International Journal of Multimedia and Ubiquitous Engineering
Vol.10, No.9 (2015), pp.235-246
http://dx.doi.org/10.14257/ijmue.2015.10.9.24

# The Sustainability of Newly Diversified Fully-Owned Subsidiaries: Production Efficiency and Strategic Diversifications

Yim, HyungRok and Jung, Wonjin

*Associate Professor, the School of Business, Associate Professor, School of Business Administration*
*Hanyang University, 133-791 Seoul, Dankook University, 448-701Young-In*
*hryim@hanyang.ac.kr, jungw@dankook.ac.kr*

***Abstract***

*A diversification strategy is highlighted as a strategic shortcut to penetrate into new business fields while it is a useful way to construct business portfolios as well. From the perspective of parents, autonomy that is given to newly diversified subsidiaries trades off with their governance on fully-owned subsidiaries. Parents become to make strategic decisions based on input-output efficiency when it comes to the longevity of newly diversified subsidiaries. In the paper, we investigate how the longevity of newly diversified subsidiaries are determined taking internal technology shocks and exogenously given market shocks into consideration. For this purpose, a game-theoretic investment game is constructed, which predicts that parents are generically inclined to liquidate their subsidiaries in newly diversified business fields in the long-run. In particular, between the market shocks and the technology shocks, the formers are more likely to affect the sustainability of subsidiaries. Our simulation work supports the theoretic predictions of the game model exactly; when other conditions are equal, the market shocks can expand parents' total net profits compared to the technology shocks. This outcome can explain why subsidiary termination frequently occurs in highly competitive technological areas characterized by volatile market environments.*

***Keywords:*** *Diversification, sustainability, strategic investment, sustainability, performance*

## 1. Introduction

Diversification is highlighted as a way of constructing business portfolios and for active foreign penetration in the pursuit of globalization [8]. For instance, [1] suggests that foreign diversification for constructing business portfolios can tolerate domestic profit volatility [7], which indicates that diversification can reduce investor's heterogeneous belief on firm performance [9]. A sequential-investment strategy can be also viewed as a way for diversification [18].

No matter what diversification types are business risks are generically embedded because firms that enter new business fields are exposed to either internal technology shocks or exogenous market shocks, or the mixture of them. In those industries characterized by rapid technological advancement, such business risks are perceived as structural ones. Own internal technology shocks highlight firms' capability to develop newer innovations, which can improve firm performances [12]. One important notion in a diversification strategy is that there exist larger diversification opportunities in immature industries [5, 4, 19].

These two factors become to formulate the product life cycle (PLC) of any subsidiaries designed to diversify into new fields. It is worthy while to note that both types of shocks can affect the longevity of newly diversified subsidiaries. For instance, technological discontinuity or demand-side discontinuity can occur; they can create inefficiency in the

ISSN: 1975-0080 IJMUE

product life cycle of subsidiaries. Fundamentally, it needs to be acknowledged that both types of shocks, if they are unfavorable ones, can cause production inefficiencies and volatility because they become to affect the expected net profits of subsidiaries. This feature can induce parents to liquidate newly diversified subsidiaries from the long-term perspective. In competitive high-tech industries, unfavorable shocks can frequently cause technological discontinuities. Unless, firms adapt to exogenous shocks efficiently, they are likely to fail [10-11].

A few previous works highlight the contributions of firm effects and industry effects on firm performances [13, 15, 17, 21]. In general, firm effects rather than industry effects play a more important role in shaping the performance of enterprises. In particular, [20] and [22] suggest that firm effects critically determine the strategic investments of newly established but rapidly growing startups. However, these previous works are limitedly applicable to those firms established for diversification purposes because they apply the firm and industry effects directly to gauging firm performances. In contrast, we would like to tackle how diversifications into new business areas through fully owned subsidiaries occur and how such subsidiaries can be sustainable taking their longevity into consideration. Subsidiaries may be able to pass an early stage owing to parents' initial fixed investments but it is not certain if they are able to survive persistently during a later stage. As long as input-output operation is efficient, then their longevity may be secured. Unless subsidiary-wise own investments are not effective, inefficiency in production will deter their sustainability.

By this sense, subsidiaries' self autonomy plays an important role in their longevity; however, it is important to acknowledge that autonomy on newly diversified subsidiaries incurs additional costs to parents [6]. In particular, autonomy can distort headquarters decision on subsidiary's longevity as higher the business volatility is. [16] points out that the quality of governance on subsidiary is proportional to the financial sequence attributable to global diversification. In relation to autonomy, subsidiaries are able to maintain autonomy as long as their productions are efficient. A naturally intriguing question is what will happen in the long-run if subsidiary's input-output operation is generically inefficient.

In the paper, we construct a game-theoretic model for drawing out testable propositions. In particular, the model is designed to explore how fully-owned subsidiaries that are diversified into new business fields can be launched, how total investment on subsidiaries, which is composed of parent's initial fixed investment and subsidiary-wise own investment, is determined, and, between exogenous market shock and internal technology shock, which one plays a more important role in the sustainability of newly diversified fully-owned subsidiary.

