STRATEGIC INVESTMENT IN TAIWAN CHAIN AND FRANCHISE STORES: A REAL OPTIONS AND GAME-THEORETIC APPROACH

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ABSTRACT

The purpose of this study is to examine and demonstrate the strategic investment decisions faced by Taiwan's chain and franchise store enterprise. We show that incorporating an abandonment option to strategic timing in a game-theoretic real option approach makes the approach more complete and accurate. The results show that the chain and franchise store industry favors large companies, a finding consistent with economies of scale. The demonstration also provides practitioners a step-by-step guideline for analyzing dynamic investment strategy in the chain and franchise store industry.

JEL: G31

KEYWORDS: Abandonment option; Chain and franchise store; Game-theoretic real options.

INTRODUCTION

The chain and franchise store industry has grown rapidly in Taiwan. Based on statistics from Association of Chain and Franchise Promotion Taiwan (2009), there are 27,833 regular chain stores, and 79,422 franchise chain stores in 2008. There are over 300 member franchisers in more than 180 different trade lines, running 30,000 franchised stores with over 200,000 employees, generating up to NT$600 billion annually. Moreover, Taiwan's chain and franchise store companies are reorganized internationally. They build brands and compete with international brands. Therefore, to be an international enterprise, the most important problem faced by a chain and franchise store company is how to evaluate investment values under uncertain situations.

It is often stressed that real option theory is best used to analyze problem of strategic investments. However, traditional real options analysis only applies to proprietary investment projects. See, for example, Dixit and Pindyck (1994). This occurs because it ignores the interaction effects of competitor moves. Many academicians and practitioners integrated game theory into a real option approach, resulting in decision-making that involves not only nature but competitor actions. Among others, Smit and Ankum (1993) analyzed project timing in production facilities. Grenadier (1996) applied game-theoretic real options in real estate investment. Weeds (2002) studied strategic delay in a research and development competition context. Smit and Trigeorgis (2007) demonstrated strategic options and games in analyzing the option value of technology investments.

Each of these works improve the quality of project decision-making faced by managers. However, most studies do not consider abandonment options in dealing with investment timing. For example, the works of Smit and Ankum (1993) and Smit and Trigeorgis (2007) only explore decisions of waiting to invest. In their game-theoretic extensive form, the branch stops when both firms invest. For most investment opportunities, each firm can decide not only when to invest, but when to abandon if the investment is made. The investment value is underestimated without considering abandonment options in the game-theoretic real options approach. Therefore, this study examines not only investment timing decisions, but the abandonment timing decision.

The goal of this study is to examine and demonstrate the strategic investment decisions faced by the chain and franchise store companies, by incorporating abandonment options to strategic timing in a game-theoretic real option approach. The chain and franchise store industry in Taiwan is competitive. A manager must incorporate impacts of anticipated competitive erosion in investment decisions. Besides, the retail market is highly variable, resulting in large uncertainty in expected market values. Therefore, the game-theoretic real option approach is best to analyze the problem of timing investment in the industry. Following the work of Smit and Ankum (1993), two players with unequal market power are examined in a three-period game.

The results show the chain and franchise store industry favors large companies consistent with economies of scale. A company with larger market power can sustain a declining market much longer than its smaller competitor. Therefore, if a small firm enters a local market, larger firms will enter the same market in next period even if the market doesn't grow. On the contrary, if a large firm had invests first, small firms won't enter the market in next period without market growth. This makes the bigger firm bigger by gathering more market share.

In the next section will review the related literature. We discuss the methodology of game-theoretic real option approach and analyze timing investment strategy in chain and franchise stores. Some concluding remarks are provided in the final section.

LITERATURE REVIEW

Irreversible investment decisions are characterized by uncertainty and choice about the timing of the investment. Initially, the uncertainty and choice are solved by a real option approach. This is because there are several limitations with regard to the characteristics of irreversibility when net present value (NPV) valuation is applied as noted by Copeland and Antikarov (2003). NPV valuation can't deal with uncertainty and resulting managerial flexibility. It ignores the value of a manager's options. This leads to underestimation of a project's value.

The decisions on irreversible capital investment problems under uncertainty have been improved considerably by real options. McDonald and Siegel (1986) pioneered the real option approach in deciding when to invest. The problem of waiting to invest is expanded to included interest rate uncertainty by Ingersoll and Ross (1992). Specific types of real option approaches have been modeled extensively. Kulatilaka and Trigeorgis (1994) and Grinyer and Daing (1993) modelled the option to abandon. Pindyck (1988) and Kester (1984) worked on the growth option. Childs, Riddiough, and Triantis (1996) discussed the problem of switch inputs and outputs. Hodder and Riggs (1985) and Smit (1997) examined staged investment problems. Much of the literature stresses the similarity between a financial call option and the invest opportunity in a real asset. As a result, the investment problem can be solved by typical valuation of an American option. Dixit and Pindyck (1994) and Trigeorgis (1996) provide excellent surveys of the related valuations and applications.

