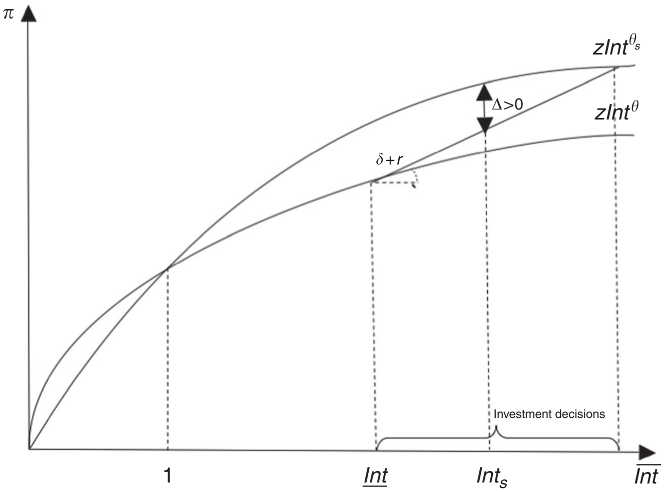

Figure 2.
Illustration for the condition when it is reasonable for a company to switch to the new strategy in intangibles

Let us find a return on intangibles θ_s under which the switching to the new strategy is beneficial. For that purpose, the following inequality should be solved with respect to θ_s:

$$\theta_s > \log_{Int_s}\left[(Int_s - \underline{Int})\frac{\delta + r}{\bar{z}} + Int^{\theta}\right]. \tag{10}$$

As seen from the inequality (10) the parameter θ_s is influenced by the initial endowment of intangibles as well as by the amount of investment in the new strategy. That might be explained by the assumption that is drawn from the resource-based view. This view asserts that the variety of resource combinations and its amount shapes a strategic resource endowment of companies and is responsible for different level of returns. Thus, we hypothesize in our paper that return on intangible-intensive strategy is a function of the initial resource endowment that a company had and amount of investment that it is willing to put in the new strategy.

This solution introduces the following result: If a firm observes the return on intangibles in the intangible-intensive strategy, which is higher than $\Theta_{S,}$ then it should immediately switch to a new strategy. If a firm switches to the intangible-intensive strategy, it should decide on the optimal level of investments. In searching for the "golden rule" in intangibles' investment, the optimal intangible stock of intangible-intensive strategy should be found.

Let us turn back to the break-even point for switching to a new strategy. We suppose that $\underline{Int_s} < \overline{Int_s}$ thus, it is reasonable for a company to change the strategy. In this case, the optimal level of investment in intangibles provokes the maximum return on the new strategy. If $Int_s \in [\underline{Int_s}, \overline{Int_s}]$, then the maximum increment of EV in connection with investment in intangibles should be found:

$$\Delta EV = \frac{\bar{z}\left(Int_s^{\theta_s} - Int^{\theta}\right) - \delta(Int_s - \underline{Int})}{r} - (Int_s - \underline{Int}) \rightarrow \max Int_s \in \left[\underline{Int_s}, \overline{Int_s}\right] \tag{11}$$

having:

$$\frac{d\Delta EV}{dInt_s} = \frac{\bar{z}\theta_s Int_s^{\theta_s - 1} - \delta}{r} - 1, \tag{12}$$

from where:

$$Int_s^0 = \left(\frac{\bar{z}\theta_s}{\delta + r}\right)^{\frac{1}{1-\theta_s}}. \tag{13}$$

The illustration of this condition is shown in Figure 3.

Therefore, the solution for the model is as follows:

$$Int_s^* = \begin{cases} Int_s^0 & Int_s^0 > \underline{Int_s}; \\ Int_s & Int_s^0 \leqslant \underline{Int_s}. \end{cases} \tag{14}$$

Notably, $Int_s^0 < \overline{Int_s}$.

Let us consider the following case: $p_h < 1 - p_l \Leftrightarrow p_h + p_l < 1$.

In this case, the current state of Markov process influences the probabilities of its future states. In particular, the probability of a good year after a bad year is lower than after a good year. That means that a company, when deciding to invest in intangibles, should take into account the current state of the economy. Still, a company does not consider historical information because Markov process implies only relation to the current state. That results in the following options of a company's investment decisions:

(1) Never switch to a new strategy in intangibles.

(2) Switch immediately to a new strategy regardless the current state of the economy. In this case, the present value of the expected cash flows depends on the state of the economy in the current year.

(3) Wait out the crisis, skipping all the bad years, and switch on the first good year.

(4) To do nothing in a good year and to switch on the first bad year.

Now, these possible decisions are studied.

