“Knowledge Appropriation vs. Knowledge Sharing”:

A Study on the Problem of Knowledge Appropriation by Local Human Resources in Asian Subsidiaries of Japanese MNEs

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September 2020 NO.2002

Knowledge Appropriation vs. Knowledge Sharing: A Study on the Problem of Knowledge Appropriation by Local Human Resources in Asian Subsidiaries of Japanese MNEs[1]

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［Key Words］
Knowledge Appropriation, Knowledge Sharing, Gray Areas Management,
Degree of Dependence on Personal Skills and Knowledge

[1] The preliminary versions of this paper were presented at JSIE Annual Conference (2017), JAIBS Annual Conference (2018), and KIEA Winter Conference (2019). The authors are very much thankful for invaluable advices from Prof. F. Adachi, Prof. Y. Okawa, Prof. K. Kondoh, Prof. T. Kasahara, Prof. S. Tabata, Prof. K. Nakayama, Prof. S. S. Gyu, Prof. M. Kim, Prof. J. Park, Prof. T. Furusawa, and Prof. S. Nakamoto. Naturally, any remaining errors are the responsibility of the authors.

Abstract

This study focuses on an interesting contrast of "knowledge appropriation vs. knowledge sharing" in author's interviews to Asian subsidiaries of Japanese MNEs, i.e., in some interviewed cases, newly promoted HCNs (Home Country Nationals) are likely to appropriate their useful skills and knowledge on "gray areas management", whereas in some other interviewed cases, they are willing to share these skills and knowledge with their subordinate members.

Then, looking into the findings in Hayashi (2018) that, by comparing the three interviewed cases, "(1) degree of dependence on personal skills and knowledge", and "(2) relative size of prospects for growing opportunities" are the two key explanatory factors in the decision making by newly promoted HCNs on "knowledge appropriation vs. knowledge sharing", this study analyzes a game between "J" (Japanese Executives) and "P" (Promoted HCNs) in Asian subsidiaries of Japanese MNEs, and examines the equilibrium path which leads to either "knowledge appropriation" or "knowledge sharing" depending on parameter conditions.

In the basic model analysis, where no policy instruments are used by "J", the following results are obtained. i.e., As for the second key factor [(2) b_{Ch} : relative size of prospects for growing opportunities], consistent with the above mentioned findings, "knowledge appropriation" takes place when "b_{Ch}" is relatively low [$b_{Ch} < \theta$ (= parameter of wage premium for the upper rank position)], while "knowledge sharing" takes place when "b_{Ch}" is relatively high [$b_{Ch} > \theta$]. On the other hand, as for the first key factor [(1) a: degree of dependence on personal skills and knowledge], it is derived that, "knowledge sharing" cannot be achieved simply by lowering the value of "a", because "(i) "total return damaging effect (−)" always outweighs "(ii) wage payment saving effect (+)" at any value of "a" [$0 < a < 1$] so long as no policy instruments are available.

In the extended model analysis, assuming the availability of the two sets of policy instruments [i.e., "②Stick Policy" and "③Carrot Policy"], parameter conditions are examined to derive the regions where the shift from "knowledge appropriation" to "knowledge sharing" can be achieved. Then, it is shown that, in the three cases out of five cases in $a_1 \times b_{Ch}$ space [$0 < a_1 < 1$, $0 < b_{Ch}$], the shift from "knowledge appropriation" to "knowledge sharing" takes place [i.e., "Case 2"～ "Case 4": knowledge appropriation → knowledge sharing], whereas "Case 1" implies the case of "consistently knowledge sharing", while the "Case 5" implies the case of "persistently knowledge appropriation".

1. Introduction

<Positive vs. Negative Effects of Localization in Japanese MNEs' Subsidiaries>

In the literature of the localization in foreign subsidiaries of Japanese MNEs, or that of the replacement of expatriate PCNs (Parent Country Nationals) to HCNs (Home Country Nationals), both positive and negative effects on their performance have been discussed.

On the positive effects of localization, as discussed in Bartlett and Yoshihara (1988), Kopp (1994), and Legewie (2002), the staffing policy of HCNs to higher executive positions is expected to enhance their performance in various ways as follows. i.e., It would encourage HCNs to explore possible opportunities for mobilizing their local knowledge with their higher levels of morale and commitment to their MNEs, as well as gaining higher legitimacy within the host country and the favorable recognition by host country's government.

In contrast, as discussed in Gong (2003), Oki (2014) and Ando (2014), the negative effects of the localization are likely to take place under certain circumstances when the roles played by expatriate PCNs are highly appreciated in foreign subsidiaries.

For instance, in Oki (2014), relating to the knowledge transfer problem, the life cycle stages of foreign subsidiaries is pointed out, i.e., at the initial starting up stages or the steadily growing stages in the business life cycles of foreign subsidiaries, the skill and experiences of PCNs are likely to be highly required for the effective transfer of tacit knowledge from their Japanese parents, and hence, the hasty localization of HCNs is likely to lower the performance of foreign subsidiaries.

For another instance, in Gong (2003) and Ando (2014), relating to the problems of knowledge transfer and subsidiary controlling, the cultural and institutional factors are pointed out, i.e., in cases where cultural and institutional conditions between Japanese parents and their foreign subsidiaries are relatively distant, greater degree of uncertainties is likely to increase the required time and efforts for the knowledge transfer as well as to cause various agency problems to monitor and control their subsidiaries. And then, in those cases, rather than localizing HCNs, the staffing policy of PCNs in foreign subsidiaries is expected to enhance their performance, as PCNs are more familiar with tacit and context specific knowledge of the firm, while they are more committed to their parents in Japan.

<Knowledge Appropriation vs. Knowledge Sharing in Asian Subsidiaries>

Then, following these literatures, the author carried out his own interview researches in 2007 and 2013 on human resource development to Asian subsidiaries of Japanese MNEs. Examining possible effects of localization of HCNs on the

performance of these subsidiaries, he observed both the positive and negative effects which were mostly consistent with the points discussed in these literatures.

However, looking into these negative effects of localization, in addition to the points discussed in the literatures, the problem of "knowledge appropriation" was observed in some interview cases, which seems to be an important underlying factor for other negative effects such as (1) stagnation in knowledge transfer, as well as (2) agency problem or insufficient controlling problem of foreign subsidiaries.

In the literature of economics and business studies, the problem of "knowledge appropriation" has been discussed where a certain member of an organization attempts to appropriate some useful knowledge and/or information (rather than sharing them with other members of the organization) for some reasons such as a fear in him/herself that his/her position might be overtaken by successors.[2]

And then, in some cases of the author's interviews in 2007 and 2013, this problem of "knowledge appropriation" was observed, where the key elements of the knowledge appropriated by the promoted HCNs seem to be closely associated with the context specific knowledge on "gray areas" (or "not clearly assigned task areas") which was discussed in the framework of "J-type vs. F-type" model (Ishida, 1982) as well as discussed in its modified version of "gray areas engagement vs. well-defined engagement" model by Hayashi (2005, 2012, 2018). i.e., In some cases, after some HCNs had been promoted to the division heads, they tried to appropriate their knowledge on the "managing capability of gray areas". In contrast, in some other cases, the exactly opposing image of "knowledge sharing" was observed, where the newly promoted HCNs were willing to share their knowledge on the "managing capability of gray areas" with their sub-ordinate members of their divisions.[3]

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[2] For instance, in Shleifer and Vishney (1989), this problem was analyzed where managers are likely to entrench themselves by making manager-specific investments that make it costly for shareholders to replace them. For another instance, in Prendergast (1995), this problem was analyzed where managers are likely to carry out too many tasks with exerting too much effort on her own tasks, while delegating too few tasks to her subordinates.

On the other hand, in the context of human resource management in foreign subsidiaries of Japanese MNEs, this problem has been pointed out in JMF (1997) and JRC (2012) etc. as an important challenge for Japanese MNEs, whereas, not sufficient studies have yet been carried out to examine (1) Why and under which conditions, is this problem likely to take place? and (2) For a foreign subsidiary of Japanese MNE, how to manage this problem? etc…

[3] As for the issue of "knowledge sharing", in various preceding researches on the organizational learning [e.g., Senge (1990)] as well as those on the knowledge management [e.g., Nonaka and Takeuchi (1995)], the importance of "knowledge sharing" and the possible manners to achieve its efficiency have been discussed. Then, following their discussions, this study is trying to investigate another question, i.e., why, how, and depending on which conditions, can both the

Furthermore, as will be discussed in section 2, comparing the three interviewed cases where relatively detailed information was available on the decision making by the promoted HCNs, the following two variables were derived as "the two key explanatory factors" for the relative size of their incentives for "knowledge appropriation vs. knowledge sharing", i.e., (1) "degree of dependence on personal skills and knowledge" is likely to raise the incentives for "knowledge appropriation", whereas (2) "relative size of prospects for growing opportunities" is likely to raise the incentives for "knowledge sharing". In addition, in many cases of the author's interviews, relating to these "two explanatory factors", "the two sets of policy instruments" were also observed, both of which would aim to mitigate "knowledge appropriation" and to encourage "knowledge sharing", i.e., (1') policy instruments to lower the "degree of dependence on personal skills and knowledge" (e.g., preparation for full-fledged manual, team learnings from QC circle activities), and (2') policy instruments to enhance "relative size of the prospects for growing opportunities" (e.g., visualization for future growth, formulation of salary growth plan).

<Research Question & Outline of the Study>

Based on these discussions in the existing literature as well as on the findings from author's interviews, this study focuses on problem of "knowledge appropriation by the newly promoted HCNs" as one of the crucial problems on the negative effects of "too much localization", and theoretically analyzes a game between "Japanese Executives (J)" and "Promoted HCNs (P)" in Asian subsidiaries of Japanese MNEs.

In particular, giving special attentions to "the two key explanatory factors" [(1) degree of dependence on personal skills and knowledge, and (2) relative size of prospects for growing opportunities] as well as to "the two sets of policy instruments" [(1') instruments to lower the "degree of dependence on personal skills and knowledge, and (2') instruments to enhance "relative size of prospects for growing opportunities], the following two questions are going to be examined.

Q1 : How and under which conditions would the localization of HCNs cause the contrasting results of "knowledge appropriation vs. knowledge sharing" in Asian subsidiaries of Japanese MNEs?

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contrasting observations of "knowledge appropriation" vs "knowledge sharing" take place?

Q2 : In case of utilizing the policy instruments, how and under which conditions would a shift from “knowledge appropriation” to “knowledge sharing” take place?

Section 2 is the preliminary examination for the theoretical analysis in section 3 and section 4. Relating to the key elements of the knowledge for both knowledge appropriation and knowledge sharing, the notion of gray areas management is explained as well as its underlying framework of “gray areas engagement vs. well-defined engagement” model by Hayashi (2005, 2012). Then, contrasting the three interviewed cases where relatively detailed information was available on the decision making by the promoted HCNs, ”the two key explanatory factors” [i.e., (1) degree of dependence on personal skills and knowledge, and (2) relative size of prospects for growing opportunities] for the relative size of their incentives for “knowledge appropriation vs. knowledge sharing” are pointed out.

Section 3 examines the first question (Q1) by using the basic model, where a game between “Japanese Executives (J)” and “Promoted HCNs (P)” is assumed without any policy instruments. Going through the analysis, either “knowledge appropriation” or “knowledge sharing” is derived as the equilibrium depending on the values of a set of parameters for the two key explanatory factors [(1) degree of dependence on personal skills and knowledge, and (2) relative size of prospects for growing opportunities].

Section 4 examines the second question (Q2) by using the extended model, where the two sets of policy instruments are assumed [i.e., “②Stick Policy” and “③ Carrot Policy”], and parameter conditions are examined to derive the regions where the shift from “knowledge appropriation” to “knowledge sharing” can be achieved.

Section 5 summarizes the analytical results, and describes some remaining problems for further researches.

2. “Gray Areas Engagement vs. Well-defined Engagement” Model and Two Explanatory Factors for “Knowledge Appro. vs. Knowledge Sharing”

In section 2.1, noting that the key elements of knowledge for both “knowledge appropriation” and “knowledge sharing” are closely associated with the management capability of “gray areas” [Ishida (1982)], the framework of “gray areas engagement vs. well-defined engagement model” [Hayashi (2005)] is briefly described.

In section 2.2, based on the discussion in Hayashi (2018, 2020), comparing the three interviewed cases where relatively detailed information was available on the decision making by the promoted HCNs, the two key explanatory factors for the relative size of their incentives for “knowledge appropriation vs. knowledge sharing” are illustrated.