The real option approach has been applied to many areas, such as natural resources, real estate, manufacturing, research and development, labor force, inventory, venture capital, merge and acquisition, and advertising, etc. See, e.g. the survey of Lander and Pinches (1998). However, the real option approach ignores the feedback of a competitor's move. Smit and Trigeorgis (2006) pointed out that managers have the flexibility to delay investment decisions so that new information is revealed and invest only when the investment is profitable from a real option perspective. However, from the game perspective, it is not advisable to delay investment because the firm doesn't earn early cash flows and loses competitive advantage owing to competitor moves. Therefore, many academics, e.g.,Weeds (2002), suggested a game-theoretic real option approach should be applied when there is an option value of waiting and when the option value is affected by competitor moves.

Leahy (1992) discovered that competitive firms make optimal entry decisions even if they moved myopically. Smit and Ankum (1993) used economic rent to explore investment timing strategy faced by duopoly firms. The simultaneous moves of game theory are extended to sequential moves by Butterfield and Pendegraft (2001). Grenadier (2001) analyzed firm strategy under uncertain situations by game-theoretic real option approach. He considered the investment in real estate under ologopoly first. Then, he analyzed the investment in an oil field under asymmetric information. Smit and Trigeorgis (2007) detailed a firm's decision about when to invest. Smit and Trigeorgis (2006) provided many examples involving important competitive/strategic decisions under uncertainty.

METHODOLOGY

An unequal market power for two competitors (A and B) is examined. The market share is three-fifths versus two-fifths. The chain and franchise store in Taiwan is easy to enter or exit, resulting a competitive industry. However, some firms have superior management ability, and invest more resources in information technology. This gives these firms a competition advantage. Moreover, the scale of economy is significant in the industry. The more stores you invest in, the lower your costs. For example, the chain stores of President Chain Store Corporation exceed 4,000, which are much more than other competitors. Therefore, President Chain Store Corporation has economies in transportation cost, purchase price, advertisement, and human resources management. As a result, it achieved more market share than its competitors. The most important decision in a chain and franchise' company is when to invest in a local market. If a specific firm has monopoly power in the market, then we can apply the real option approach to solve the problem of when to invest. However, as mentioned before, the chain and franchise store market is a competitive industry. Any firm in this industry takes not only the market's growth into account, but the competitor's move. Consequently, the game-theoretic model needs to be included in a real option approach. The game-theoretic real option approach had been studied and applied in many studies, e.g., the works of Smit and Ankum (1993) and Smit and Trigeorgis (2007). This paper will extend their work to study strategic investment in the chain and franchise store industry.

The example presented in Smit and Ankum (1993) can be applied to analyze strategic investment decisions faced by a chain and franchise store firm. There are two players (A and B) in a three-period game. Smit and Ankum (1993) depicted an extensive form to show the two-player actions and their investment value pairs. When both players invest immediately, the branch of the extensive form closes. This is because they didn't consider the abandonment option. We extend the investment branch to allow both players have the option to shut down. This is important becuase a chain and franchise store can easily close a retail store. To compare the work of Smit and Ankum (1993), the next market cash flow and present value are assumed to increase 50% ($u = 1.5$), or decline 66% ($d = 0.66$), the risk-free rate is 10% ($r = 0.1$,) and investment outlay requires 50 ($I = 50$). The variation of market values comes from the fact that the chain and franchise stores compete not only with each other, but also with other potential competitors, such as an electronic commercial network or department stores. In addition, variation may come from a customer's purchasing power or wholesale price.

The dynamics of market cash flow present value is assumed to followed binomial process, which is shown in Figure 1. The present value of market cash flow is assumed to be 100 ($V_0 = 100$), and market cash flow is 10% of present value in each period. The market cash flow likes dividends in a financial stock option.

The investment value (V) would be

$$V = [CF_1 + R_1]/(1+r) - I, \tag{1}$$

when player abandons at end of stage 1,

$$V = CF_1/(1+r) + [CF_2 + R_2]/(1+r)^2 - I, \tag{2}$$

when player abandons at end of stage 2, and

$$V = CF_1/(1+r) + [CF_2 + V_2]/(1+r)^2 - I, \tag{3}$$

when player continues to stay beyond stage 2. In the above calculation, CF_t denotes cash flow at stage

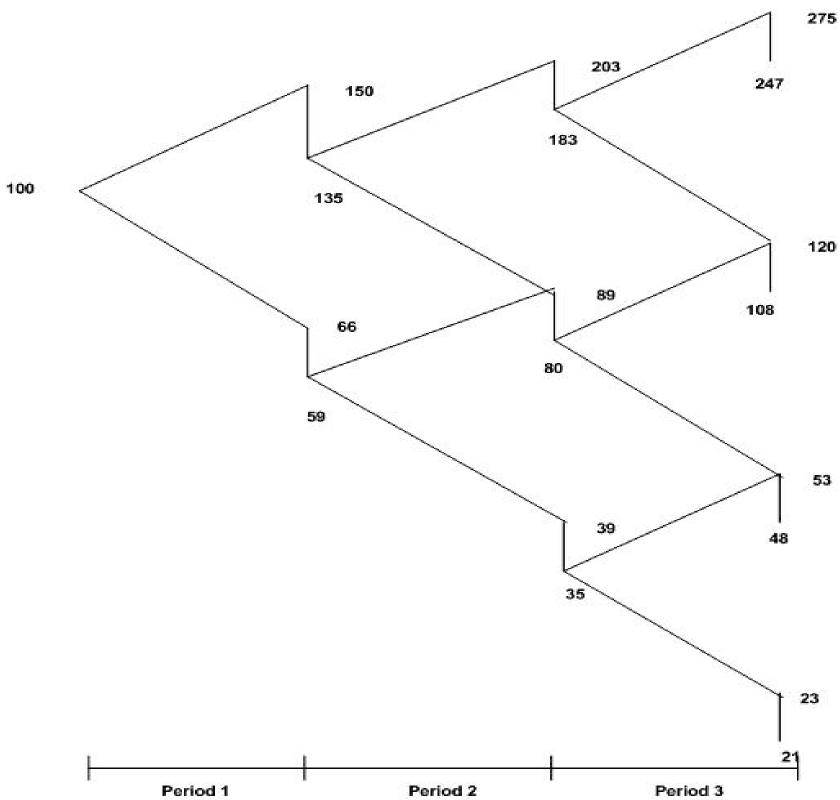
t, r denotes risk-free rate, R_t represents salvage value at stage t, I denotes investment outlay, and V_2 is expected investment value at state 2.