The paper is organized as follows. In Section 2, an investment game is constructed, which derives theoretic predictions on the performance of newly diversified subsidiaries along to their sustainability. A simulation experiment is prepared in Section 3, and Section 4 discusses some simulation results. Section 5 summarizes the main findings of the paper along to conclusion remarks.

## 2. The Investment Game

### 2.1. A Diversification Strategy

An entrepreneurial firm $i$ diversifies into a newly emerging business area denoted as $J$ by establishing a new fully-owned subsidiary denoted as $S_i$. It is frequently observed that firms establish new divisions for the purpose of diversification because they are inclined to take advantage of firm-specific internal capital markets. $S_i$ is different from spin-offs or spinouts because it is wholly owned by $i$.

The utility from $S_i$ is a twice differentiable log linear function. In order to launch $S_i$, a fixed investment, denoted as $f$, is required and it determines $S_i$'s size initially. $S_i$ needs to invest its own-investment, *i.e.* $z$, since its initial take-off. $z$ represents any types of capital expenditures including R&D investment and capital goods investment. In our context, $f$ represents a fixed cost and $z$ can be understood as a variable cost. $S_i$ is required to afford $f$ and $z$ simultaneously throughout its life cycle. $S_i$ can earn $M_i$ with a probability of $p$, whereas it can wastes $K$ vainly with a probability of $1-p$; the expected income from $S_i$ is $pM_i-(1-p)K$.[1] This means that $i$'s diversification may not be always successful because such business risks as technological discontinuity or demand uncertainty are embedded in penetrating into $J$. $i$'s total utility under $S_i$ is defined as a linear combination given as (1).

$$\ln(M-f)+\ln\{pM_i-(1-p)K-z\}+\ln(f+z) \qquad (1)$$

$M$ is $i$'s own income from existing businesses and $i$ needs to afford $f$ in order to launch $S_i$. Thus, the net own income of $i$ is defined as $\ln(M-f)$. The subsidiary $S_i$ can earn the net income of $\ln\{pM_i-(1-p)K-z\}$, which indicates that the subsidiary has to invest $z$. Typically, new divisions are smaller than their parents in real business practices because the parent $i$ cannot afford to launch $S_i$ otherwise. At the meanwhile, we do not deny a possibility that $S_i$ grows as large as $i$, or even bigger than the parent firm. Throughout the evolution of $S_i$, such event will hardly occur because the parent firm cannot initiate $S_i$ indeed if its opportunity cost to afford $f$ is too large against its own profit stream.

### 2.2. Strategic Investments

The total investment of $f+z$ is the capital resources for $S_i$'s competition in $J$. Denote $f+z$ as $I$. Without the loss of generosity, we assume that $f+z$ and $M_i$ has one-to-one relationship. Simply speaking, $S_i$'s production is evaluated to be efficient if $S_i$'s input-output operation follows the constant returns to scale, which makes $S_i$ be more self sustainable. The evolutionary path of $S_i$ is composed of an early stage and a later stage. $f$ and $z$ play different roles in the evolution of $S_i$. $f$ is an initial endowment for $S_i$ in the early stage, whereas $z$ enhances $S_i$'s sustainability in the later stage. In equilibrium, $f^*$ and $z^*$ are determined as

$$f^*=\frac{2M-\{pM_i-(1-p)K\}}{3} \qquad (2)$$

$$z^*=\frac{2\{pM_i-(1-p)K\}-M}{3} \qquad (3)$$

In order to initiate $S_i$, both $f^*$ and $z^*$ should be positive numbers, which derives Proposition 1. In that, $i$ launches $S_i$ with the expectation of a positive net profit from its new division. If $i$ is capable of earning positive own profit, it is more likely to be. Proposition 2 suggests that the superior the $S_i$'s performance is, $S_i$ becomes to take advantage of own internal investment $z^*$. Henceforth, $S_i$ is more likely to survive longer independently from $i$'s fixed investment. If $S_i$'s performance is expected to be lower, then $i$ is inclined to increase $f^*$.

Proposition 1. In equilibrium, the net profit from $S_i$ is always expected to be positive as long as its parent yields positive own profit.

Proof. Because both $f^*$ and $z^*$ should be positive for the self-sustainability of $S_i$, it should be satisfied that $\frac{M}{2}\le pM_i-(1-p)K\le 2M$ where $M\ge 0$. Therefore, the expected net profit of $pM_i-(1-p)K$ is positive.

It cannot be denied that $K>M$ posteriorly. However, in terms of expected value, it is $pM>(1-p)K$ priorly.

Proposition 2. If the diversification through $S_i$ is expected to be highly profitable, $S_i$

is inclined to rely on $z^*$ while i affords a larger $f^*$ otherwise.

Proof. In the interval of $\frac{M}{2} \leq \{pM_i - (1-p)K\} \leq M$, it is satisfied that $f^* \geq z^*$. But it is $z^* > f^*$ if $M < \{pM_i - (1-p)K\} \leq 2M$.

One can easily know that the higher the probability to earn $M_i$, the higher the $z^*$ will be as $\frac{\partial z^*}{\partial p} = \frac{M_i + K}{3} > 0$; however, a lower $f^*$ is preferred under the same condition because of $\frac{\partial f^*}{\partial p} = -\frac{(M_i + K)}{3} < 0$. Thus, it is evident that the lower the probability to waste $K$, the higher the $z^*$ is expected while the lower the $f^*$ will be. From these, proposition 3 reveals that $p$ and $K$ affect $f^*$ and $z^*$ interactively but in different ways.