2.1 “Gray Areas Engagement vs. Well-defined Engagement” Model

2.1.1 Misalliance Problem and “Gray Areas vs. Well-defined Engagement” Model

“Gray areas engagement vs. well-defined engagement model” [Hayashi (2005)] is a modified version of “J vs. F-Model” [Ishida (1982, 1994)], both of which focus on the notion of “gray areas” (“not clearly assigned task areas”) [Ishida (1982)] or “the area of mutual responsibility” [Ishida (1994)] as a major source of the misalliance problem between Japanese parents and foreign subsidiaries.

The model discusses the management of the gray areas, and contrasts the relative efficiency achieved in Japanese parents with that achieved in Asian subsidiaries. In Fig.1 [Japanese parents], given the mentality of Japanese employees or PCNs which is comfortable with flexible engagement with their stronger commitment to the firm, gray areas are likely to be smoothly managed to become “overwrapping areas”, where the flexible cooperation and mutual learnings can be achieved among them. On the other hand, in Fig.2 [Asian subsidiaries], given the mentality of HCNs which is comfortable with well-defined engagement in clearly assigned tasks with their stronger sense of specialized professionalism, gray areas are likely to be left as “vacant areas”, where each member is not willing to commit to manage these areas, and mutual learnings based on their knowledge and information sharing cannot be smoothly achieved.

In addition, it was also discussed in Hayashi (2005) that the contrasting nature of “Gray Areas Engagement vs. Well-defined Engagement” Model can be illustrated from the three aspects of (1) manners of tasks and job assignment, (2) mode of skill and knowledge, and (3) manners of coordination and collaboration,

which are shown in Table 1.

2.1.2 Dynamic Modification to Manage the Misalliance Problem

As discussed in Hayashi (2005), this framework of "gray areas engagement vs. well-defined engagement model" can also be useful to illustrate the stylized pattern of dynamic modification which mitigates the misalliance problem as follows.

As observed in JMF (1997), JRC (2012), and Hayashi (2004, 2005), various types of efforts have been carried out in Asian subsidiaries of Japanese MNEs which seem to be helpful in mitigating the misalliance problem, e.g., preparation for user-friendly manuals, standardization of skills and contents of tasks, QC circle activities, systematic development of multiple skills, etc. In Hayashi (2005), using the framework of the "gray areas engagement vs. well-defined engagement model", each of these efforts is interpreted as a part of the stylized pattern of "stepwise hybrid modification of clarification and enhancement" as illustrated in Fig.3 and Table 2.

As the 1st step & static modification, the clarification of "gray areas" is carried out. i.e., In order to adapt to local conditions (e.g., mentality of HCNs for well-defined commitment and for stronger sense of specialized professionalism), the original "gray areas engagement model" is likely to be modified, where some of the elements of "well-defined engagement model" are likely to be implemented. For instance, (1) preparation of user-friendly & full-fledged manuals, (2) standardization in contents of skills and tasks, (3) emphasis on vertical coordination (report to the boss, command from the boss) etc. are frequently implemented, so that the contents of "gray areas" are to be more clarified and/or their size is to be relatively small.

On the other hand, as the 2nd step & dynamic modification, the enhancement of "gray areas managing capability" is carried out with taking considerable time & efforts in Asian subsidiaries. i.e., In order to achieve higher efficiency associated with "gray areas" management, some elements of "gray areas engagement model" is likely to be enhanced. For instance, (1) a system of qualification to develop multiple skilled workers, (2) quasi-cell and full-cell production system, (3) QC circle activities and cross-sectional project teams etc. are frequently implemented, so that useful knowledge and information on "gray areas" are to be shared by team members, and their mentality and capability for "gray areas management" is to be enhanced through their smooth and flexible cooperation as well as through their mutual learnings.[4]

[4] In Hayashi (2005, 2012), on the recent evolution in Japanese parents, it was

2.2 Illustration of Two Explanatory Factors for "Knowledge Appropriation vs. Knowledge Sharing"

In this section, based on the discussion in Hayashi (2018, 2020), examining the three interviewed cases where relatively detailed information was available on the decision making by the promoted HCNs, the two key explanatory factors for "knowledge appropriation vs. knowledge sharing" are illustrated. i.e., Comparing case X and case Y, (1) "degree of dependence on personal skills and knowledge" is likely to raise the incentive for "knowledge appropriation", which leads to the stagnation in the development of "gray areas managing capability". Then, examining case Z, (2) "relative size of prospects for growing opportunities" is likely to raise the incentive for "knowledge sharing", which leads to the promotion in its development.[5] [6]

2.2.1 Case X: "Knowledge Appropriation" with "Higher Dependence on Personal Skills and Knowledge"

As described above, it takes considerable time & efforts for Asian affiliate to develop gray areas managing capability. Whereas, in case X, possibly due to the market condition (i.e., high competitive pressures with many newly entrants) and to the firm specific condition (i.e., not sufficient support available from Japanese parent), Asian affiliate could not afford sufficient time & efforts in its development. And thus, the gray areas managing capability was developed only to the limited core members of HCNs, and the "degree of dependence on personal skills and knowledge"

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discussed that the conventional pattern of "Gray Areas Engagement" model (Fig.1) has been significantly modified, where various elements of "Well-defined Engagement" Model have been introduced, so that another version of stepwise hybrid modification of clarification and enhancement are now observed in Japanese parents. This modification is mainly aiming for revising possible demerits of conventional J-system (i.e., excessive redundancy in time and efforts regarding to gray areas management, vagueness in the autonomy and responsibility of the top management).

[5] In Hayashi (2018), based on the author's findings in previous interviews, the two key explanatory factors were illustrated. Then, in Hayashi (2020), based on this discussion, the following two points were analyzed, i.e., (1) The arising mechanisms of "knowledge appropriation vs. knowledge sharing" were explicitly explored, where a pair of different set of conditions which leads to the observed opposing results was examined, (2) Viewing as a jointly occurring problem of "ineffective control" & "inefficient knowledge transfer", a dynamic feedback of "knowledge appropriation" is explored as contrasted with that of "knowledge sharing".

[6] The brief overview of the four series of author's interviews is described in Appendix 1, while the detailed description of the three interviewed cases of X, Y, and Z is in Hayashi (2018).

was relatively high in the sense that a factory might face serious difficulties without the full commitments by the currently promoted HCNs.

In this circumstance, after promoted to the division heads, some of these HCNs started to appropriate their knowledge in a following manner. i.e., After the promotion, their individual "gray areas managing capability" was steadily improved, because they had more learning opportunities of "trials and errors" while receiving useful advices from senior Japanese advisors. However, they were not willing to share these knowledge and information on "gray areas management" with other members, and they were not supportive for making user-friendly manuals for certain areas of the advanced technology, for fear that they might lose their advantages over their subordinate members. In addition, they would negatively evaluate the voluntary activities by some of the subordinate members to promote cross-sectional collaboration which would be useful for information and knowledge sharing on "gray areas management".

Furthermore, as pointed out by Hayashi (2018), given higher dependence on personal skills and knowledge, the incentives of promoted HCNs for knowledge appropriation are likely to be high due to the dual reasons of (a) lower risk of knowledge appropriation, and (b) higher benefit from knowledge appropriation, which are summarized as follows as in Fig.4.

Firstly, as for the risk of knowledge appropriation, the risk is likely to be lower from the viewpoint of the promoted HCNs, i.e., because "gray areas managing capability" of subordinate members (candidates for the successors) were not yet developed, and a factory might face serious difficulties without the full commitments by the currently promoted HCNs. And thus, to avoid these difficulties in a factory, even in the case of "knowledge appropriation" by currently promoted HCNs, PCNs executives cannot easily replace them to their subordinate members.

Secondly, as for the benefit from knowledge appropriation, the benefit is likely to be higher from the viewpoint of the promoted HCNs, i.e., because the gap in the level of knowledge and information is relatively huge between the promoted HCNs and their subordinate members, the chances of taking advantages of knowledge appropriation (monopolizing useful knowledge and information) is relatively large. In addition, due to this huge gap, it is relatively easy for the promoted HCNs to appropriate newly incoming flows of knowledge and information, as they are in the advantageous positions in controlling their flows.

2.2.2 Case Y: "Knowledge Sharing" under "Lower Dependence on Personal Skills and Knowledge"

On the other hand, in case Y, possibly due to two favorable conditions [(1) high communication capability of PCNs (Japanese executive who stayed studying in China for years), (2) high availability of timely & technical support from Japanese parent], the Asian affiliate had spent sufficient time and efforts in the development of gran areas managing capability.

Accordingly, it was pointed out that the number of core members with sufficient levels of "gray areas managing capability" was relatively high, and the "gap in useful knowledge and information" between the promoted HCNs and their subordinate members was relatively small, which leads to the lower degree of dependence on personal skills and knowledge in case Y.

In this circumstance, the evaluation system was implemented to induce "knowledge sharing" in case Y. i.e., For the promoted HCNs, "knowledge appropriation" was negatively evaluated, while "knowledge sharing" was highly evaluated as capable and qualified as a leader. Then, "knowledge sharing" was in fact observed, where the promoted HCNs were willing to share useful knowledge, information, and learning opportunities with their subordinate members, so that "gray areas managing capability" of individual members as well as that of subsidiary as a whole would be steadily promoted.

Furthermore, given lower dependence on personal skills and knowledge, the incentives of promoted HCNs for knowledge appropriation are likely to be low due to the dual reasons of (a) higher risk of knowledge appropriation, and (b) lower benefit from knowledge appropriation, which are the mirror images of Case X as follows as shown in Fig.5.

Firstly, as for the risk of knowledge appropriation, the risk is likely to be higher from the viewpoint of the promoted HCNs, i.e., because "gray areas managing capability" of subordinate members (candidates for the successors) were already well developed, and a factory might manage possible troubles and problems even without currently promoted HCNs. And thus, in case of the "knowledge appropriation" by currently promoted HCNs, PCNs executives might go ahead to replace them to their subordinate members with a qualified level of gray areas managing capability.

Secondly, as for the benefit from knowledge appropriation, the benefit is likely to be smaller from the viewpoint of the promoted HCNs, i.e., because the gap in the level of knowledge and information is relatively small between the promoted

HCNs and subordinate members, the chances of taking advantages of knowledge appropriation (monopolizing useful knowledge and information) is relatively small. In addition, due to this minimized gap, it is relatively difficult for the promoted HCNs to appropriate newly incoming flows of knowledge and information, as they are not so much in the advantageous positions in controlling their flows.

2.2.3 Case Z: "Knowledge Sharing" with "High Prospects for Growing Opportunities"

Similar to case X, one of the salient features of this case was a relatively high degree of dependence on skills & knowledge of particular HCNs (i.e., "Mr.A", who was appointed to be the vice president in 1993, when the subsidiariestarted her operations in China).

However, unlike case X, Mr.A did not appropriate his knowledge and information, but instead, he took a strong leadership to share his knowledge and information with other HCNs, and carried out various efforts in a stylized manner of stepwise hybrid modification as follows. i.e., For HCNs of production workers, like case Y, as the first step of "clarification", the standardization for the contents of tasks and required skills were carried out, and as the second step of "enhancement", the system of qualification for required skills in each section was implemented. For HCNs in upper classes, as the second step of "enhancement", the cross functional working group for business planning and product designing was implemented, where the executives and core managers from the three sections of sales, product designing, and manufacturing were actively involved.

Here, in case Z, as pointed out in Hayashi (2018), as the second key factor, "relative size of prospects for growing opportunities" seemed to have played a crucial role in the decision making of the promoted HCNs on "knowledge appropriation vs. knowledge sharing" as shown in Fig.6. Furthermore, "higher incentive for knowledge sharing" due to this second factor seemed to be sufficiently large to overweigh "higher incentive for knowledge appropriation" due to the first factor, which was observed in interviews as follows.

In firm Z, as an important principle for human resource development, there was a saying that "Leave it to him/her, while not leaving it to him/her", which was based on the management philosophy of Mr.B, who was the president of firm Z (Japanese parent) from the founder's family. i.e., The boss is supposed to entrust him/her with challenges and goals, while respecting his/her own ideas and initiatives. At the same time, the boss is always supposed to care for him/her to share his/her

challenges and goals.

Indeed, sharing this philosophy, Mr.B and Japanese parent entrusted Mr.A with challenging missions such as developing new product designs and initiating new market channels. And again, sharing this philosophy, Mr.A entrusted his subordinate members with proposing their own challenges in subsidiary in Chana. In particular, proposing his original vision for the subsidiary, he strived his sincere efforts for achieving this vision together with his members, namely, “Sense the global trend, and create our own design from China”. Accordingly, through the persistent efforts in their above mentioned “cross functional working group”, recently, they had more opportunities where they found themselves improved and getting more sophisticated as a team.