The expected investment values of player A and B come from the calculation:

$$V_A = p \times V_{u,A} + (1-p) \times V_{d,A}\,, \quad V_B = p \times V_{u,B} + (1-p) \times V_{d,B}\,, \tag{4}$$

where $p = (1 + r - d)/(u - d) = (1 + 0.1 - 0.66)/(1.5 - 0.66) = 0.52$ is neutral probability, μ, d are the incremental or decline percentage of market value, and $V_{i,j}$ denotes the investment value of player j when the nature goes up (μ) or down (d).

Figure 1: Dynamics of present value of market cash flow



The market cash flow and present value are assumed to increase 50% ($u = 1.5$), or decline 66% ($d = 0.66$), and risk-free rate is 10% ($r = 0.1$). the present value is 100, and will increase to 150 or decline to 66 next stage. the second cash flow is equal to 15 (150 minus 135), or 7 (66 minus 59).

When both players invest immediately, the value of each player would be (10, -10) if market share is three-fifths versus two-fifths. That's because $V_A = 100 \times 3/5 - 50 = 10$, $V_B = 100 * 2/5 - 50 = -10$. Most investment outlays have salvage values in the subsequent periods. I assume that the original investment outlay has salvage value of 40 ($R_1 = 40$) and 30 ($R_2 = 30$) at end of stage 1 and 2, respectively. Each player can stop its investment to recover the salvage value if nature moves down. However, the market may sustain one player's operation even if nature moves down. The options to abandon between competitors become a game.

RESULTS

Both Players Invest Simultaneously in the First Stage

Figure 2 shows the value pairs for the two-player investment decisions. The extensive form only extends branch if both players invest simultaneously. In the two-stage game, each player can decide to abandon (a) at stage 2 or stage 3, or stay (s) beyond stage 3. When nature moves up at stage 1 and 2, the value pairs would be equal to (42, 39) if both players decide to stay at stage 1 and 2.

This is because $V_A = 15(3/5)/1.1 + 203(3/5)/1.1^2 - 50 = 59$,

$V_B = 15(2/5)/1.1 + 203(2/5)/1.1^2 - 50 = 23$ .If nature moves up at stage 1 and moves down at stage 2, the value pairs of player A and B would be equal to $V_A = 15(3/5)/1.1 + 89(3/5)/1.1^2 - 50 = 2$ and $V_B = 15(2/5)/1.1 + 89(2/5)/1.1^2 - 50 = -15$.

The expected investment value of player A is $V_A = p \times V_{u,A} + (1-p) \times V_{d,A} = 0.52 \times 59 + 0.48 \times 2 = 31$, and B $V_B = p \times V_{u,B} + (1-p) \times V_{d,B} = 0.52 \times 23 + 0.48 \times (-15) = 5$.

The subgame perfect Nash equilibrium set of strategies can be reached by backward induction. Both players would stay if nature (N) moves up (u) at the early stage, and continue to stay no matter if nature moves up or down in the following stage. The expected value pairs would be (31, 5).