Proposition 3. If the probability to earn $M_i$ is high while K is large enough at the same time, i becomes to increase $z^*$.

Proof. Note that $\frac{\partial^2 f^*}{\partial p \partial K} < 0$ and $\frac{\partial^2 z^*}{\partial p \partial K} > 0$.

The total investment for $S_i$ is $I^* = \frac{M + \{pM_i - (1-p)K\}}{3}$. Proposition 4 can explain why large corporations can diversify more easily. Fundamentally, $M_i$ affect $I^*$ interactively with $p$ while $M$ does not. If $p \rightarrow 1$, then $\frac{\partial I^*}{\partial M} = \frac{\partial I^*}{\partial M_i}$. Therefore, generally speaking, those new subsidiaries launched by large corporations are more likely to perform better.

Proposition 4. The total investment for $S_i$ depends on the parent's size more than it depends on $S_i$'s own size.

Proof. Note that $\frac{\partial I^*}{\partial M} = \frac{1}{3}$ and $\frac{\partial I^*}{\partial M_i} = \frac{p}{3}$, and thus $\frac{\partial I^*}{\partial M} > \frac{\partial I^*}{\partial M_i}$.

### 2.2. Product Life Cycle and Sustainability

Figure 1 describes the evolutionary path of $S_i$. The $45^o$ dashed line corresponds to the constant returns to scale for $S_i$'s input-output operation, which is denoted as *EE*; it is the production efficient line that is the strategic pathway of $S_i$'s evolution. In Figure 1, $A_1$ represents the early stage and $A_2$ represents the later stage. In the early stage of $A_1$, $S_i$ can run with the total investment of $I^*$ efficiently because $S_i$'s input-output operation is located well above "EE" line with the constant returns to scale.

However, Proposition 5 suggests that $S_i$ is gradually exposed to a potential threat of termination as its PLC proceeds because $S_i$'s production becomes to lie under "*EE*" in $A_2$. Hence, the parent firm $i$ is motivated to withdraw from $J$ in the later stage of $A_2$ as production inefficiency naturally occurs.

Proposition 5. In the early stage, $S_i$ is able to produce efficiently; however, i is motivated to withdraw from the newly diversified market in the later stage.

Proof. Up to $M_i^* \leq \frac{M-(1-p)K}{3-p}$, $S_i$ is self-sustainable; however, $I^*$ becomes no more efficient in the later stage of $A_2$ as its production becomes to be located under the strategic pathway of *EE*.

 

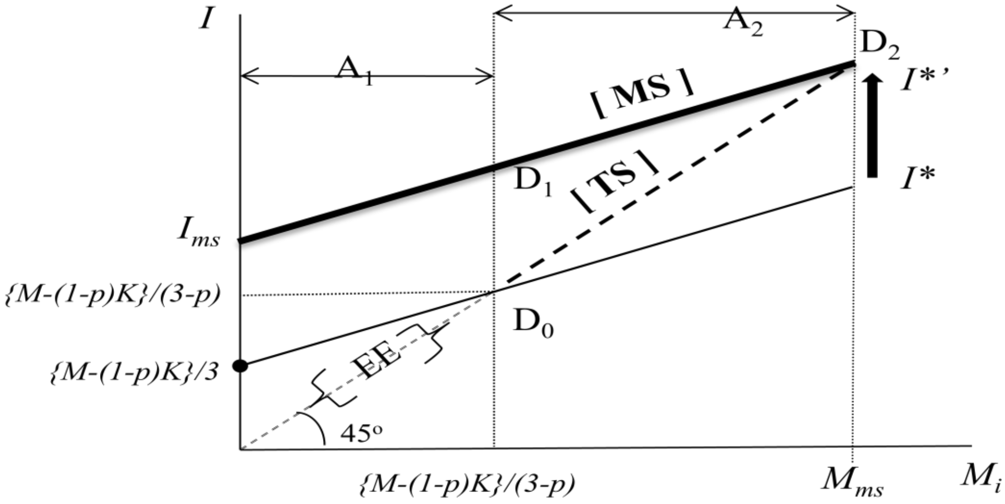


**Figure 1. The Evolution of $S_i$'s Investment Pathway**

The sustainability of $S_i$ is directly related to its input-output operational inefficiency in the later stage $A_2$, which makes $S_i$ be less self-sustainable. Intuitively, this type of inefficiency originates from embedded transaction costs accruing to $i$'s exploring $J$. As long as $S_i$ is $i$'s fully-owned subsidiary, the parent needs to afford the transaction costs.[2] Due to the inefficiency concern, $S_i$ can be liquidated during $A_2$.

Under the potential threat of liquidation, how $i$ makes $S_i$ competitive is left as an important managerial issue. Solutions can be sought both internally and externally. An internal technology shock represents firm specific internal impact while a market shock does market-oriented external impact. Between them, the internal technology shock can adjust the propensity of $S_i$'s total investment to trace the strategic pathway *EE* during $A_2$. In contrast, the market shock expands $M_i$ exogenously. A naturally intriguing question is which one between the two different shocks can elicit a larger total investment. According to Proposition 6, it is not the internal technology shock but the market shock that can enhance the performance of $S_i$ as well as its sustainability.