3. Basic Model Analysis

Based on the findings in author's interviews as discussed in the last section, this section examines the first question (Q1) by using the basic model, where a game between "Promoted HCN (P)" and "Japanese Executives (J)" is assumed without any policy instruments for J. Going through the analysis, either "Ap (Appropriation of knowledge)" or "Sh (sharing of knowledge)" is derived as the game's equilibrium depending on the values of a pair of parameters (a, b) for each of the two key explanatory factors [(1) degree of dependence on personal skills and knowledge, and (2) relative size of prospects for growing opportunities].

Q1 : How and under which conditions would the localization of HCNs cause the contrasting results of "knowledge appropriation vs. knowledge sharing" in Asian subsidiaries of Japanese MNEs?

3.1 Players of the Game and their Options (See Fig.7)

(1) P: Promoted HCN (Host Country National)

* Ap: Appropriation of knowledge

  After being promoted to a certain upper rank position, P (promoted HCN) would appropriate her/his knowledge for gray areas management.

* Sh: Sharing of knowledge

  After being promoted to a certain upper rank position, P would share her/his knowledge for gray areas management with other members.

(2) J: Japanese Executives

* St: Stay at the position

  J (Japanese executives) would let P to stay at the upper rank position until the end of the period.

* Ch: Change to a younger HCN

  J would let P change from the upper rank position to a regular position at a given timing in the middle of the period, while promoting Y (younger HCN) from the regular position to the upper rank position.

(3) Y: Younger HCN

* Y is explicitly assumed in the game as a wage receiver from J.
* However, Y has no options to choose. When J would choose St, P stays at the upper rank position, and Y stays at the regular position. On the other hand, when J would choose Ch, Y is promoted to the upper rank position.

3.2 Parameters Affecting the Total Return of Asian Affiliate

(1) a：Degree of dependence on personal skills and knowledge [0 < a < 1]

* The value of "a" indicates the ratio of damage in the total return of Asian affiliate which is caused by the change from P to Y for upper rank position.

(2) θ：Parameter of wage premium for the upper rank position [0 < θ]

* A certain ratio (θ) is additionally paid to the person in upper rank, because "extra tasks" are assigned to her/him compared with regular members.

(3) b：Relaticve size of prospects for growing opportunities [0 < b]

* The value of "b" indicates the ratio of increase in total return which is achieved when P chooses Sh (sharing of knowledge) rather than Ap (appropriation of knowledge).

(3') b_{St}：Value of "b" which is achieved when P chooses Sh, and J chooses St.
b_{Ch}：Value of "b" which is achieved when P chooses Sh, and J chooses Ch.

* Assumption of Highly Talented Y [0 < b_{St} < b_{Ch}]
  The total return is assumed to be higher when J chooses Ch (P is changed to Y) rather than choosing St (P & Y are staying at their positions)

3.3 Pay-Offs of Players for Each Combination of Options for P and J

* Three Rules of Wage Payment by Japanese Executives
  ① For the upper rank position, the extra ratio of θ is additionally paid.
  ・The extra ratio of θ is paid, because "extra tasks" are assigned to the upper rank position.
  ② Depending on the changes in the level of the total return of Asian subsidiaries, the level of wage payment is proportionally changed.
  ③ However, even in cases of significant reductions in the level of total return, the minimum wage payment is maintained to be no less than W (wage level in the open labor market)

Then, as shown in Table 3, the pay-offs of the players (P, Y, J) for each combination of options for P and Y is as follows.

1) (Ap, St): This combination of options is assumed to be the benchmark. i.e., At this combination, the benchmark total return is assumed to be "π", where P appropriates her/ his knowledge, and the Asian affiliate is highly dependent on her/his personal capability of gray areas management.

* Benchmark Total Return : π
  - "Benchmark Total Return" is assumed to be the total profit of Asian affiliate before wage payment is made to P and Y at the combination of (Ap, St)
* R_P : $(1+\theta)\cdot W$
  - Following rule ①, the extra ratio of θ is additionally paid to P.
* R_Y : W
  - Given the benchmark total return (π), W is paid to Y, which is equivalent to the wage level in the open labor market.
* R_J : $\pi-(2+\theta)\cdot W$
  - J would receive the residuals of profit. This rule is also applied to other combinations of options.

2) (Ap, Ch): At this combination of options, Ap (appropriation of knowledge) takes place by P, and J chooses Ch (P is changed to Y). Then, due to the loss in personal skills & knowledge of P, the total return of Asian affiliate is reduced.

* Total Return : $(1-a)\cdot \pi$
  - Due to the loss in skills & knowledge of P, the total return is reduced by the ratio of "a".
* R_P : W
  - Following rule ①, the extra ratio of θ is no longer paid to P.
  - Suppose rule ② is applied, the wage would be lowered to $(1-a)\cdot W$.
  - However, because of rule ③, the wage is maintained at W.
* R_Y : $(1-a)(1+\theta)\cdot W$ [when $(1-a)(1+\theta)$]
  - On one hand, Y is promoted to upper rank position, and the ratio θ is additionally paid to Y (by rule ①).
  - On the other hand, the wage level is lowered by the ratio of "a" due to the reduction in total return (by rule ②)
* R_Y : W [when $(1-a)(1+\theta) < 1$]
  - Suppose rules ① & ② are applied, the wage would be $(1-a)(1+\theta)\cdot W$.
  - However, because of rule ③, the wage is maintained at W.

3) (Sh, St): At this combination of options, P shares his/her skills and knowledge on gray areas management with other members to enhance the total return of Asian affiliate. On the other hand, J chooses St (P & Y are staying at their positions).

* Total Return : $(1+b_{St})\cdot\pi$
  - The total return of Asian affiliate is enhanced by the ratio of "b_{St}".
* R_P : $(1+b_{St})(1+\theta)\cdot W$
  - Following rule ①, the extra ratio of θ is paid to P.
  - In addition, following rule ②, the wage is increased by the ration "b_{St}".
* R_Y : $(1+b_{St})\cdot W$
  - Following rule ②, the wage is increased by the ration "b_{St}".

4) (Sh, Ch): At this combination of options, P shares his/her skills and knowledge on gray areas management with other members to enhance the total return of Asian affiliate. On the other hand, Y is highly evaluated for her/his talented capability, and J would choose Ch (P is changed to Y).

* Total Return : $(1+b_{Ch})\cdot\pi$
  - The total return of Asian affiliate is enhanced by the ratio of "b_{Ch}".
* R_P : $(1+b_{Ch})\cdot W$
  - Following rule ①, the extra ratio of θ is no longer paid to P.
  - On the other hand, following rule ②, the wage is increased by ratio of "b_{St}".
* R_Y : $(1+b_{Ch})(1+\theta)\cdot W$
  - Following rule ①, the extra ratio of θ is paid to Y.
  - In addition, following rule ②, the wage is increased by the ratio of "b_{St}".

3.4 Description of the Game

A two-stages extensive form game with complete information is assumed, where P (Promoted HCN) is the leader, and J (Japanese executives) is the follower (See the game tree as illustrated in Fig.7).

* 1st Stage: P chooses either Ap (appropriation of knowledge) or Sh (sharing of knowledge)
* 2nd Stage: After observing the choice by P, J chooses either St (let P stay at upper rank position) or Ch (change P to Y for upper rank position)

3.5 Equilibrium of the Game (See Table 4, Fig.8 & Fig.9)

Sub-game perfect equilibrium is examined to derive the following proposition.

【Proposition 1: Equilibrium of the Basic Model】

1-1) Occurrence of Knowledge Appropriation

* If "$b_{Ch} \leqq \theta$" is satisfied, then, (Ap, St) is the equilibrium path for the game, where P (promoted HCN) appropriates her/his skills and knowledge, and she/he stays at the upper rank position.[7]
* In this case, the total profit of Asian affiliate before wage payment (=sum of the pay-offs of the three players) is smaller than the maximized one which would be achieved if (Sh, Ch) were chosen.

1-2) Realization of Knowledge Sharing

* If "$b_{Ch} \geqq \theta$" is satisfied, then, (Sh, Ch) is the equilibrium path for the game, where P (promoted HCN) shares her/his skills and knowledge, and J (Japanese executives) let her/him change to Y (younger HCN) for the upper rank position.
* In this case, the total profit of Asian affiliate before wage payment (=sum of the pay-offs of the three players) can be the maximized one.

【Explanation of Proposition 1】

Using the backward induction, this proposition can be explained as follows.

＜2nd Stage: Choice by J＞

2-1) Cases when P chooses "Ap" at the 1st Stage

This is the subgame where J is supposed to choose "St" or "Ch" after the observation that P chose "Ap" (knowledge appropriation) at the 1st stage.

As discussed below, we can show that J definitely chooses "St" (Stay of P), because $R_J^{ApSt} > R_J^{ApCh}$ is satisfied at any given values of "a" [$0 < a < 1$]. In proving this point, let R_J^{ApSt} to be the benchmark, and the difference between R_J^{ApSt} and R_J^{ApCh} (i.e., $\triangle R_J^{ApCh} = R_J^{ApCh} - R_J^{ApSt}$) is examined.

Then, as shown in Figure 8 & 9, in both cases of parameter conditions of ① $(1-a)(1+\theta) \geqq 1$, and ② $(1-a)(1+\theta) \leqq 1$, $\triangle R_J^{ApCh}$ is equal to the sum of the following two effects both of which are caused by "Ch" (change of P to Y) , i.e.,

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[7] As will be shown, in case of "$b_{Ch} = \theta$", both "knowledge appropriation" and "knowledge sharing" are the equilibrium paths of the game.

(i) total return damaging effect (−) and

(ii) wage payment saving effect of (+).

However, as in Fig.8, it would be shown that "(i) total return damaging effect" always outweighs "(ii) wage payment saving effect" at any given values of "a" [0 < a < 1].

2-2) Cases when P chooses "Sh" at the 1st Stage

This is the subgame where J is supposed to choose "St" or "Ch" after the observation that P chose "Sh" (knowledge sharing) at the 1st stage.

As discussed below, we can show that J definitely chooses "Ch" (change of P to Y), because $R_J^{ApSt} < R_J^{ApCh}$ is satisfied at any given values of "a" [0 < a < 1]. To show this point, it should be noted that "highly talented Y (younger HCN)" and "0 < b_{St} < b_{Ch}" are assumed in the model. Given this assumption, as illustrated in Fig.8, it is shown that $R_J^{ApSt} < R_J^{ApCh}$ is always satisfied.

＜1st Stage: Choice by P＞

At this stage, P is supposed to compare R_P^{ApSt} [= (1+ θ)・W] and R_P^{ShCh} [= (1+b_{Ch})・W], with foreseeing the choice by J at the second stage. In other words, P compares the following choices of (i) and (ii), i.e.,

(i) to choose "Ap" (knowledge appropriation) while staying at the upper rank position with keeping her/his wage premium (θ)

(ii) to choose "Sh" (knowledge sharing) while contributing the growth of Asian affiliate ("b_{Ch}") and receiving her/his increased wage level due to the resulted growth

Accordingly, the choice by P is dependent on the relative size of θ & "b_{Ch}". i.e., As shown in Fig.9, suppose the growing opportunity of Asian affiliate is relatively small and "$b_{Ch} \leqq \theta$" is satisfied, and then, "Ap" is chosen and (Ap, St) becomes the equilibrium path [＝Occurrence of knowledge appropriation]. On the other hand, suppose the growing opportunity of Asian affiliate is relatively large and "$b_{Ch} \geqq \theta$" is satisfied, and then, "Sh" is chosen and (Sh, Ch) becomes the equilibrium path [＝Realization of knowledge sharing].

4. Model with Two Sets of Policy Instruments

This section examines the second question (Q2) by using the extended model, where a game between P and J is assumed with policy instruments to illustrate the theoretical possibility of equilibrium shift. After explaining the availability of two sets of policy instruments [(1') instruments to lower the "degree of dependence on personal skills and knowledge, and (2') instruments to enhance "relative size of prospects for growing opportunities], the equilibrium is derived as one of the five different cases, which implies that in the three of these five cases, the shift from "knowledge appropriation" to "knowledge sharing" takes place with the use of either one set of policy instruments.

Q2 : In case of utilizing the policy instruments, how and under which conditions would a shift from "knowledge appropriation" to "knowledge sharing" take place?

4.1 Two Sets of Policy Instruments

(1) Instruments A: "Stick Policy"

The first set of instruments is "stick policy", which would induce J to choose "Ch" at the second stage of the game. For this purpose, two instruments are assumed where "instrument A-1" is the one to lower the value of "a" (degree of dependence on personal skills and knowledge), and "instrument A-2" is the one to lower the value of "θ" (parameter of wage premium for the upper rank position).