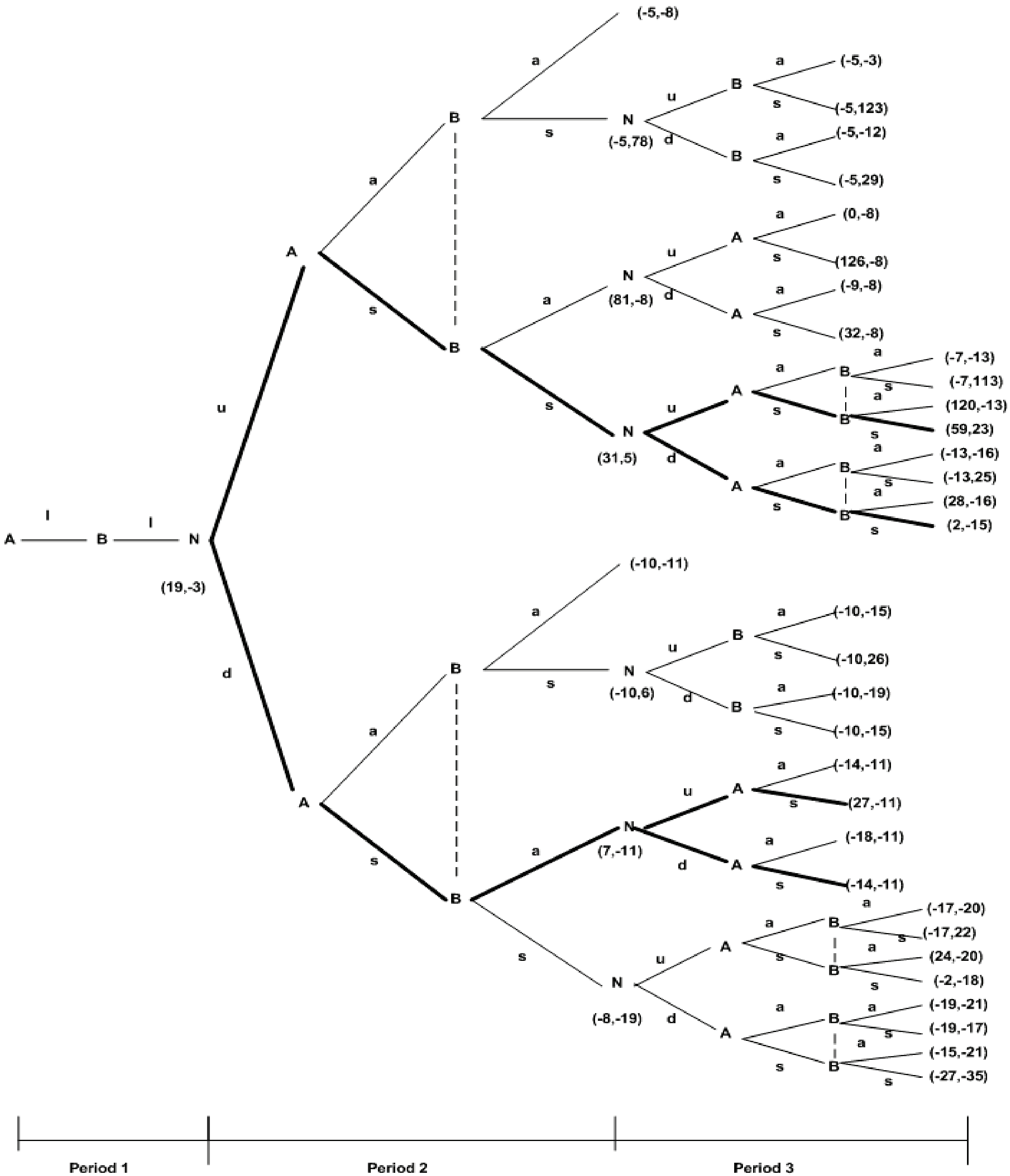
However, when nature moves down (d) at stage 1, the strategy equilibrium would be (stay, abandon) and the value pairs are (7, -11). The dominant strategy for player B is to abandon when nature moves down at the early stage. This is because player B seizes less market share than that of player A. If player B also continues to stay, player B would lose more (-19 < -11). Therefore, unless the market turns out to be large enough to support both players, the preferred strategy of follower B should be abandon.

The expected value of player A equals to $V_A = p \times V_{u,A} + (1-p) \times V_{d,A} = 0.52 \times 31 + 0.48 \times 7 = 19$, and B $V_B = p \times V_{u,B} + (1-p) \times V_{d,B} = 0.52 \times 5 + 0.48 \times (-11) = -3$. Based on the backward induction, the expected investment value pairs is (19, -3), which are larger than those without abandonment options (10, -10). Both players would receive a poorer outcome if they decide stay at the same time when the market turns out to be worse. One player can increase his value by abandoning investment, but the competitor seizes the whole market and result in a larger investment value.