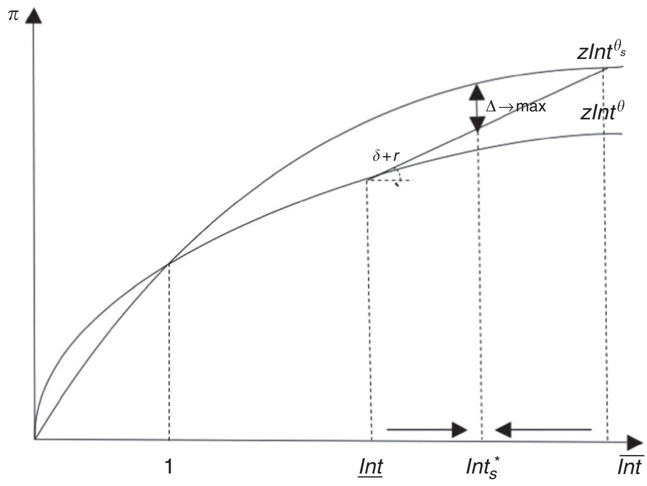

Figure 3.
"Golden rule" for investment in intangibles when switching to a new strategy

Never switch to a new strategy in intangibles

Let us find the actual value of the expected cash flows if a company consistently choses a status-quo strategy. $V_n(z_h)$ and $V_n(z_l)$ are present value of the expected cash flows under good and bad initial conditions, respectively. We have that:

$$V_n(z_h) = z_h Int^\theta - \delta Int + E\left(\sum_{t=1}^{\infty} \frac{z_t Int^\theta - \delta Int}{(1+r)^t} | z_0 = z_h\right) \tag{15}$$

$$V_n(z_l) = z_l Int^\theta - \delta Int + E\left(\sum_{t=1}^{\infty} \frac{z_t Int^\theta - \delta Int}{(1+r)^t} | z_0 = z_l\right) \tag{16}$$

We rewrite out the condition (15) as follows:

$$\begin{aligned} V_n(z_h) = z_h Int^\theta - \delta Int + (1-p_l)\left(\frac{z_h Int^\theta - \delta Int}{1+r} + E\left(\sum_{t=2}^{\infty} \frac{z_t Int^\theta - \delta Int}{(1+r)^t} | z_1 = z_h\right)\right) \\ + p_l\left(\frac{z_l Int^\theta - \delta Int}{1+r} + E\left(\sum_{t=2}^{\infty} \frac{z_t Int^\theta - \delta Int}{(1+r)^t} | z_1 = z_l\right)\right) \end{aligned} \tag{17}$$

Considering (16) and (17) we get:

$$V_n(z_h) = z_h Int^\theta - \delta Int + \frac{1}{1+r}((1-p_l)V_n(z_h) + p_l V_n(z_l)). \tag{18}$$

Similarly, for $V_n(z_l)$ we get:

$$V_n(z_l) = z_l Int^\theta - \delta Int + \frac{1}{1+r}(p_h V_n(z_h) + (1-p_h)V_n(z_l)). \tag{19}$$

Let us solve the system of Equations (18) and (19) Subtracting Equation (19) from the Equation (18) we get:

$$V_n(z_h) - V_n(z_l) = \frac{1+r}{r+p_h+p_l}(z_h - z_l)Int^\theta \tag{20}$$

Apparently, the last expression implies that the difference in the present value of the expected cash flows under condition $p_h + p_l < 1$ is less than under condition $p_h + p_l = 1$, which demonstrates that a bad year decreases the probability of a good year in the nearest future.

Substituting (20) in (19) we find $V_n(z_l)$:

$$V_n(z_l) = \frac{1+r}{r}\left(z_l + \frac{p_h}{r+p_h+p_l}(z_h - z_l)\right)Int^\theta - \frac{1+r}{r}\delta Int \tag{21}$$

and $V_n(z_h)$:

$$V_n(z_h) = \frac{1+r}{r}\left(z_l + \frac{p_h + r}{r+p_h+p_l}(z_h - z_l)\right)Int^\theta - \frac{1+r}{r}\delta Int \tag{22}$$

Immediately switch to a new strategy regardless the current state of the economy

Let us find the estimated value of the expected cash flows s if a company immediately switches to a new strategy in intangibles. Similarly to the previous case we get:

$$V_s(z_h) = z_h Int^{\theta} - \delta Int - (Int_s - Int) + E\left(\sum_{t=1}^{\infty} \frac{z_t Int_s^{\theta_s} - \delta Int_s}{(1+r)^t} | z_0 = z_h\right) \tag{23}$$

$$V_s(z_l) = z_l Int^{\theta} - \delta Int - (Int_s - Int) + E\left(\sum_{t=1}^{\infty} \frac{z_t Int_s^{\theta_s} - \delta Int_s}{(1+r)^t} | z_0 = z_l\right) \tag{24}$$