【A-1. Instrument to lower the value of "a"】

Ex.1: Preparation for full-fledged manual

Ex.2: Skill development of multiple members

* The value of "a" is lowered by $\triangle a$ (from a_1 to a_2), which will take the policy cost of $D_{A\text{-}1} = j \cdot (\triangle a)^2$.
  $[1 > a_1 > 0,\ a_1 > a_2 \geqq 0,\ \Delta a = a_1 - a_2,\ \text{and}\ 0 \leqq \Delta a \leqq a_1,\ D_{A\text{-}1} = j \cdot (\Delta a)^2]$
* If the value of "a" is lowered, the damage in π (total return) can be reduced even in cases when P is changed to Y, which would induce J to choose "Ch" at the second stage of the game.
* As the illustrative examples of this instrument, ①Preparation for full-fledged manual, which can be the "breakwater" in case of the replacement of HCNs, and ②Development of gray areas managing capability for multiple HCNs to

the same positions and/or tasks, can be pointed out. In fact, both of them were frequently observed in Asian subsidiaries in author's interviews.

【A-2. Instrument to lower the value of "θ"】

① Support from Japanese parents for sending their Human Resources

② Reduction in wage premium as well as in task assignment to Y

* The value of "θ" is lowered by $\triangle\theta$ (from θ_1 to θ_2), which will take the policy cost of $D_{A\text{-}2} = k \cdot (\triangle\theta)^2$.

$[\theta_1 > 0,\ \theta_1 > \theta_2 \geqq 0,\ \Delta\theta = \theta_1 - \theta_2,\ \text{and}\ 0 \leqq \Delta\theta \leqq \theta_1,\ D_{A\text{-}2} = k \cdot (\Delta\theta)^2]$

* In cases when P is changed to Y, J asks Japanese parent for necessary support to send their HRs, so that the caused damages can be completely recovered. At the same time, depending on the degree of this support from Japanese parent, the wage premium for Y as well as the tasks assigned to Y is reduced.
* These assumptions are also consistent with the observation in author's interviews. i.e., In several cases, Asian subsidiaries asked Japanese parents for their necessary support to send their managers and engineers, when serious damages had occurred due to the replacement and/or moving out of their promoted HCNs. In addition, in majority of cases, Asian subsidiaries have promoted HCNs and assigned their tasks or positions based on the improve-ment in their gray areas managing capability.

(2) Instrument B: "Carrot Policy"

The second set of instruments is "carrot policy", which would induce P to choose "Sh" (knowledge sharing) at the first stage by offering her/him a higher prospect for her/his growing opportunities. For this purpose, the following instrument is assumed.

【Offering Merit Bonus (B) to P】

* J makes a contract with P that, if J chooses "Ch" (Change of P to Y) at the second stage of the game, J would pay a certain additional amount (B) to P as a merit bonus [$B > 0$].
* In other words, B would be paid to P even when P chooses "Ap" (knowledge appreciation) at the first stage of the game. This assumption is made to avoid the verification problem associated with incomplete contracts.

4.2 Description of the Game

Extending the basic model, an extensive form game with complete information is assumed as follows (See the game tree as illustrated in **Fig.14**).

(1) (−1)st Stage: Choice by J

* J chooses either of the followings: ①Nothing Done, ②Stick Policy (Use of A-1 & A-2), and ③Carrot Policy (Use of B)

* Here, "④Both Use of Stick & Carrot (Use of A-1&A-2 and B)" is not examined as a possible option for J, as this choice cannot be in the equilibrium because of the following reasons.
* i.e., In this model, "stick policy" is assumed to induce P to choose "Sh" (knowledge sharing) by taking the cost of "$D_{A\text{-}1}$ & $D_{A\text{-}2}$" to raise "R_J^{ApCh}", so that $R_J^{ApCh} > R_J^{ApSt}$ can be satisfied. On the other hand, "carrot policy" is assumed to induce P to choose "Sh" by taking another cost of "M" to raise "R_P^{ShCh}", so that $R_P^{ShCh} > R_P^{ApSt}$ can be satisfied.
* Here, no complementary effects are assumed between these two policy sets, and either one of these policy sets is sufficient to bring the shift from "Ap" to "Sh". And thus, J's choice is simply made by comparing the costs of the two policy alternatives of "$D_{A\text{-}1}+D_{A\text{-}2}$ vs. M" (rather than combining these two policy sets and taking the both costs of "$D_{A\text{-}1}+D_{A\text{-}2}$ & M").

(2) Following Stages after 0th Stage

2-1) In Case of "①Nothing Done"

After the 1st stage, this case is identical with the case of "Basic Model".

* 0th Stage:
  - Nothing is done by J.
* 1st Stage:
  - P chooses either "Ap (knowledge appropriation)" or "Sh (knowledge sharing)".
* 2nd Stage:
  - After observing the choice by P, J chooses either "St (let P stay at upper rank position)" or "Ch (change P to Y for upper rank position)".

2-2) In Case of "②Stick Policy" (Use of A-1 & A-2)

* 0^{th} Stage :
  - J chooses the use of A-1 & A-2, and decides the size of $\triangle a = a_1 - a_2$.
  - Then, J uses A-1 and lowers the value of "a" ($a_1 \rightarrow a_2$), while taking the policy cost of $D_{A\text{-}1} = j \cdot (\triangle a)^2$.
* 1^{st} Stage :
  - P chooses either "Ap (knowledge appropriation)" or "Sh (knowledge sharing)".
* 2^{nd} Stage-i : In case when P chooses "Ap"
  - J chooses either "St (let P stay)" or "Ch (change P to Y) + $\triangle \theta$ (use of A-2 and lowers the value of θ)."
  - Then, in case of "Ch+$\triangle \theta''$, J lowers the value of θ ($\theta_1 \rightarrow \theta_2$), while taking the policy cost of $D_{A\text{-}2} = k \cdot (\triangle \theta)^2$. In this case, J changes "P" to "Y" for the higher rank position, and asks Japanese parent for necessary support to send their HRs, while reducing the wage premium as well as the task assignments to the newly promoted "Y".
* 2^{nd} Stage-ii : In case when P chooses "Sh"
  - J chooses either "St (let P stay)" or "Ch (change P to Y)."

2-2) In Case of "③Carrot Policy" (Use of B)

* 0^{th} Stage :
  - J chooses the use of B, and makes a contract with P that, if J chooses "Ch" (Change of P to Y) at the second stage, J would pay B to P as a merit bonus.
* 1^{st} Stage :
  - P chooses either "Ap (knowledge appropriation)" or "Sh (knowledge sharing)".
* 2^{nd} Stage-i : In case when P chooses "Ap"
  - J chooses either "St (let P stay)" or "Ch (change P to Y) + B (pay B to P as a merit bonus)."
* 2^{nd} Stage-ii : In case when P chooses "Sh"
  - J chooses either "St (let P stay)" or "Ch (change P to Y) + M (pay B to P as a merit bonus)."

4.3 Equilibrium of the Game

Sub-game perfect equilibrium is examined to derive the following proposition.

【Proposition 2: Equilibrium of the Extended Model】(See Fig.14 & Fig.15)
Given the initial values for each parameters, the unique equilibrium path of this game is derived as one of the five different cases as follows.

＜Case 1＞ "Initial Good Equilibrium": No Policy Instruments are Used
the region which satisfies the following condition in $a_1 \times b_{Ch}$ space
＊ $0 < a_1, < 1, \quad 0 < \theta_1 \leqq b_{Ch}$

＊ If (a_1, b_{Ch}) is located in the above described region, the following set of choices is the unique equilibrium path for the game.
＊ In this "Case 1", both (1) the total profit of Asian affiliate before wage payment (＝sum of the pay-offs of the three players), as well as (2) the pay off of J, can be maximized.

[Equilibrium Path in "Case 1"]
＊ $(-1)^{st}$ Stage: J chooses "①Nothing Done."
＊ 0^{th} Stage: J chooses "nothing done."
＊ 1^{st} Stage: P chooses "Sh (knowledge sharing)".
＊ 2^{nd} Stage: J chooses "Ch (change P to Y for upper rank position)".

【Explanation of Case 1】

If (a_1, b_{Ch}) is in the above described region, $\theta_1 \leqq b_{Ch}$ is satisfied, which implies the identical condition as described in 1-2) of the "Proposition 1" in the basic model analysis. Then, as shown in "Proposition 1-2)", (Sh, Ch) or "knowledge sharing" is realized without any use of policy instruments.

＜Case 2＞ Stick Policy (1): Only "A-2" is Used as a Credible Threat :
the region which satisfies the following condition in $a_1 \times b_{Ch}$ space
＊ $0 < a_1 \leqq a^*, \quad 0 < b_{Ch} < \theta_1$
[a*: the "critical value of a_1" for the support from Japanese parent]

＊ If (a_1, b_{Ch}) is in the above described region, the following set of choices is the unique equilibrium path for the game.

* Similar to “Case 1”, in this “Case 2”, both (1) the total profit of Asian affiliate before wage payment (＝sum of the pay-offs of the three players), as well as (2) the pay off of J, can be maximized.

[Equilibrium Path in “Case 2”]

* $(-1)^{st}$ Stage:
  - J chooses “②Stick Policy”.
* 0^{th} Stage:
  - J chooses the use of A-1 & A-2, and decides the size of A-1 ($=\triangle a$) = 0. (As for A-1, J does not have to lower the value of “a” and J does not have to take the policy cost [i.e., $D_{A\text{-}1} = j \cdot (\triangle a)^2 = 0$])
  - At the same time, J announces to P that J might use “A-2” at the second stage, i.e., if P chooses “Ap” at the first stage, J might choose “Ch” with using “A-2” at the second stage.
* 1^{st} Stage:
  - P chooses “Sh (knowledge sharing)”.
  - Here, the instrument “A-2” serves as a credible threat to P, so that P does not choose “Ap” at 1^{st} stage.
* 2^{nd} Stage:
  - J chooses “Ch (change P to Y)” without the use of “A-2”.

【Explanation of Case 2】

Firstly, it will be shown why J would choose “Ch” at the 2^{nd} stage even if P chooses “Ap” at the 1^{st} stage, which is a different result from the one discussed in the basic model.

As illustrated earlier in Fig.8 and Fig.9, in case of the basic model, for any value of “a_1” [$0 < a_1 < 1$], the above mentioned “(i) total return damaging effect” always outweighs the “(ii) wage payment saving effect”, and accordingly, $R_J^{ApCh} < R_J^{ApSt}$, or $\triangle R_J^{ApCh} = R_J^{ApCh} - R_J^{ApSt} < 0$ is always satisfied.

In contrast, in case of the extended model, as shown in Fig.11 and Fig.12, if the value of “a_1” is sufficiently close to zero, and thus, if the “(i) total return damaging effect” is relatively small, then, the“(ii) wage payment saving effect” might outweigh the “(i) total return damaging effect”, so that $\triangle R_J^{ApCh} = R_J^{ApCh} - R_J^{ApSt} > 0$ might be satisfied. This is because, in case of the extended model, due to the use of “A-2” (to lower the value of θ), the “(ii) wage payment

saving effect" has now an extra term of $\Delta\theta \cdot W$, and thus, this effect might be relatively large.

Here, in examining this effect as well as examining the choice by J on "Ch" vs. "St" at the second stage, the policy cost of "A-2" [$D_{A\text{-}2} = k \cdot (\triangle\theta)^2$] is considered, and the function of $M(a_1) = \max_{\triangle\theta} Z(\triangle\theta\ ;\ a_1)$ [where $Z = \triangle R_J^{ApCh} - k \cdot (\triangle\theta)^2$] is defined. i.e., For a given value of a_1, $M(a_1)$ is defined as the maximized value of Z, which is optimized by choosing $\triangle\theta$. Then, if $M(a_1) \geqq 0$, J would choose "Ch" while paying the policy cost of "A-2".

As illustrated in appendix 2-1, within the region of "a_1" which corresponds to the feasible region of $\triangle\theta$, it is shown that there is a unique value of a_1 (= a*) which satisfies $M(a_1) = 0$, and then, within the sub-region of $0 < a_1 \leqq a^*$, $M(a_1) \geqq 0$, or $[R_J^{ApCh} - k \cdot (\triangle\theta)^2] \geqq R_J^{ApSt}$ is satisfied. In other words, in this sub-region of $0 < a_1 \leqq a^*$, R_J^{ApCh} is sufficiently greater than R_J^{ApSt} even after considering the policy cost of "A-2" [$= k \cdot (\triangle\theta)^2$], so that J chooses "Ch" at the 2nd stage in case P chooses "Ap" at the 1st stage.

Thus, summarizing the overall discussions, <u>when "$0 < a_1 \leqq a^*$" is satisfied</u>, in the subgame after P chooses "Ap", J chooses "Ch" at the 2nd stage. Then, foreseeing this result, P chooses "Sh" at the 1st stage, and thus, (Sh, Ch) becomes the unique equilibrium path, which is identical as in "Case 1".