Proposition 6. Initially, an exogenous market shock can enhance $\mathrm{S_i}$'s investment. Unless an internal technology shock is large enough, the exogenous market shock is able to increase $\mathrm{S_i}$'s total investment in the long-run.

Proof. In Figure 1, a market shock, denoted as *MS*, can move $I^*$ upward to $I^{*\prime}$. As a result, it scales up the total investment of $S_i$ from $D_0$ to $D_1$ and the intercept move to $I_{ms}$ from $\frac{M-(1-p)K}{3}$ accordingly. However, *ex post* $M_{ms}$, the market shock fails to adjust $I^{*\prime}$ to follow the *EE* line. In contrast, the internal technology shock can adjust the slope of $I^*$ to trace the *EE* line at the kinked point of $D_0$ as depicted by the dark dashed TS line.

Still, the internal technology shock can improve $S_i$'s production efficiency, which can reinforce $S_i$'s sustainability; if the internal technology shock is large enough to make $S_i$'s production follow the kinked line in Figure 1, then the internal technology shock can make $S_i$ stand alone. However, this can occur only when the life cycle of $J$ can be extended over $D_2$.

## 3. The Simulation Experiment

### 3.1. The Scenario

In the early stage, $I$ and $J$ are separated markets. $i$'s technology is characterized by $\theta_{I,1}^{i}$ where the subscript $I$ represents $i$'s main market and 1 represents the early stage. Initially, $j$ monopolizes $J$ with a technology characterized by $\theta_{J,1}^{j}$ and thus $\theta_{J,1}^{j} > \theta_{I,1}^{i}$. $j$ competes in $I$ through its wholly owned subsidiary $S_j$, which means that consumers in $I$ purchase from $J$ but consumers in $J$ do not purchase from $I$. The probability of consumers in $I$ to purchase from $i$ ($\lambda_I^i$) is defined as the multi-logit distribution in (4) and the probability of consumers in $I$ to purchase from $S_j$ is similarly defined. The probability of consumers in $J$ purchase from $j$ is defined as (5). Note that $\alpha_I^I$ is the propensity of consumers in $I$ to purchase from $I$ while $\alpha_J^J$ is the propensity of consumers in $J$ to purchase from $J$. $\alpha_J^I$ represents the propensity for the consumers in $I$ to purchase from $J$. In (4) and (5), the subscript 1 represents the values of the early stage.

$$\lambda_{I,1}^{i} = \frac{e^{\alpha_I^I\theta_{I,1}^i - p_{I,1}^i}}{1+e^{\alpha_I^I\theta_{I,1}^i - p_{I,1}^i}+e^{\alpha_I^I\theta_{I,1}^{S_j} - p_{I,1}^{S_j}}} \ \& \ \lambda_{I,1}^{S_j} = \frac{e^{\alpha_I^I\theta_{I,1}^{S_j} - p_{I,1}^{S_j}}}{1+e^{\alpha_I^I\theta_{I,1}^i - p_{I,1}^i}+e^{\alpha_I^I\theta_{I,1}^{S_j} - p_{I,1}^{S_j}}} \quad (4)$$

$$\lambda_{J,1}^{j} = \frac{e^{\alpha_J^J\theta_{J,1}^j - p_{J,1}^j}}{1+e^{\alpha_J^J\theta_{J,1}^j - p_{J,1}^j}} \quad (5)$$

In the early stage, $j$ enjoy demands from both $I$ and $J$ but $i$ can sell only in $I$. Hence, their demands are defined as $D_1^i = n_{I,1}\lambda_{I,1}^i$ and $D_1^j = n_{I,1}\lambda_{I,1}^{S_j} + n_{J,1}\lambda_{J,1}^j$. In the lager stage, $i$ diversifies into market $J$ through its fully-owned subsidiary $S_i$ with $\theta_{J,2}^{S_i}$ where $\alpha_I^J$ represents the propensity for the consumers in $J$ to purchase from $I$. Then, $\lambda_{I,2}^i$, $\lambda_{I,2}^{S_j}$, $\lambda_{J,2}^j$, and $\lambda_{J,2}^{S_i}$ are defined to be (6) and (7). The subscript 2 represents the values of the later stage.

$$\lambda_{I,2}^{i} = \frac{e^{\alpha_I^I\theta_{I,2}^i - p_{I,2}^i}}{1+e^{\alpha_I^I\theta_{I,2}^i - p_{I,2}^i}+e^{\alpha_J^I\theta_{I,2}^{S_j} - p_{I,2}^{S_j}}} \ \& \ \lambda_{I,2}^{S_j} = \frac{e^{\alpha_J^I\theta_{I,2}^{S_j} - p_{I,2}^{S_j}}}{1+e^{\alpha_I^I\theta_{I,2}^i - p_{I,2}^i}+e^{\alpha_I^I\theta_{I,2}^{S_j} - p_{I,2}^{S_j}}} \quad (6)$$

$$\lambda_{J,2}^{j} = \frac{e^{\alpha_J^J\theta_{J,2}^j - p_{J,2}^j}}{1+e^{\alpha_I^J\theta_{J,2}^{S_i} - p_{J,2}^{S_i}}+e^{\alpha_J^J\theta_{J,2}^j - p_{J,2}^j}} \ \& \ \lambda_{J,1}^{S_i} = \frac{e^{\alpha_I^J\theta_{J,2}^{S_i} - p_{J,2}^{S_i}}}{1+e^{\alpha_I^J\theta_{J,2}^{S_i} - p_{J,2}^{S_i}}+e^{\alpha_J^J\theta_{J,2}^j - p_{J,2}^j}} \quad (7)$$