Player A Invests While Player B Delays in the First Stage

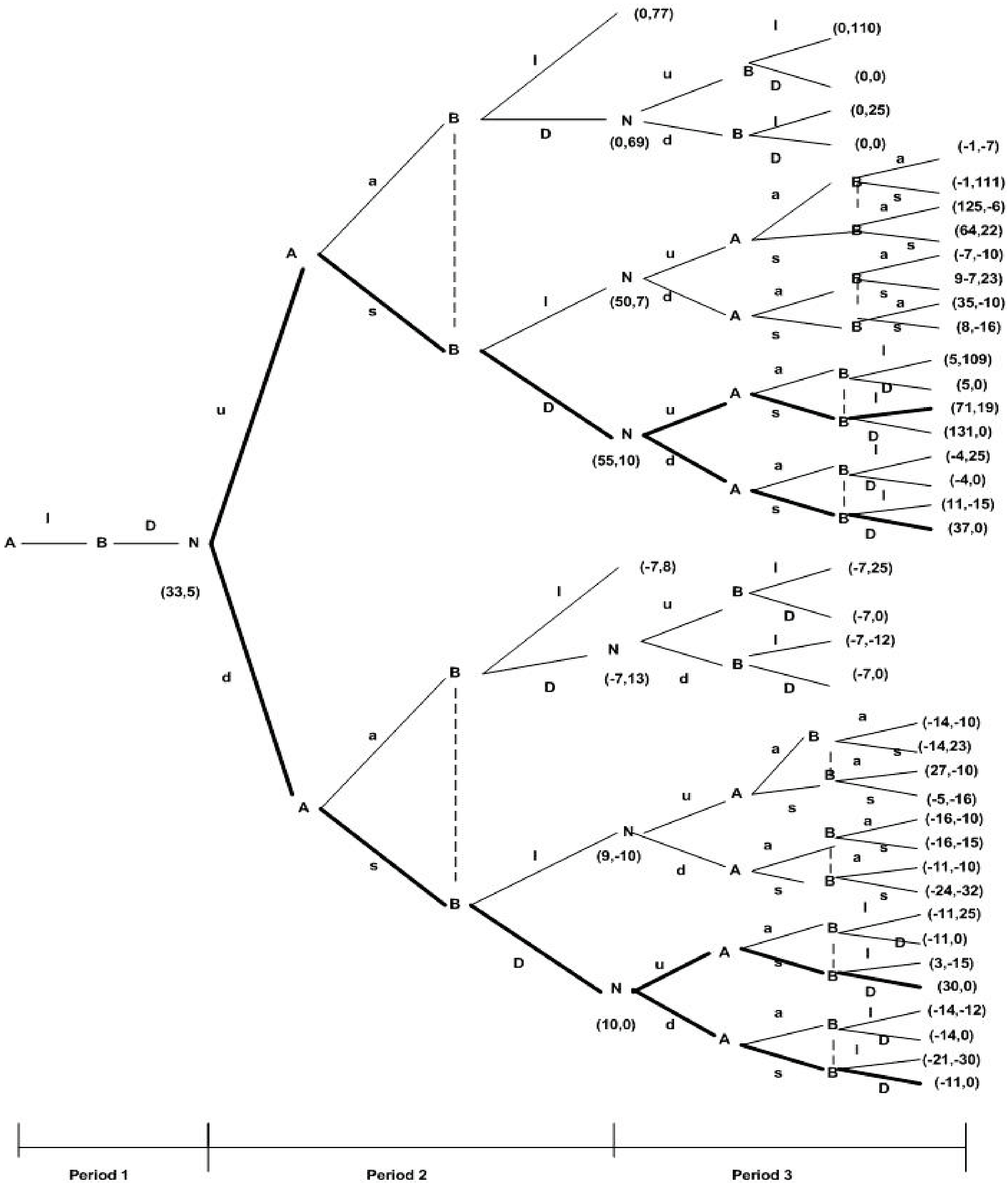
Next, I will discuss the example of a leader player A, who invests, while the follower player B delays in the first stage. Exhibit 3 presents the backward induction outcome. When the market turns out to be favorable in the early stage, player A will stay no matter what the market develops in the successive stage. Player B should delay in the second stage, and still delay if market doesn't goes up in the third stage. On the contrary, if the market goes up in the third stage, player B should invest. The subgame perfect Nash equilibrium set of strategies for the two players are (stay, delay) at second stage, resulting in value pairs (55, 10) When nature moves down in the early stage, the dominant strategy for player A is to stay beyond stage 2 no matter how nature moves in the following stage, while the dominant strategy for player B is still to delay. Therefore, unless the market turns out to be large enough to support both players, the preferred strategy of weak player B should be to delay. Based on the backward induction, the subgame perfect Nash equilibrium set of strategies for the two players are (stay, delay) at second stage, resulting in value pairs (10, 0). The expected investment value pairs is (33, 5), when player A invests while player B delays in the first stage.

Figure 2: Investment values when two players invest simultaneously.



Each player (A, B) can decide to abandon (a) at stage 2, stage 3, or stay (d) beyond stage 3. The nature (N) may move up (u) or down (d). The market shares of A and B are three-fifths and two-fifths. The values of both players (A, B) are shown in parentheses. The bold line shows the subgame perfect Nash equilibrium.

Figure 3: Investment values when player A invests while player B delays



Leader A can decide to abandon or stay at stage 2, stage 3, while follower B must decide to invest or still delay at stage 2 or 3. The nature (N) may move up (u) or down (d). The market shares of A and B are three-fifths and two-fifths. The values of both players (A, B) are shown in parentheses. The bold line shows the subgame perfect Nash equilibrium..

Player A Delays While Player B Invests in the First Stage

Exhibit 4 presents the backward induction outcome when player A delays while follower B invests in the first stage. When the market turns out to be favorable in the early stage, the subgame perfect Nash equilibrium set of strategies for the two players are (investment, stay) at second stage. The player B will stay beyond stage 2 no matter how the market develops in the successive stage. Player A should invest in the second stage, and stay beyond stage 2 even if the market moves down in the following stage. The value pairs of both players are (28, 13). The result is different than the above case when player A invests and player B delays, whose subgame perfect Nash equilibrium set of strategies are (stay, delay) at the second stage. When player B invests first, player A will invest immediately invest if nature moves up. However, if player A invests first, player B waits to see even if nature moves up in the second stage.

When nature moves down at the early stage, the dominant strategy for player B is to abandon, while player A is to delay at stage 2. In the third stage, player A should delay when the nature moves down still, but invest if the nature goes up in the successive stage. The subgame perfect Nash equilibrium set of strategies for the two players are (delay, abandon) in the second stage, resulting in value pairs (13, -7). Based on the backward induction, the expected investment value pairs of both player would be equal to (15, 12).