Here, noting that "A-2" serves as a credible threat in this sub-region, the vertical line of $a_1 = a^*$ is called "Marginal Line for Credible Threat" in Fig.15. Furthermore, as neither "A-1" nor "A-2" is used, the maximized levels can be achieved for both of (1) the total profit of Asian affiliate before wage payment and (2) the payoff of J, which is also identical as in "Case 1".

＜Case 3＞ Stick Policy (2): Dual Use of "A-1 & A-2"

the region which satisfies the following condition in $a_1 \times b_{Ch}$ space

- **$a^* < a_1 < 1$**
- **$b_{Ch} \geqq j \cdot (a_1 - a^*)^2 / (D - W)$**
- **$b_{Ch} \leqq -(j/W) \cdot (a_1 - a^*)^2 + \theta_1$**

  where $D = \{\pi - (1+\theta_1) \cdot W\}$

* If (a_1, b_{Ch}) is in the above described region, the following set of choices is the equilibrium path for the game.[8]

[8] In the above described region, (i) if (a_1, b_{Ch}) is on "Indifferent Line between ②

＊ In this “Case 3”, for both (1) the total profit of Asian affiliate before wage payment (＝sum of the pay-offs of the three players), and (2) the pay off of J, the values have to be smaller than those achieved in “Case 1” and “Case 2”.

[Equilibrium Path in “Case 3”]

＊ $(-1)^{st}$ Stage:

・J chooses “②Stick Policy”.

＊ 0^{th} Stage:

・J chooses the use of A-1 & A-2, and decides the size of A-1 ($\triangle a$) = $a_1 - a^*$, or lowers the value of “a” to be equal to a* to take the policy cost.

[i.e., $D_{A\text{-}1} = j \cdot (\triangle a)^2 = j \cdot \{(a_1 - a^*)^2\}$

・At the same time, J announces to P that J might use “A-2” at the second stage, if J chooses “Ch”, and if it is necessary to use this instrument.

＊ 1^{st} Stage:

・P chooses “Sh (knowledge sharing)”.

・Similar to “Case 2”, here, “A-2” serves as a credible threat to P.
(Suppose P chose “Ap” at 1^{st} stage, then, J chooses “Ch” and uses “A-2”.)

＊ 2^{nd} Stage:

・J chooses “Ch (change P to Y)” without the use of “A-2”.

【Explanation of Case 3】

In this case, as a_1 is greater than a*, so long as the size of A-1 ($=\triangle a$) = 0, $M(a_1)$ becomes smaller than 0, and J would choose “St” in the subgame after P chooses “Ap”. However, if a_1 is sufficiently close to a*, then, it might be possible that J would pay the policy cost of “A-1” to lower the value of “a_1” up to “a*” (i.e., $\triangle a = a_1 - a^*$), so that J would choose “Ch” in the subgame after P chooses “Ap”, while J can still achieve the higher pay-off by this “②Stick Policy” rather than other choices [①Nothing Done, ③Carrot Policy].

In fact, as illustrated in Appendix 2-2 & 2-4, if (a_1, b_{Ch}) is in the above region, even paying the policy cost of A-1 [i.e., $D_{A\text{-}1} = j \cdot (\triangle a)^2 = j \cdot \{(a_1 - a^*)^2\}$], J can achieve higher pay-off by choosing “②Stick Policy” rather than other choices.

Stick Policy & ③Carrot Policy”, both “Dual Use of A-1 & A-2” and “Use of B” are the equilibrium paths of the game (i.e., overlapping region of Case 3 & Case 4), and (ii) if (a_1, b_{Ch}) is on “Marginal Line for ②Stick Policy”, both “Dual Use of A-1 & A-2” and “Stay at Bad Equilibrium” are the equilibrium paths of the game (i.e., overlapping region of Case 3 & Case 5).

Here, the indifferent pay-offs condition between "②Stick Policy" and "① Nothing Done" is shown in Appendix 2-2, which is illustrated as "Marginal Line for ②Stick Policy" [i.e., If the value of "a_1" is beyond this line, the use of "A-1 & A-2" are too costly for J] in Fig.15. On the other hand, the indifferent pay-offs condition between "②Stick Policy" and "③Carrot Policy" is shown in Appendix 2-4, which is illustrated as "Indifferent Line between ②Stick Policy & ③Carrot Policy" [i.e., If the value of "b_{Ch}" is below this line, the use of "②Stick Policy" gives higher pay-offs than that of "③Carrot Policy"] in Fig.15.

＜Case 4＞ Carrot Policy: Use of "B"

the region which satisfies the following condition in $a_1 \times b_{Ch}$ space

* $a^* < a_1 < 1$
* $\theta_1 \cdot W / D \leqq b_{Ch} < \theta_1$
* $b_{Ch} \geqq \theta_1 - (j / W) \cdot (a_1 - a^*)^2$

  where $D = \{\pi - (1+\theta_1) \cdot W\}$

* If (a_1, b_{Ch}) is in the above described region, the following set of choices is the equilibrium path for the game.
* In this "Case 4", as for (1) the total profit of Asian affiliate before wage payment (＝sum of the pay-offs of the three players), the value is maximized as the identical level of those in "Case 1" and "Case 2". However, as for (2) the pay off of J, the value is definitely smaller as compared with those in "Case 1" and "Case 2", because there are some income transfer from J to P.

[Equilibrium Path in "Case 4"]

* $(-1)^{st}$ Stage:
  - J chooses "③Carrot Policy".
* 0^{th} Stage:
  - J makes a contract with P that, if J chooses "Ch" (Change of P to Y) at the second stage of the game, J would pay a certain additional amount (B) to P as a merit bonus [B ＞0, See Fig.14].
* 1^{st} Stage:
  - P chooses "Sh (knowledge sharing)".
* 2^{nd} Stage:
  - J chooses "Ch (change P to Y) + B (payment of bonus to P)" .

【Explanation of Case 4】

As discussed in "case 1", if b_{Ch} is not smaller than θ, P can receive sufficient pay-off by choosing "Sh" ($R_P^{ShCh} \geqq R_J^{ApSt}$), so that "Good Equilibrium" is derived.

Here, it will be shown that, even when b_{Ch} is smaller than θ, if b_{Ch} is sufficiently close to θ, then, by choosing "③Carrot Policy" (payment of B to P), P can receive sufficient pay-off by choosing "Sh" ($R_P^{ShCh} \geqq R_P^{ApSt}$), while J can still achieve a pay-off which is not lower than other policy choices.

In fact, as shown in Appendix 2-3 and 2-4, if (a_1, b_{Ch}) is in the above described region, even after paying B to P, J can still choose "③Carrot Policy" to achieve a pay-off which is not lower than other options.

Here, the indifferent pay-offs condition between "③Carrot Policy" and "① Nothing Done" is shown in Appendix 2-3, which is illustrated as "Marginal Line for ③Carrot Policy" [i.e., If the value of "b_{Ch}" is below this line, the payment of B is too costly for J] in Fig.15. On the other hand, the indifferent pay-offs condition between "③Carrot Policy" and "②Stick Policy" is shown in Appendix 2-4, which is illustrated as "Indifferent Line between ②Stick Policy & ③Carrot Policy" [i.e., If the value of "b_{Ch}" is below this line, the use of "②Stick Policy" gives higher pay-offs than that of "③Carrot Policy] in Fig.15.

＜Case 5＞ Stay at "Bad Equilibrium"：

the region which satisfies the following condition in "$a_1 \times b_{Ch}$ space

- **$a^* < a_1 < 1$**
- **$0 < b_{Ch} < \theta_1 \cdot W / D$**
- **$b_{Ch} \leqq j \cdot (a_1 - a^*)^2 / (D - W)$**

  where $D = \{\pi - (1+\theta_1) \cdot W\}$

* If (a_1, b_{Ch}) is in the above described region, the following set of choices is the equilibrium path for the game.
* In this "Case 5", the good equilibrium cannot be achieved. Thus, for both of (1) the total profit of Asian affiliate before wage payment (＝sum of the pay-offs of the three players), and (2) the pay off of J, the values are smaller than those realized in other cases.

[Equilibrium Path in "Case 5"]

* $(-1)^{st}$ Stage: J chooses "①Nothing Done."
* 0^{th} Stage: J chooses "nothing done."
* 1^{st} Stage: P chooses "Ap (knowledge appropriation)".
* 2^{nd} Stage: J chooses "St (Stay of P at the upper rank position).

【Explanation of Case 5】

If (a_1, b_{Ch}) is in the above described region, the value of "a_1" is much larger than "a*" and the value of "b_{Ch}" is much smaller than "θ_1". And accordingly, in either choice of "②Stick Policy" or "③Carrot Policy", it takes too much policy cost, and J cannot achieve higher pay-offs than the level achieved by "①Nothing Done".

Here, the indifferent pay-offs condition between "①Nothing Done" and "② Stick Policy" is shown in Appendix 2-2, which is illustrated as "Marginal Line for ② Stick Policy" [i.e., If the value of "a_1" is beyond this line, the use of "A-1 & A-2" are too costly for J] in Fig.15. On the other hand, the indifferent pay-offs condition between "①Nothing Done" & "③Carrot Policy" is shown in Appendix 2-3, which is illustrated as "Marginal Line for ③Carrot Policy" [i.e., If the value of "b_{Ch}" is below this line, the payment of B is too costly for J] in Fig.15.

5. Concluding Remarks

5.1 Summary of the Analysis

Based on the existing literature on both the positive and negative effects of the localization as well as on the findings from author's interviews, this study focused on an interesting contrast of "knowledge appropriation vs. knowledge sharing". i.e., In some interviewed cases, newly promoted HCNs are likely to appropriate their useful skills and knowledge on "gray areas management", whereas in some other interviewed cases, they are willing to share these skills and knowledge with their subordinate members.

Then, comparing the three interviewed cases where relatively detailed information was available, a set of findings on "knowledge appropriation vs. knowledge sharing" was pointed as follows.

i) Key elements of knowledge for both "knowledge appropriation" and "knowledge sharing" are closely associated with the "managing capability of gray areas".
ii) As the key explanatory factors for the decision making by the promoted HCNs on "knowledge appropriation vs. knowledge sharing", (1) "degree of dependence on personal skills and knowledge", and (2) "relative size of prospects for growing opportunities" seemed to have played their crucial roles.
iii) In Asian subsidiaries, relating to these two key explanatory factors in ii), the two sets of policy instruments [(1') instruments to lower the "degree of dependence on personal skills and knowledge, and (2') instruments to enhance "relative size of prospects for growing opportunities] have been utilized in order to aim for the shift from "knowledge appropriation" to "knowledge sharing".

Noting this set of findings observed in the interviews, a game between "Japanese Executives (J)" and "Promoted HCNs (P)" in Asian subsidiaries was assumed to examine the following two questions.

Q1 : How and under which conditions would the localization of HCNs cause the contrasting results of "knowledge appropriation vs. knowledge sharing" in Asian subsidiaries of Japanese MNEs?

Q2 : In case of utilizing the policy instruments, how and under which conditions would a shift from "knowledge appropriation" to "knowledge sharing" take place?

As the result of the analysis, mostly consistent with the above set of findings in author's interviews, the parameter conditions were derived, where the unique equilibrium path of the game was obtained which leads to either "knowledge appropriation" or "knowledge sharing".

In section 3, assuming that no policy instruments are utilized, Q1 was examined to derive parameter conditio19ns which leads to either "knowledge appropriation" or "knowledge sharing" as the equilibrium path.

Then, as for the second key factor [(2) b_{Ch} : relative size of prospects for growing opportunities], consistent with the above mentioned findings of "i) & ii)", "knowledge appropriation" takes place when "b_{Ch}" is relatively low [$b_{Ch} \leqq \theta$], while "knowledge sharing" takes place when "b_{Ch}" is relatively high [$b_{Ch} \geqq \theta$].

On the other hand, as for the first key factor [(1) a: degree of dependence on personal skills and knowledge], examining the cases when "$b_{Ch} < \theta$ ", so long as the value of "a" is positive, knowledge sharing cannot be achieved even if the value of "a" is lowered to approach zero. This is because (i) "total return damaging effect (−)" always outweighs "(ii) wage payment saving effect (+)" at any values of "a" [0 < a <1] as illustrated in Fig.8 & 9.

In section 4, assuming the availability of the two sets of policy instruments [i.e., "②Stick Policy" and "③Carrot Policy"], parameter conditions are examined to derive the regions where the shift from "knowledge appropriation" to "knowledge sharing" can be achieved.

Then, it is shown that, in the three cases out of five cases in $a_1 \times b_{Ch}$ space [0 < a_1<1, 0 < b_{Ch}], the shift from "knowledge appropriation" to "knowledge sharing" takes place [i.e., "Case 2" ～ "Case 4": knowledge appropriation → knowledge sharing], whereas "Case 1" implies the case of "consistently knowledge sharing", while the "Case 5" implies the case of "persistently knowledge appropriation".