By diversification, $i$ can obtain demands from both markets, and thus $i$'s demand is defined as (8) and $j$'s demand is defined as (9) in the lager stage where $n_{I,2}$ and $n_{J,2}$ are the total number of consumers in $I$ and $J$.

$$D_2^i = n_{I,2}\lambda_{I,2}^i + n_{J,2}\lambda_{J,2}^{S_i} \quad (8)$$

$$D_2^j = n_{I,2}\lambda_{I,2}^{S_j} + n_{J,2}\lambda_{J,2}^j \quad (9)$$

$i$'s profit in the later stage is given to (10) and the equilibrium prices of $i$ and $S_i$ must satisfy the first order condition derived from (10) and the equilibrium prices of $j$ and $S_j$ must satisfy the first order condition derived from (11), respectively. The total equilibrium profits of $i$ and $j$ are earned by solving the system of the nonlinear equations in (6)-(11) simultaneously. The system is solved iteratively by maximum likelihood estimation technique.

$$\pi_2^i = \max_{\{p_{I,2}^i, p_{J,2}^{S_i}\}}\left[\left(p_{I,2}^i - c^i\right)n_{I,2}\lambda_{I,2}^i + (p_{J,2}^{S_i} - c^{S_i})n_{J,2}\lambda_{J,2}^{S_i}\right] \quad (10)$$

$$\pi_2^j = \max_{\{p_{I,2}^{S_j}, p_{J,2}^j\}}\left[\left(p_{I,2}^{S_j} - c^{S_j}\right)n_{I,2}\lambda_{I,2}^{S_j} + (p_{J,2}^j - c^j)n_{J,2}\lambda_{J,2}^j\right] \quad (11)$$

 

### 3.2. The Parameters and the Variables

In the early stage, the size of both markets is identical, and so $n_{I,1}$ and $n_{J,1}$ are set to be 0.7 along to $c^i = c^{S_i} = c^j = c^{S_j} = 0.2$. The qualities of $i$ and $j$ are set to be $\theta^i_{I,1}$=0.5 and $\theta^j_{J,1}$=0.7.[3] In the experiments, it is assumed that subsidiaries are able to produce at the same quality level with their parents, which means that $\theta^{S_j}_{I,1}$=0.7. In the second stage, the technology shock is defined as $\theta^i_{I,2}$=$\theta^{S_i}_{J,2}$=$\omega^{2.5} * \theta^i_{I,1}$ and $\theta^j_{J,2}$=$\theta^{S_j}_{I,2} = \omega^{2.5} * \theta^j_{J,1}$ and the external market shock is defined as $n_{I,2} = \omega^{2.5} * n_{I,1}$ and $n_{J,2} = \omega^{2.5} * n_{J,1}$. The consumer's preferences are given to $\alpha^I_I = \alpha^I_J = \alpha^J_I = \alpha^J_J = 1$. Simulation experiments are done by increasing the scale of $\omega$. As higher the $\omega$, the shocks become to have larger impacts.

## 4. Simulation Results

Figure 2 describes the evolutions of $S_i$'s profit paths under a technology shock and a market shock. The simulation results provide two important implications. First, both the technology and market shocks enhance $i$'s profit unanimously as larger their scales are. Second, if the scales of both shocks, measured by $\omega$, are infinitesimal, they have similar effects; however, the market shock becomes to contribute more to $i$'s profit as the scale of the two shocks increases. Figure 3 describes the percentage increments of the $S_i$'s profit paths. As $\omega$ increases to 1.6, $S_i$'s profit jumps more under the market shock than under the technology shock.

One noticeable feature is that $S_i$'s profit jumps as $\omega$ increases but with decreasing scales, which is clearly shown in Figure 4. What is important here is that $S_i$ may be able to reach to $D_2$ in Figure 1 either by the technology shock or the market shock. At a glance, it seems that the larger the shocks are, the more likely for $i$' s utility to increase. However, this does not hold up in the long-run. In fact, the larger the shocks are, the profit gains from the shocks start to shrink down as shown in Figures 3 and 4, and $i$ becomes to consider the termination of $S_i$. This outcome clearly demonstrates that any diversification through a wholly owned subsidiary has its own product life cycle.