Both Players Delays in the First Stage in the First Stage

Finally, I examine the case of both player delays in the first stage. Exhibit 5 presents the backward induction outcome when the market turns out to be favorable in the early stage. Player A will invest and stay even if the market moves down in the successive stage. The player B should still delay in the second stage, and invest if the market goes up in the third stage. The value pairs of both players are (51, 5). The strategy of player B is similar to the case of leader A invests firstly while player delays in the first stage.

Figure 6 shows the backward induction outcome when nature moves down in the early stage. The dominant strategy for both players is to wait in the second stage. If the market turns out to be favorable in the third stage, player A would invest and player B would still delay. If the nature doesn't go up, both players should wait and see. Based on backward induction, the value pairs of waiting option are (13, 0). The expected investment value pairs of both players are (33, 3).

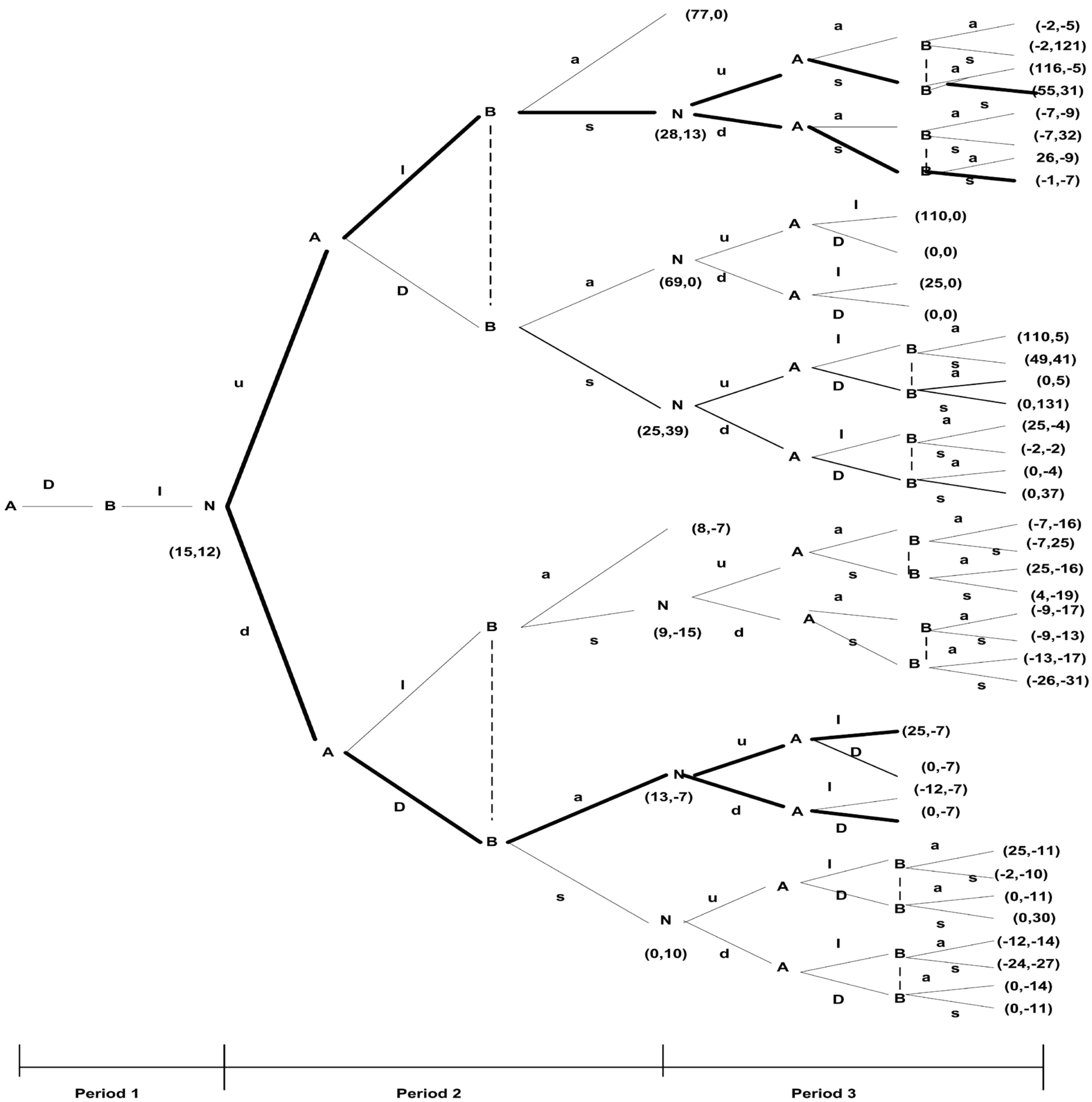
Strategic Investment Decision

Exhibit 7 shows the strategic investment decision for two players which have unequal market powers. The Nash equilibrium for the two players is a game of chicken. When player A invests, player B is better off by wait and see. When player B invests, play A should delay to see how the market moves. The value pairs are (15, 12) or (33, 5). The value of leader A is larger than follower B. This is because when follower B invests and leader A waits in the first stage, leader A will invest if market the goes up in the next stage. However, if the leader A invests first and follower B waits, follower B will still waits even if the market goes up in the second stage. The bigger a firm is, the bigger the firm becomes. In the competitive market, the scale of economics dominates the competitive advantage.