In details $V_s(z_h)$ is expressed as follows:

$$\begin{aligned} V_s(z_h) &= z_h Int^{\theta} - \delta Int - (Int_s - Int) \\ &+ \frac{1-p_l}{1+r}\left(z_h Int_s^{\theta_s} - \delta Int_s + E\left(\sum_{t=2}^{\infty} \frac{z_t Int_s^{\theta_s} - \delta Int_s}{(1+r)^t} | z_1 = z_h\right)\right) \\ &+ \frac{p_l}{1+r}\left(z_l Int_s^{\theta_s} - \delta Int_s + E\left(\sum_{t=2}^{\infty} \frac{z_t Int_s^{\theta_s} - \delta Int_s}{(1+r)^t} | z_1 = z_l\right)\right). \end{aligned} \tag{25}$$

Notably, the expression in parentheses after the multipliers $(1-p_l)/(1+r)$ and $p_l/(1+r)$ up to name of variables matches the right-hand parts of the Equations (23) and (24), respectively. That means that we can replace *Int* and θ by Int_s and θ_s:

$$\begin{aligned} V_s(z_h) &= z_h Int^{\theta} - \delta Int - (Int_s - Int) + \frac{1-p_l}{1+r} V_n(z_h)\big|_{Int=Int_s;\theta=\theta_s} + \frac{p_l}{1+r} V_n(z_l)\big|_{Int=Int_s;\theta=\theta_s} \\ &= z_h Int^{\theta} - \delta Int - (Int_s - Int) + \frac{1}{1+r}\left(\left(z_l + \frac{r+p_h}{r+p_h+p_l}(z_h - z_l)\right) Int_s^{\theta_s} - \delta Int_s\right) \\ &- \frac{p_l}{r+p_h+p_l}(z_h - z_l) Int_s^{\theta_s}. \end{aligned} \tag{26}$$

Finally, we get:

$$V_s(z_h) = z_h Int^{\theta} - \delta Int - (Int_s - Int) - \frac{\delta}{r} Int_s + \frac{1}{r}\left(z_l + \frac{r+p_h-rp_l}{r+p_h+p_l}(z_h - z_l) Int_s^{\theta_s}\right) \tag{27}$$

Similarly for $V_s(z_l)$ we get:

$$V_s(z_l) = z_l Int^{\theta} - \delta Int - (Int_s - Int) + \frac{p_h}{1+r} V_n(z_h)\big|_{Int=Int_s;\,\theta=\theta_s} + \frac{1-p_h}{1+r} V_n(z_l)\big|_{Int=Int_s;\,\theta=\theta_s}; \tag{28}$$

$$V_s(z_l) = z_h Int^{\theta} - \delta Int - (Int_s - Int) - \frac{\delta}{r} Int_s + \frac{1}{r}\left(z_l + \frac{p_h(1+r)}{r+p_h+p_l}(z_h - z_l) Int_s^{\theta_s}\right). \tag{29}$$

Then, we should find the following difference: $V_s(z_h) - V_s(z_l)$:

$$V_s(z_h) - V_s(z_l) = (z_h - z_l) Int^{\theta} + \frac{1-(p_h+p_l)}{r+p_h+p_l}(z_h - z_l) Int_s^{\theta_s}. \tag{30}$$

Addend of the expression is positive which means that the following relation reflects the condition of switching to the new strategy:

$$\left(V_s(z_h)-V_s(z_l)\right)\big|_{p_h+p_l<1} > \left(V_s(z_h)-V_s(z_l)\right)\big|_{p_h+p_l=1}. \tag{31}$$

Wait the crisis out

Let us find present value of the expected cash flows $V_w(z_l)$ under the strategy to switch when the first good year onsets and taking that the current year is bad.

By analogy with the previous cases, taking that under the first good year a company should switch or, in other words, postpone a new strategy if the current state of economy is bad.

For $V_w(z_l)$ we prescribe the following equation:

$$V_w(z_l) = z_l Int^{\theta} - \delta Int + \frac{p_h}{1+r} V_s(z_h) + \frac{1-p_h}{1+r} V_w(z_l), \tag{32}$$

taking into consideration (27) we find:

$$V_w(z_l) = \frac{1+r}{r+p_h}\left(z_l Int^{\theta} - \delta Int\right) + \frac{p_h}{r+p_h}\left(z_h Int^{\theta} - \delta Int - (Int_s - Int) - \frac{\delta}{r} Int_s\right)$$
$$+ \frac{p_h}{(r+p_h)r}\left(z_l + \frac{r+p_h-rp_l}{r+p_h+p_l}(z_h - z_l) Int_s^{\theta_s}\right). \tag{33}$$