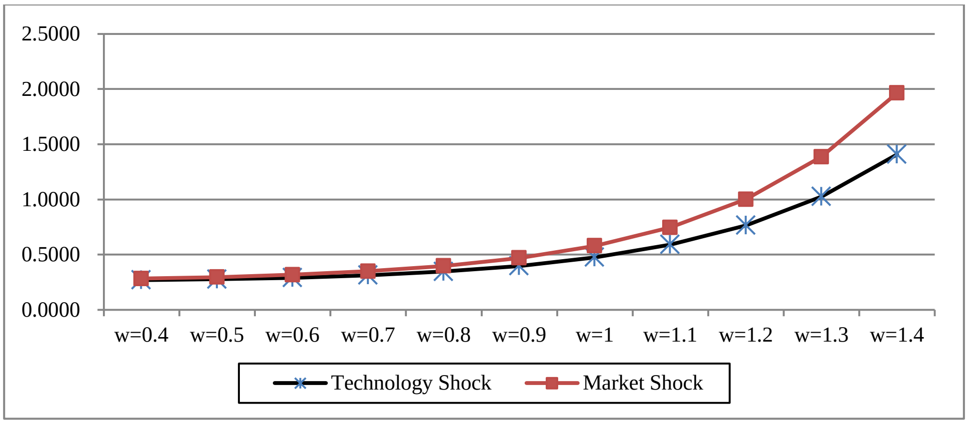


**Figure 2. The Evolutionary Profit Paths**

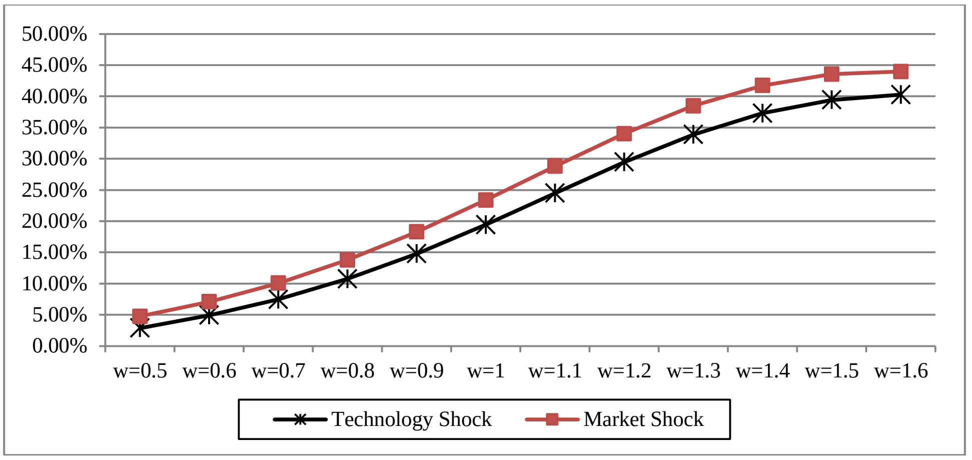


**Figure 3. The Profit Paths: The Percentage Increments**

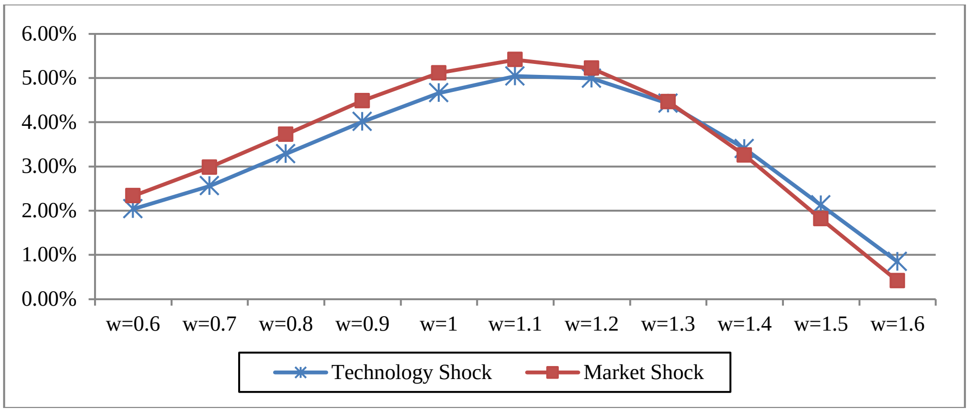


**Figure 4. The Profit Paths: The Percentage Points Increments**

The price paths described in Figure 5 are broadly consistent to the profit paths described in Figure 2. Unanimously, the equilibrium price of $S_i$ increases as larger the scales of the two shocks are. Figure 6 depicts clear differences between the evolution paths of $S_i$'s equilibrium price under the two shocks and the evolution paths of $S_i$'s equilibrium profit under the two shocks. Surely, $S_i$'s equilibrium price increases along to $\omega$. However, no evidence can be found that its increments start to shrink down when $\omega$ increases, quite differently from Figure 5. In fact, the increments of $S_i$'s equilibrium price converge to some different point s depending on the types of shocks.