In "Case 1" [①Initial Good Equilibrium: No Policy Instruments are used], as "b_{Ch}" (relative size of prospects for growing opportunities) is relatively high [$b_{Ch} \geqq \theta_1$ (parameter of wage premium for the upper rank position)], "knowledge sharing" can be achieved without any use of policy instruments, which is identical with the region of "Realization of Knowledge Sharing" as derived in the basic model analysis.

In "Case 2" [②Stick Policy (1): Only "A-2" is used as a Credible Threat], "b_{Ch}" is relatively low [$b_{Ch} < \theta_1$], and "a_1" (degree of dependence on personal skills and knowledge) is not greater than "the critical value" (a*) [i.e., $a_1 \leqq a^*$], and

then, “knowledge sharing” (Good Equilibrium) can be achieved only with the use of “A-2” as a credible threat. i.e., J announces to P at 0th stage that J might use “A-2” at the 2nd stage, which can induce P to choose “Sh” (knowledge sharing) at the 1st stage of the game. Here, unlike the case of the basic model analysis, this inducement can work, as “(ii) wage payment saving effect (+)” can outweigh “(i) total return damaging effect (−)” because of an extra term of “$\Delta\theta \cdot W$” which is now possible by lowering the value of θ in the use of “A-2”.

In “Case 3” [②Stick Policy (2): Dual Use of “A-1 & A-2”], “b_{Ch}” is relatively low [$b_{Ch} < \theta_1$], and “a_1” is greater than “the critical value” (a*) [i.e., $a_1 > a^*$], whereas, it is still sufficiently close to “the critical value”, so that “knowledge sharing” (Good Equilibrium) can still be achieved with the dual use of “A-1” and “A-2”. Here, as “a_1” is greater than “a*”, J has to pay the policy cost for “A-1” at the 0th stage. On the other hand, as for the cost of “A-2”, J does not have to pay at the 2nd stage, which is similar to “Case 2”. Then, as “a_1” is sufficiently close to “a*”, J can still achieve higher pay-off by choosing “②Stick Policy” rather than other choices.

In “Case 4” [③Carrot Policy: Use of “B”], “b_{Ch}” is smaller than “θ_1”, but it is sufficiently close to “θ_1” [$b_{Ch} < \theta_1$], while “a_1” is much greater than “the critical value” (a*) [i.e., $a_1 > a^*$]. Then, “knowledge sharing” (Good Equilibrium) can still be achieved with the use of “B”. Here, as “b_{Ch}” is smaller than “θ_1”, J has to make a contract with P for the payment of B at the 0th stage, and in fact, has to pay that amount at the 2nd stage. However, as “b_{Ch}” is sufficiently close to “θ_1”, J can still achieve higher pay-off by choosing “③Carrot Policy” rather than other choices.

In “Case 5” [⑤Stay at “Bad Equilibrium”], “b_{Ch}” is much smaller than “θ_1”, [$b_{Ch} < \theta_1$], and “a_1” is much larger than “the critical value” (a*) [i.e., $a_1 > a^*$]. Then, “knowledge sharing” (Good Equilibrium) cannot be achieved as the equilibrium path of the game. Here, due to these parameter conditions, in either choice of “②Stick Policy” or “③Carrot Policy”, it takes too much policy cost, and J cannot achieve higher pay-offs than the level achieved by “①Nothing Done”.

5.2 Remaining Problems for Further Researches

As for the remaining problems for further researches, the following two issues can be pointed out.

Firstly, the two main questions (Q1 & Q2) are to be further explored from both empirical and theoretical aspects. As discussed above, based on a set of findings in the three cases of author's interviews, a game between J and P was examined in this study. However, by exploring some other interviewed cases as well as from other sources, some other empirical findings and/or some other key explanatory factors on "knowledge appropriation vs. knowledge sharing" might be available, so that the two main questions can be analyzed in more updated and/or sophisticated manners.

Secondly, the issue of "optimum mix" of HCNs & PCNs, or "optimum timing (shift)" from PCNs to HCNs was unanswered in this study, which was proposed as one of the promising research topics by Oki (2013) in the context of global HRM (Human Resource Management) systems of Japanese MNEs.

On the other hand, as discussed in section 1, this study has focused on the problem of "knowledge appropriation" as one of the crucial issues of "too much localization". Then, in the analysis, the game was assumed to start "after" a certain HCN is promoted to a certain upper rank position, while the decision process of the promotion itself as well as its positive and/or negative impacts on Asian subsidiaries was not explicitly analyzed.

Thus, it would be a very interesting topic if we can analyze the problem of "knowledge appropriation vs. knowledge sharing", where the decision processes of HCNs' promotion itself is endogenized and/or the impact of the promotion is examined by comparing the cases of "being promoted" and those of "not being promoted", so that some useful implications for the "optimum mix" or "optimum timing" problem can be obtained.

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Appendix 1: Overview of Interviews to Japanese MNEs

In order to examine possible roles of Japanese MNEs in developing Asian economies, a series of interviews were carried out by the author in 1998 which was a part of the research project on "FDI (foreign direct investment) in Asia" by Economic Research Institute, Economic Planning Agency, Government of Japan. Subsequently, three series of interviews were carried out in 2002, 2007, and 2013 by the author, as a part of research projects of Asia Pacific Research Center, Nanzan University.

The overview of these series of interviews is as follows. In each case, a semi-structured interviews were made for around 1 to 2 hours, where (1) facing problems in skill development of local human resources, and (2) possible solutions for these problems are questioned.

Interview Period	Locations	Number of Cases	Detailed Description
1) Aug.-Dec.1998	Sg, Ml.	32 cases	Hayashi (1998, 1999)
2) Jul.-Sept.2002	Jp, Sg, Ml, Ch	17 cases	Hayashi (2004)
3) Jun.-Sept.2007	Jp, Ch, Ml, Th.	24 cases	Hayashi (2008b)
4) Mar.-Sept.2013	Sg, Ml, Ch .	32 cases	Hayashi (2013, 2014)

Appendix 2: Mathematical Appendix

【Appendix 2-1: Effect of "A-2" [Instrument to Lower θ (△θ＝θ₂－θ₁)]】

To examine the effect of "A-2" [Instrument to Lower θ(△θ＝θ₂－θ₁)], the function of M(a_1) is defined as 1), which shows the maximized changes in the pay-off for J with the use of "A-2" for a given value of "a_1".

$$M(a_1) = \max_{\triangle\theta} Z(\triangle\theta;\ a_1) \qquad \cdots\ 1)$$

$$\text{where}\quad Z = \triangle R_J^{ApCh} - D_{A\text{-}2} = R_J^{ApCh} - R_J^{ApSt} - k\cdot(\triangle\theta)^2$$

$$= -a_1\cdot\{\pi - (1+\theta_1)\cdot W\} + (1-a_1)\cdot\triangle\theta\cdot W - k\cdot(\triangle\theta)^2$$

$$\text{s.t.}\quad 0 \leqq \triangle\theta \leqq \theta_1 - a_1/(1-a_1) \qquad \cdots\ 2)$$

$$\text{where}\quad 0 \leqq a_1 \leqq \theta_1/(1+\theta_1) \qquad \cdots\ 3)$$

Here, the feasible region of "△θ" is shown in 2), which is derived from the premium wage condition for Y (Younger HCN), where $R_Y^{ApCh} = (1-a_1)(1+\theta_2)\cdot W \geqq W$ [p15, Table 3], or equivalently, $(1-a_1)(1+\theta_1-\triangle\theta) \geqq 1$. Then, corresponding to this feasible region, the region of "a_1" is obtained as shown in 3).[i]

Firstly, in order to examine the continuity for M(a_1), the continuity for the optimum value of △θ for "a_1", which is described as "$\tilde{\triangle\theta}(a_1)$" below, is examined at $0 \leqq a_1 \leqq \theta_1/(1+\theta_1)$.

$$\tilde{\triangle\theta}(a_1) = \arg\max_{\triangle\theta} Z(\triangle\theta;\ a_1) \qquad \cdots\ 4)$$

Solving the maximization problem of 1), $\tilde{\triangle\theta}(a_1)$ is obtained as 4').

$$\tilde{\triangle\theta}(a_1) = \min\{(1-a_1)\cdot W/2k,\ \theta_1 - a_1/(1-a_1)\} \qquad \cdots\ 4')$$

Here, in case $\tilde{\triangle\theta}(a_1)$ is obtained as the interior solution [i.e., when $0 < \tilde{\triangle\theta}(a_1) < \theta_1 - a_1/(1-a_1)$], it is shown that $\tilde{\triangle\theta}(a_1) = (1-a_1)\cdot W/2k$, and then, $\tilde{\triangle\theta}(a_1)$ is a continuous function at "$0 \leqq a_1 \leqq \theta_1/(1+\theta_1)$".

On the other hand, in case $\tilde{\triangle\theta}(a_1)$ is obtained as the corner solution, $\tilde{\triangle\theta}(a_1) = \theta_1 - a_1/(1-a_1)$, and it is shown that $\tilde{\triangle\theta}(a_1)$ is a continuous function at "$0 \leqq a_1 \leqq \theta_1/(1+\theta_1)$" as well.

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[i] In Appendix 2-1, "$a_1 = 0$" is included in the region in consideration, because the intermediate value theorem is used in examining the existence of roots for $M(a_1) = 0$.

Therefore, $M(a_1)$ is also shown to be continuous at "$0 \leqq a_1 \leqq \theta_1/(1+\theta_1)$".

Secondly, noting that "$M(a_1) \geqq 0$" is the critical condition [i.e., When satisfied, J would choose "Ch" with the use of instrument "A-2"], this condition is examined.

Here, looking at the both ends of the corresponding region of "a_1" [i.e., $a_1 = 0$, and $a_1 = \theta_1/(1+\theta_1)$], the values of $M(a_1)$ are calculated to find $M(0) > 0$, and $M(\theta_1/(1+\theta_1)) < 0$ as follows.

Suppose $a_1 = 0$, $M(0)$ is obtained as follows.

$$M(0) = -\ k \cdot (\triangle\theta - W/2k)^2 + W^2/4k$$

・when $\theta_1 \geqq W/2k$, $\tilde{\triangle\theta}(0) = W/2k$ [Case of Interior Solution]

➡ $M(0) = W^2/4k > 0$ (+)

・when $\theta_1 < W/2k$, $\tilde{\triangle\theta}(0) = \theta_1$ [Case of Corner Solution]

➡ $M(0) = -\ k \cdot \theta_1 \cdot (\theta_1 - W/k) > 0$ (+ + −)

When $a_1 = \theta_1/(1+\theta_1)$, the feasible region of $\triangle\theta$ is confined only to $\triangle\theta = 0$, and thus, $\tilde{\triangle\theta}(\theta_1/(1+\theta_1)) = 0$, and $M(\theta_1/(1+\theta_1))$ is obtained as follows.

$$M(\theta_1/(1+\theta_1)) = -a_1 \cdot \{\pi - (1+\theta_1) \cdot W\} < 0 \quad (+ \quad +)$$

Here, noting that $M(a_1)$ is a continuous function within the region of "$0 \leqq a_1 \leqq \theta_1/(1+\theta_1)$", from the intermediate value theorem, we can find at least one root which satisfies $M(a_1) = 0$ within this region.

Among these roots, the largest one is denoted as a*, and then, from 1) and 4), we can write the following.

$$M(a^*) = \max_{\triangle\theta} Z(\triangle\theta; a^*) = Z(\tilde{\triangle\theta}(a^*); a^*) = 0 \qquad \cdots 5)$$

Then, within the region of $0 \leqq a_1 \leqq \theta_1/(1+\theta_1)$, it is shown that the partial differentiation of $Z(\tilde{\triangle\theta}(a^*); a_1)$ is strongly negative, and $\tilde{\triangle\theta}(a^*)$ is within the feasible region of $\triangle\theta$ as described in 4) and 7).

$$\partial Z(\tilde{\triangle\theta}(a^*); a_1)/\partial a_1 = -\{\pi - (1+\theta_1) \cdot W\} - \tilde{\triangle\theta}(a^*) \cdot W < 0 \qquad \cdots 6)$$

$$0 \leqq \tilde{\triangle\theta}(a^*) \leqq \theta_1 - a^*/(1-a^*) < \theta_1 - a_1/(1-a_1) \qquad \cdots 7)$$

Thus, from 4)-7), it is shown that $M(a_1)$ is strongly positive within the sub-region of "$0 \leqq a_1 < a^*$" to satisfy the following 8).

$$M(a_1) = Z(\tilde{\triangle\theta}(a_1); a_1) \geqq Z(\tilde{\triangle\theta}(a^*); a_1) > Z(\tilde{\triangle\theta}(a^*); a^*) = M(a^*) = 0 \quad \cdots 8)$$

In sum, from these discussions, it is shown that there is a unique root of a^* which satisfies $M(a^*) = 0$ as well as the following conditions.