CONCLUSION

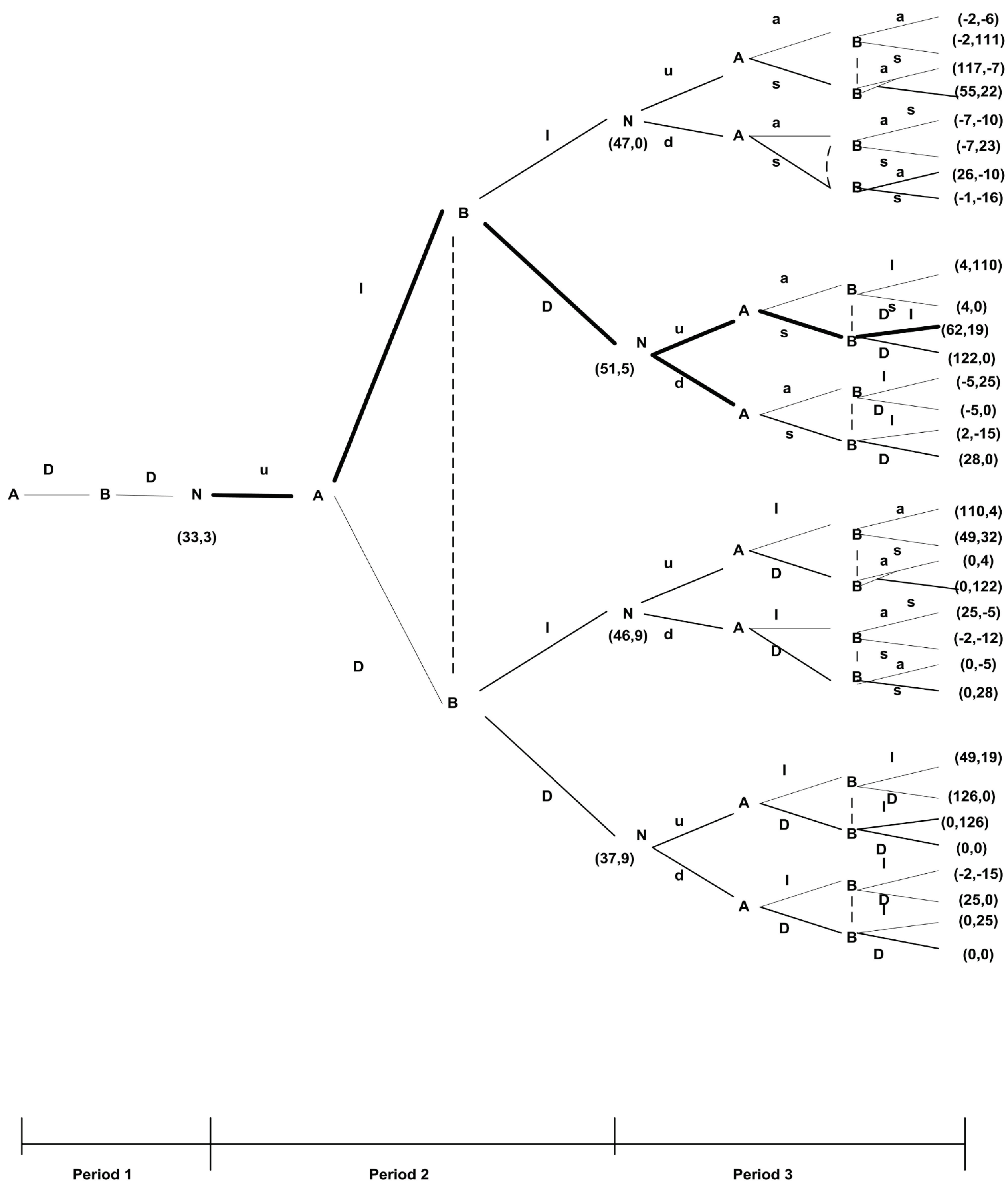
The chain and franchise store industry is very competitive in Taiwan. It becomes essential for a firm to be more flexible in their investment strategy. The purpose of this study is to examine and demonstrate strategic investment decisions faced by chain and franchise stores companies, by incorporating abandonment options to strategic timing in a game-theoretic real option approach. Each firm can decide not only when to invest, but when to abandon if he had invested. This paper incorporates an abandonment option to strategic timing in a game-theoretic real option approach, making the approach more complete and accurate. The example presented in Smit and Ankum (1993) is extended to analyze when to invest with the option to abandon. There are two players in a three-period game. By comparison to Smit and Ankum, the next market cash flow and present value are same as their work.