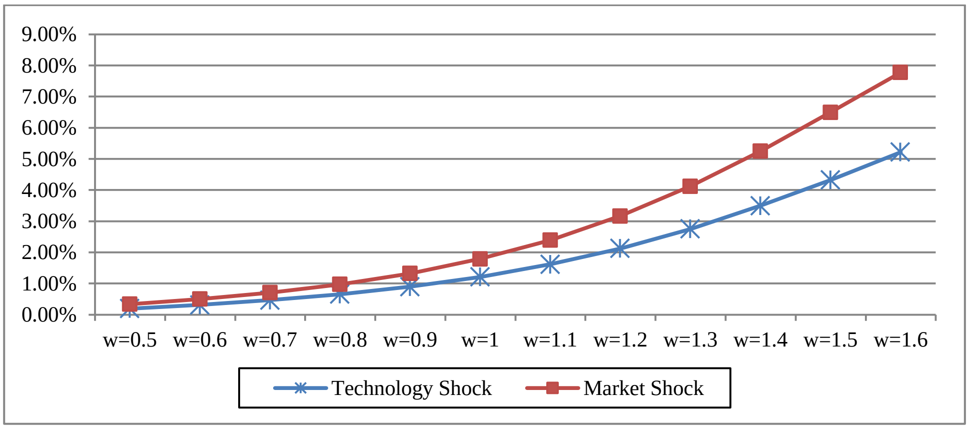


**Figure 5. The Price Paths: The Percentage Increments**

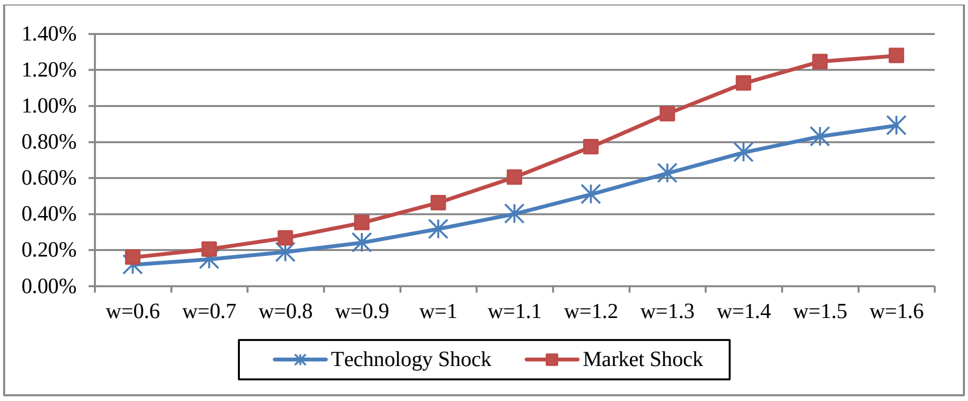


**Figure 6. The Price Paths: The Percentage Points Increments**

## 5. Conclusions

The main theme of the paper is to scrutinize the fundamental strategic features of diversification. In particular, we highlighted a diversification strategy through establishing a fully owned subsidiary. The main architecture of the paper is composed two step-wise approaches. As a first step, we develop a game-theoretic model to explore how strategic investments occur for the diversification strategy and to draw out testable hypotheses based on the model. In a second step, we constructed a simulation approach to verify the predictions of the game model thorough simulation experiments.

In the game-theoretic model, we separated subsidiary's investment from parent's initial investment for initiating its subsidiary. When parent's utility is a log linear function, the model provides four business implications on strategic investments. First, in equilibrium, parents diversify with a strong expectation that their newly diversified subsidiaries can generate positive net profits. Second, as long as their subsidiaries' profits are expected to be high enough, parents tend to rely on their subsidiaries' own investments rather they afford larger parental-wise fixed investments and *vice versa*. Third, when the chances to fail in newly diversified fields are high, parents are inclined to depend on their subsidiaries' own investments rather than their initial fixed investments. Fourth, it is the size of parent rather than subsidiary's own size that affects total investments for subsidiaries.

Ultimately, two important predictions were derived regarding to the sustainability of subsidiary. First, generically, parents tend to liquidate their subsidiaries no matter what their subsidiaries can maintain production efficiency because the expected profits of subsidiaries gradually decline. Second, between market shock and technology shock, the former can extend the sustainability of subsidiary. By some simulation experiments, it is found that both types of the shocks enhance parent's total profit *ex post* diversification but, evidently, the market shock affects total profit more than the internal technology shock does. It is a contrasting result against [20] and [21] who demonstrated that technology shocks significantly affect the performances of rapidly growing but recently established startups.

These results originate from investment behavioral differences between startups and incumbents. To startups, their own technological superiority plays a fundamental role in shaping their long-run sustainability, which can neutralize the impacts of exogenous market shocks. In terms of a diversification strategy, the sustainability of a newly established subsidiary is supported by a parent's fixed investment and its own investment. As long as its decision making is subordinated into the parent firm, there is no choice but to react more sensitively on uncontrollable exogenous market shocks than on internal technology shocks. This implies that, in general, self-autonomy can be allowed during the early stage of newly diversified subsidiaries, which enables them to begin operations independently from their parents to a certain degree; however, unless favorable market shocks occur in newly diversified fields, parents are inclined to control their subsidiaries in a later stage. The prediction of our work is consistent to [14] who demonstrates that the financial crunch during 2008-2009 critically deteriorated firm performances and [3] who approves diversifications can improve parents' short-term performances.