* $0 \leqq a_1 < a^*$ ➡ $M(a_1) > 0$
* $a_1 = a^*$ ➡ $M(a_1) = 0$
* $a^* < a_1 < \theta_1/(1+\theta_1)$ ➡ $M(a_1) < 0$

【Appendix 2-2: Relative Pay-Offs between "②Stick Pol b icy" & "①Nothing Done"】

Given the conditions where "$a^* < a_1$" and "$b_{Ch} < \theta_1$", the pay-off for J in case of "②Stick Policy" [Dual Use of A-1 & A-2] is obtained when P chooses "Sh" and J chooses "Ch", while taking the policy cost of $D_{A\text{-}1}$ [$= j \cdot (\triangle a)^2$]. Thus, from Table 3, it is obtained as follows.

$$R_J^{ShCh} - D_{A\text{-}1} = (1 + b_{Ch}) \cdot \{\pi - (2+\theta_1) \cdot W\} - j \cdot (a_1 - a^*)^2 \quad \cdots 9)$$

On the other hand, the pay-off for J in case of "①Nothing Done" is obtained when P chooses "Ap" and J chooses "St", while taking no policy cost. Thus, from Table 3, it is obtained as follows.

$$R_J^{ApSt} = \pi - (2+\theta_1) \cdot W \quad \cdots 10)$$

Then, from 9) & 10), the relative pay-offs conditions between "②Stick Policy" & "①Nothing Done" are derived as follows.

* $b_{Ch} > j \cdot (a_1 - a^*)^2/(D - W)$ where $D = \{\pi - (1+\theta_1) \cdot W\}$
  ➡ Higher pay-off is achieved by "②Stick Policy".
* $b_{Ch} = j \cdot (a_1 - a^*)^2/(D - W)$
  ➡ "②Stick Policy" and "①Nothing Done" are indifferent.
  [This condition implies "Marginal Line for Dual Use of A-1 & A-2".]
* $b_{Ch} < j \cdot (a_1 - a^*)^2/(D - W)$
  ➡ Higher pay-off is achieved by "①Nothing Done".

【Appendix 2-3: Relative Pay-Offs between "③Carrot Policy" & "①Nothing Done"】

Given the conditions where "$a^* < a_1$" and "$b_{Ch} < \theta_1$", the necessary condition for B (merit bonus) to induce P to choose "Sh" is "$R_P^{ShCh} + B \geqq R_P^{ApSt}$", or

$$(1 + b_{Ch}) \cdot W + B \geqq (1+\theta_1) \cdot W, \quad \text{or equivalently,} \quad B \geqq (\theta_1 - b_{Ch}) \cdot W$$

Thus, the pay-off for J in case of "③Carrot Policy" [with this minimum payment of B"] is obtained as follows.

$$R_J^{ShCh} - (\theta_1 - b_{Ch}) \cdot W = (1 + b_{Ch}) \cdot \{\pi - (2+\theta_1) \cdot W\} - (\theta_1 - b_{Ch}) \cdot W \quad \cdots 11)$$

On the other hand, the pay-off for J in case of "①Nothing Done" is shown in 10).

Then, from 10) & 11), the relative pay-offs conditions between "③Carrot Policy" & "①Nothing Done" are derived as follows.

* $b_{Ch} > \theta_1 \cdot W / D$ where $D = \{\pi - (1+\theta_1) \cdot W\}$
  ➡ Higher pay-off is achieved by "③Carrot Policy".
* $b_{Ch} = \theta_1 \cdot W / D$
  ➡ "③Carrot Policy" and "①Nothing Done" are indifferent.
  [This condition implies "Marginal Line for B (merit bonus).]
* $b_{Ch} < \theta_1 \cdot W / D$
  ➡ Higher pay-off is achieved by "①Nothing Done".

【Appendix 2-4: Relative Pay-Offs between "②Stick Policy" & "③Carrot Policy"】

Given the conditions where "$a^* < a_1$" and "$b_{Ch} < \theta_1$", the pay-off for J in case of "②Stick Policy" is shown in 9), while the pay-off for J in case of "③Carrot Policy" is shown in 11).

Then, from 9) & 11), the relative pay-offs conditions between "②Stick Policy" & "③Carrot Policy" are derived as follows.

* $b_{Ch} < j \cdot (a_1 - a^*)^2 / W + \theta_1$
  ➡ Higher pay-off is achieved by "②Stick Policy".
* $b_{Ch} = j \cdot (a_1 - a^*)^2 / W + \theta_1$
  ➡ "②Stick Policy" and "③Carrot Policy" are indifferent.
  [Indifferent Line between "②Stick Policy" & "③Carrot Policy"]
* $b_{Ch} > j \cdot (a_1 - a^*)^2 / W + \theta_1$
  ➡ Higher pay-off is achieved by "③Carrot Policy".

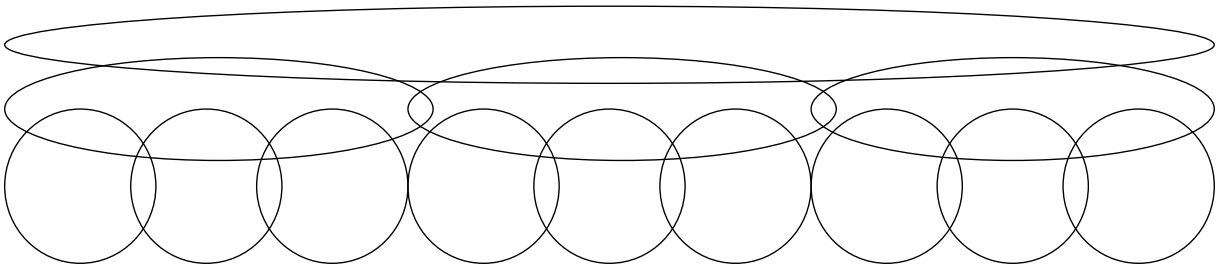


Fig.1 Gray Areas Engagement-Model

Note: "Gray areas" are likely to become "overlapping areas", as they are efficiently managed by flexible collaboration of team members.

Source: Hayashi (2004)

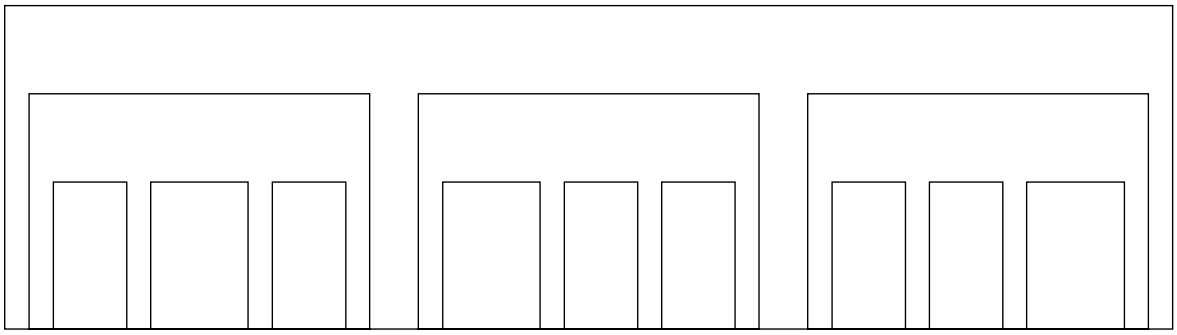


Fig.2 Well-defined Engagement-Model

Note: "Gray areas" are likely to become "vacant areas", which are supposed to be managed by the responsible upper rank managers.

Source: Hayashi (2004)

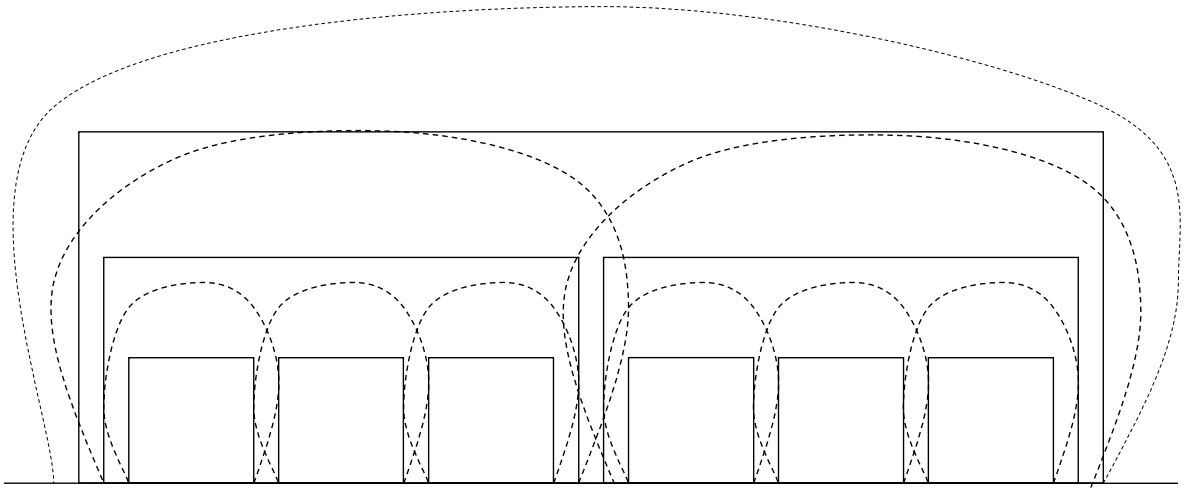
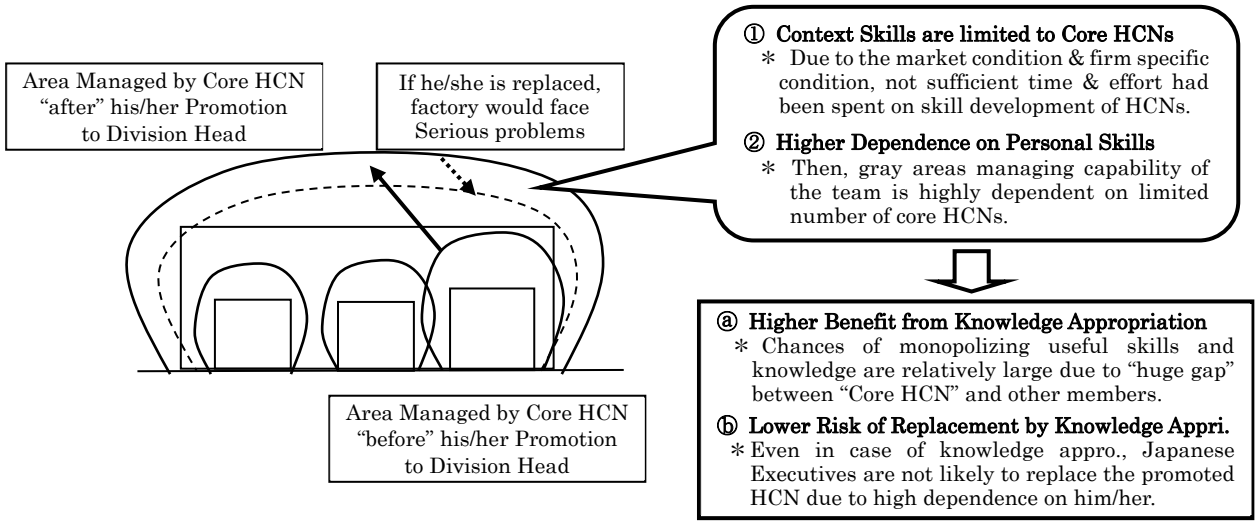


Fig.3　Image of Stepwise Hybrid Modification

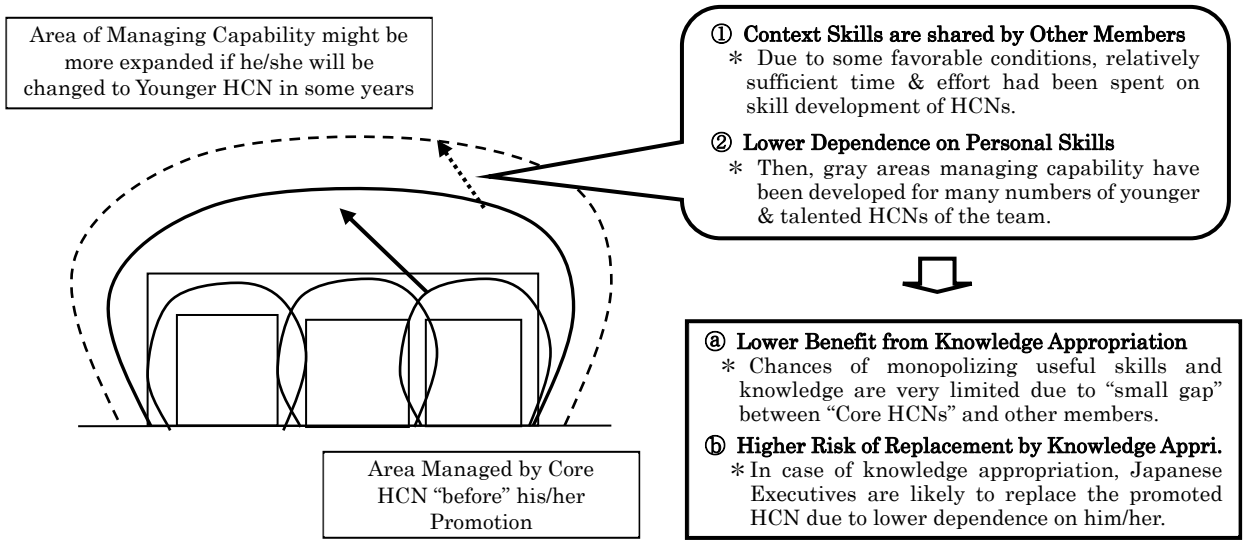
Source: Hayashi (2005)