Figure 4: Investment Values When Player A Delays While Player B Invests



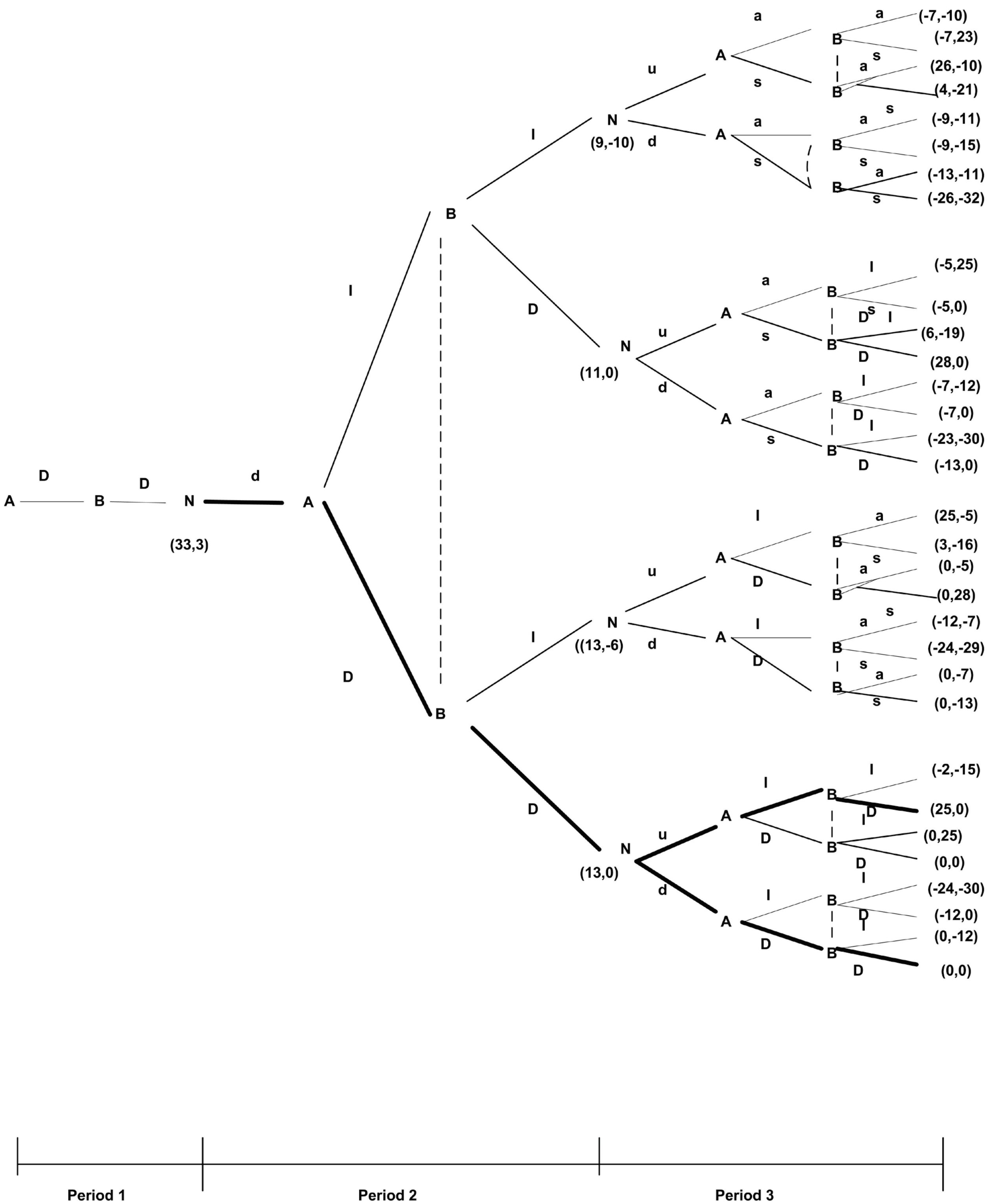
The extensive form extends branch of leader A delays (D) while follower B invests (I). Leader A must decide to invest or delay at stage 2, stage 3, while follower B can decide to stay (s) or abandon (a) at stage 2 or 3. The nature (N) may move up (u) or down (d). The market shares of A and B are three-fifths and two-fifths. The values of both players (A, B) are shown in parentheses. The bold line shows the subgame perfect Nash equilibrium.

Figure 5: Investment Values When Both Players Delay



The extensive form extends branch of both players delays (D). Both players decide to invest or delay at stage 2, stage 3. The exhibit only shows the time when nature (N) may move up (u). The market shares of A and B are three-fifths and two-fifths. The values of both players (A, B) are shown in parentheses. The bold line shows the subgame perfect Nash equilibrium.

Figure 6: Investment Values When Both Players Delay



The. extensive form extends branch of both players delays (D). Both players decide to invest or delay at stage 2, stage 3. The exhibit only shows the time when nature (N) moves down (d).The market shares of A and B are three-fifths and two-fifths. The values of both players (A, B) are shown in parentheses. The bold line shows the subgame perfect Nash equilibrium.

The results show that the chain and franchise store industry favors large companies. A bigger firm will invest in retail stores faster than a smaller one. A company with larger market power can sustain a declining market much longer than its competitor. The small firm is better to wait until the market improves. The paper provides a guideline for analyzing investment strategies in chain and franchise stores. Nevertheless, it cannot answer all possible situations a firm might encounter in the chain. The demonstration can be extended to incorporate more firms, or investigate the effect of changing market share. This will leave for further research.

Figure 7: Strategic Investment Game in the First Stage

Player A	**Player B**	
Investment value	Investment	Delay
Investment	19,-3	**33,5**
Delay	**15,12**	33,3

The standard form shows investment game for the two players, which have unequal market power. The values of both players (A, B) are shown in parentheses. The bold numbers show the perfect Nash equilibrium.

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