To do nothing in a good year and to switch on the first bad year

Let us find present value of the expected cash flows $V_w(z_h)$ under the strategy to switch when the first bad year onsets taking that the current year is good. In this case we have:

$$V_w(z_h) = z_h Int^{\theta} - \delta Int + \frac{1-p_l}{1+r} V_w(z_h) + \frac{p_l}{1+r} V_s(z_l), \tag{34}$$

where taking into consideration (29) we find the following:

$$V_w(z_h) = \frac{1+r}{r+p_l}\left(z_h Int^{\theta} - \delta Int\right) + \frac{p_l}{r+p_l}\left(z_l Int^{\theta} - \delta Int - (Int_s - Int) - \frac{\delta}{r} Int_s\right)$$
$$+ \frac{p_l}{(r+p_l)r}\left(z_l + \frac{p_h(1+r)}{r+p_h+p_l}(z_h - z_l) Int_s^{\theta_s}\right). \tag{35}$$

Let us chose the optimal strategy taking all the results from (1) to (4).

If $z_0 = z_h$ a company can choose one out of three strategies:

(1) Never switch: in this case the present value of the expected cash flows $V_n(z_h)$ is expressed by the formula (22).

(2) Immediately switch: in this case the present value of the expected cash flows $V_s(z_h)$ is expressed by the formula (27).

(3) To postpone the switching until z_l onsets: in this case the present value of the expected cash flows $V_w(z_h)$ is expressed be the formula (35).

Apparently, the third strategy is always worse comparing to the first and the second ones. That leads us to the conclusion that:

$$V_w(z_h) < \max\left\{V_n(z_h);\ V_s(z_h)\right\}. \tag{36}$$

Similarly, if $z_0 = z_l$ a company can chose one out of three strategies:

(1) Never switch: in this case the present value of the expected cash flows $V_n(z_l)$ is expressed by the formula (21).

(2) Immediately switch: in this case the present value of the expected cash flows $V_s(z_l)$ is expressed by the formula (24).

(3) To postpone the switching until z_h onsets: in this case the present value of the expected cash flows $V_w(z_l)$ is expressed be the formula (33).

Conclusion

This paper addresses a relevant issue: the decision on changes in the strategy of companies over the use of intangibles. A conceptual model has been developed in order to decide if it is better for a company to keep its status-quo or intensify its intangibles.

The model includes a number of relevant parameters, namely: the intangible stock in different strategies (*Int*, Int_s), the return on intangibles in different strategies (θ, θ_s), the depreciation rate of intangibles (δ), discounted factor (r) and the exogenous shock of the economy (z). The Bellman-equation framework enables to get a solution and an interpretation of the conditions of a company strategic decision on intangibles.

The first solution was found for the case when the probabilities of the different states in the economy (good or bad economic situation) are independent. The key finding for that case is that companies should decide to keep status-quo or to change its strategy immediately under some particular conditions such as:

- There is a range of intangibles in which it is beneficial for a company to switch to a new strategy on intangibles. Notably, there are two break-even points. There is a minimum break-even point that reflects the minimum intangible stock that is needed to payback those investments associated with the new strategy. There is a maximum break-even point after which it is not reasonable for a company to switch to the intangible-intensive strategy because the investments are not going to be covered by the return that they provide.
- There is also a threshold of return on intangibles in the new strategy. This threshold introduces the minimum capacity of the new intangible-intensive strategy that enables an increase in the EV of the firm.
- These two conditions build themselves the area of possible solutions in which it is beneficial to switch to a more intangible-intensive strategy for company's sake. According to the "golden rule," in this area an optimal amount of investment can be found in this area.

In case the probability of the economic state of one year is conditioned by the previous one, the main finding is that the company has to postpone its decision. Depending on the relation among the factors that influence, either positively or negatively, the decision to switch to a new strategy, the optimal decision should be undertaken. In case of interrelated probabilities the solution is significantly more complicated compared with the previous case. Still, some conclusions can be drawn:

- If a company undertakes a decision in a good year, all other things being equal, the effect of switching to the intangible-intensive strategy is greater than if the decision was taken in a bad year. Still, the requirements of this optimal solution have to be met: θ_s must exceed a given threshold and Int_s must be inside a particular range.
- Under some conditions a company should postpone the decision to switch to a new strategy. That implies the following: if a company undertakes a decision in a bad year

and the effect of a positive shock of the economy on profit (z_h) is not significant comparing to a negative shock (z_l) the company should wait out the crisis and then immediately switch in the first good year (this result is true when all other conditions are fulfilled). Otherwise, if the effect of the positive shock is significant and covers all the negative factors of switching to a new strategy a company should switch even during the economic crisis.

This paper's findings contribute to the understanding of a company's strategic behavior, as this paper comes to show many factors conditioning the decision of switching to an intangible-intensive strategy. Apparently, all these factors cannot concur always for all companies. This result theoretically justified might be important for understanding the diversity of company strategies for intangibles. Still further empirical analysis may allow us to estimate the parameters involved in this conceptual model. But, this will be the next step in this research.

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