## References

[1] F. Balli, F. M. Pericoli and E. Pierucci, "Foreign Portfolio Diversification and Risk-sharing", Economics Letters, vol. 125, no. 2, **(2014)**, pp. 187-190.
[2] H. P. Bowen, H. K. Baker and G. E. Powell, "Globalization and Diversification Strategy: A Managerial perspective", Scandinavian Journal of Management, vol. 31, no. 1, **(2015)**, pp. 25-39.
[3] C. Chen and C. Yu, "Managerial Ownership, Diversification, and Firm Performance: Evidence from an Emerging Market", International Business Review, vol. 21, no. 3, **(2012)**, pp. 518-534.
[4] S. S. Chen and K. W. Ho, "Corporate Diversification, Ownership Structure, and Firm Value: The Singapore Evidence", International Review of Financial Analysis, vol. 9, no 3, **(2000)**, pp. 315–326.
[5] A. Delios, N. Zhou and W. W. Xu, "Ownership Structure and the Diversification and Performance of Publicly-Listed Companies in China", Business Horizons, vol. 51, no. 6, **(2008)**, pp. 473–483.
[6] D. J. Denis, D. K. Denis and K. Yost, "Global Diversification, Industrial Diversification, and Firm Value", Journal of Finance, vol. 57, no. 5, **(2002)**, pp.1951–1979.
[7] J. Farooqi, O. Harris and T. Ngo, "Corporate Diversification, Real Activities Manipulation, and Firm value", Journal of Multinational Financial Management, vol. 27, **(2014)**, pp. 130-151.
[8] W. Gao and J. Chou, "Innovation Efficiency, Global Diversification, and Firm Value", Journal of Corporate Finance, vol. 30, **(2015)**, pp. 278-298.
[9] J. Jiao, B. Qiu and A. Yan, "Diversification and Heterogeneity of Investor Beliefs", Journal of Banking & Finance, vol. 37, no. 9, **(2013)**, pp. 3435-3453.
[10] J. Lerner, "An Empirical Exploration of a Technology Race", The RAND Journal of Economics, vol. 28, no. 2, **(1997)**, pp. 228-247.
[11] J. Lerner, "Pricing and Financial Resources: An Analysis of the Disk Drive Industry, 1980-88", Review of Economics and Statistics, vol. 77, no. 4, **(1995)**, pp. 585-98.
[12] C. Lin and C. Chang, "The Effect of Technological Diversification on Organizational Performance: An Empirical Study of S&P 500 Manufacturing Firms", Technological Forecasting and Social Change, vol. 90, **(2015)**, pp. 575-586.
[13] A. M. McGahan, "The Performance of US Corporations: 1981-1994", Journal of Industrial Economics, vol. 47, no.4, **(1999)**, pp. 373-398.
[14] C. Rudolph and B. Schwetzler, "Conglomerates on the Rise Again? A Cross-Regional Study on the Impact of the 2008–2009 Financial Crisis on the Diversification Discount", Journal of Corporate Finance, vol. 22, **(2013)**, pp. 153-165.
[15] R. P. Rumelt, "How Much Does Industry Matter?", Strategic Management Journal, vol. 12, no. 3, **(1991)**, pp. 167-185.
[16] F. M. Salama and K. Putnam, "The Impact of Corporate Governance on the Financial Outcomes of Global Diversification", the International Journal of Accounting, vol. 48, no. 3, **(2013)**, pp. 364-389.
[17] R. Schmalensee, "Product Differentiation Advantages of Pioneering Brands", American Economics Review, vol. 72, no. 3, **(1982)**, pp. 349-365.
[18] J. L. Smith and R. Thompson, "Rational Plunging and the Option Value of Sequential Investment: The Case of Petroleum Exploration", The Quarterly Review of Economics and Finance, vol. 49, no. 3, **(2009)**, pp. 1009-1033.
[19] O. K. Tam and M.G.Tan, "Ownership, Governance and Firm Performance in Malaysia", Corporate Governance: An International Review, vol. 15, no. 2, **(2007)**, 208–222.
[20] H. R. Yim, "Competition and Its Virtue to New Startups under the Potential Threat of Entry", Economic Computation and Economic Cybernetics Studies and Research, vol. 45, no. 3, **(2011)**, pp. 167-187.
[21] H. R. Yim, "The Strategic Pathway to the Rapid Growth: Impact of Strategic Behaviors on the Financial Performance of Very Rapid-growth Startups", African Journal OF Business Management, vol. 6, **(2012)**, pp. 1808-1836.
[22] H. R. Yim, "Quality Shock vs. Market Shock: Lessons from Recently Established Rapidly Growing U.S. Startups", Journal of Business Venturing, vol. 23, **(2008)**, pp. 141–164

 

## Authors

**Hyung Rok Yim**, is an associate professor at the School of Business, Hanyang University that is an AACSB (The Association to Advance Collegiate Schools of Business) accredited business school after he is awarded Ph.D. in Economics from Claremont Graduate University. The main research interests are entrepreneurship, innovation, and firm growth, which are approached by simulation based game theoretic approaches.

**Wonjin Jung**, is an associate professor in the School of Business and Economics at Dankook University, Korea. He received his Ph.D. in Management Information Systems from Claremont Graduate University and his MS from the University of Wisconsin. His research interests focus on data quality, user interface design, human-computer interaction, and social networking service.

 