Fig.4 Case X : "Knowledge Appropriation" with Higher Dependence on Personal Skills and Knowledge



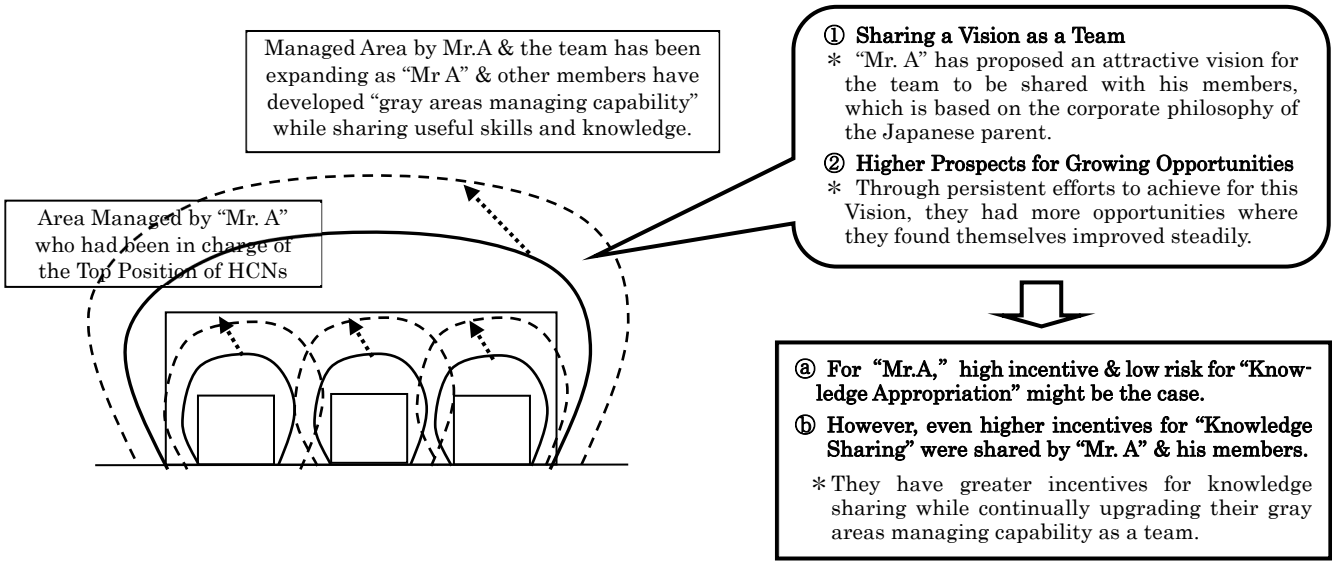
(Source) Hayashi (2018)

Fig.5 Case Y : "Knowledge Sharing" under Lower Dependence on Personal Skills and Knowledge



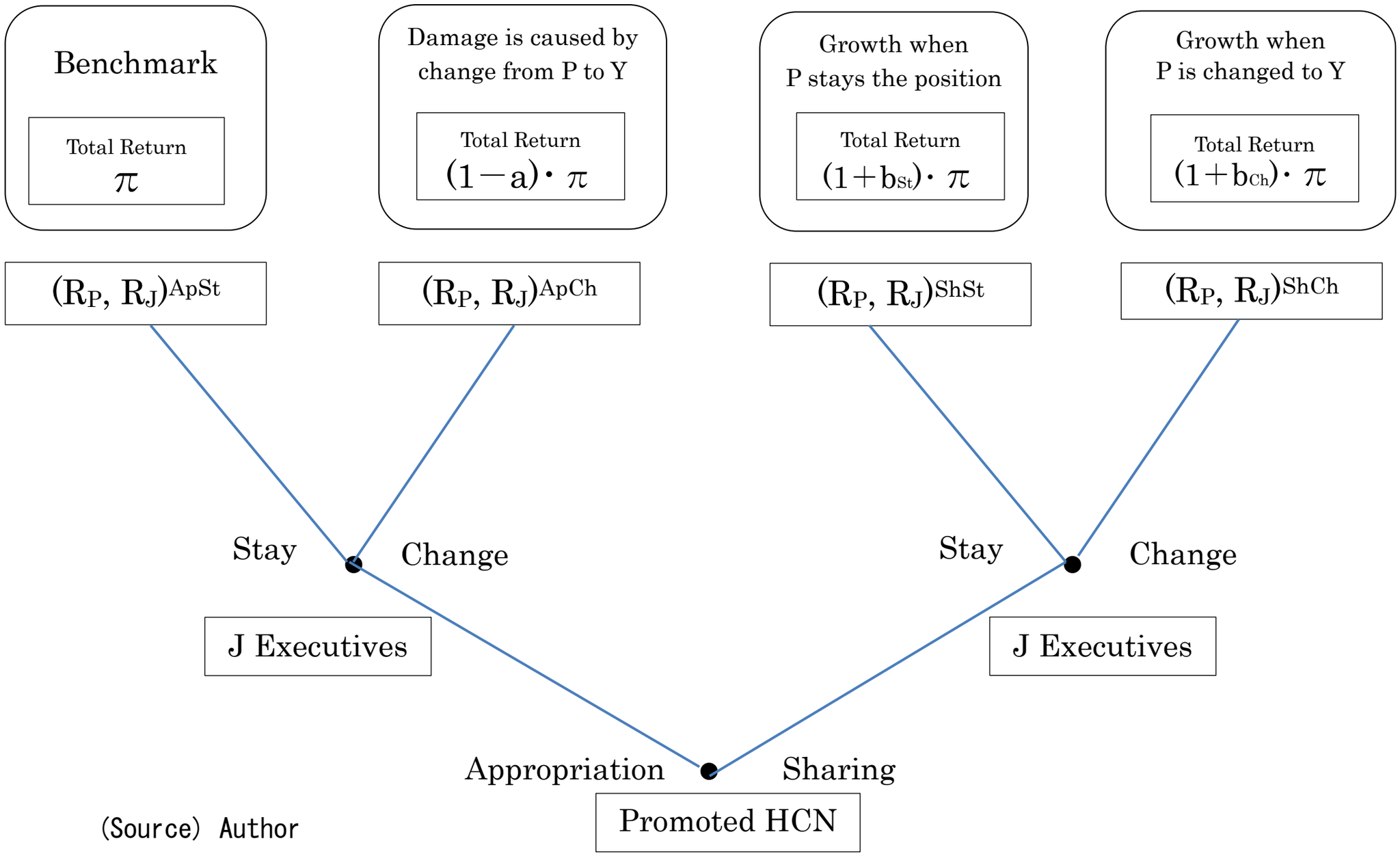
(Source) Hayashi (2018)

Fig.6 Case Z：“Knowledge Sharing” with Higher Prospects for Growing Opportunities



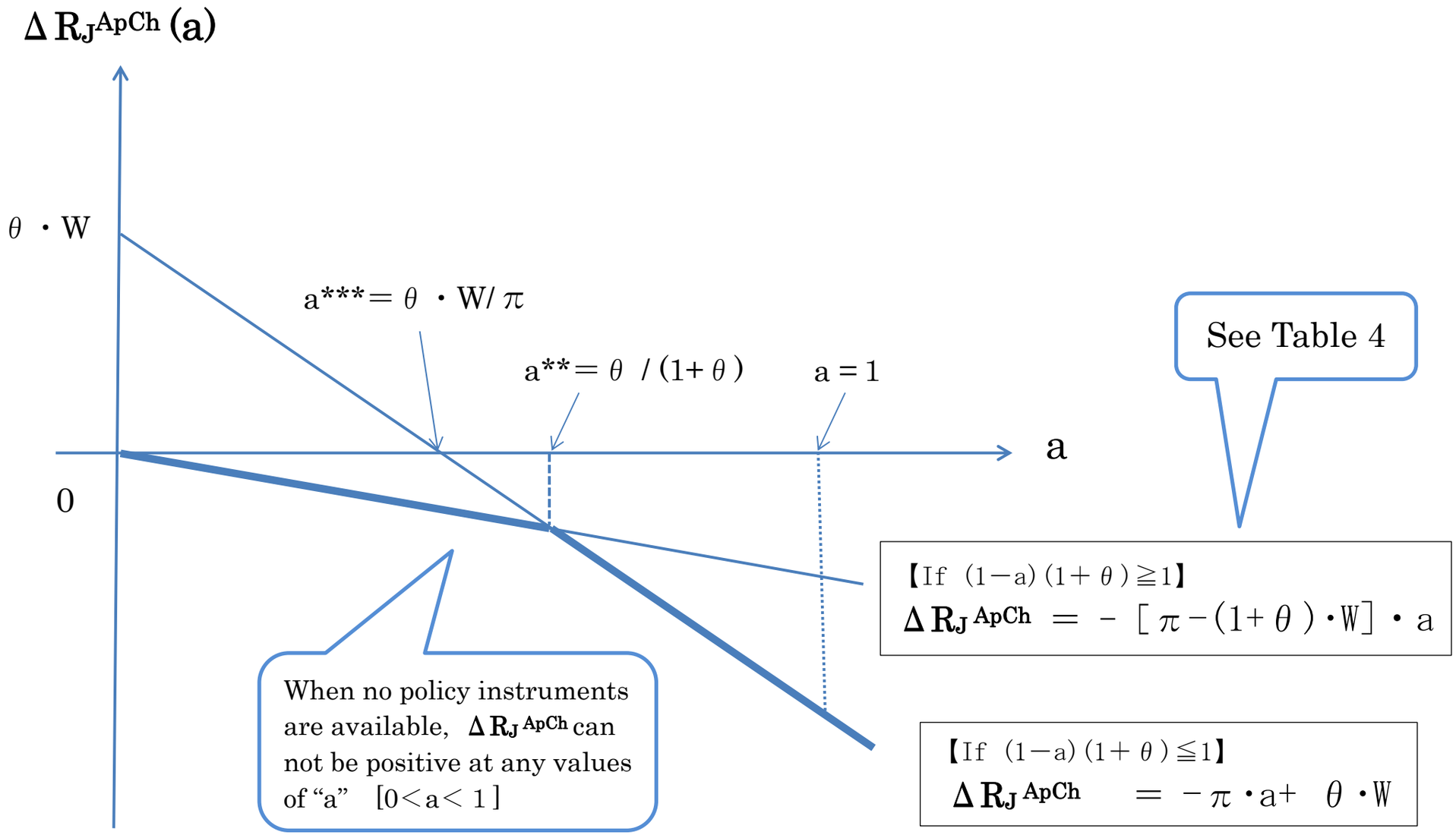
(Source) Hayashi (2018)

Fig.7　Game Tree in Basic Model



(Source) Author

Fig.8　Illustration of $\triangle R_J^{ApCh}(a) = R_J^{ApCh} - R_J^{ApSt}$



(Source) Author

Fig.9　Illustration of Equilibrium of the Game: Basic Model

【2nd Stage-i) Choice by J】[Table 4, Fig.8]

① If $(1-a)(1+\theta) \geqq 1$　$[0 < a \leqq a^{**}]$

$$\Delta R_J^{ApCh} = \underbrace{-a \cdot \pi}_{\text{Damage}(--)} + \underbrace{a \cdot (1+\theta) \cdot W}_{\text{Wage Saving}(+)}$$

② If $(1-a)(1+\theta) \leqq 1$　$[a^{**} \leqq a < 1]$

$$\Delta R_J^{ApCh} = \underbrace{-a \cdot \pi}_{\text{Damage}(--)} + \underbrace{\theta \cdot W}_{\text{Wage Saving}(+)}$$

At $0<a<1$, $\Delta R_J^{ApCh} < 0$ [See Fig.8]

➡ J chooses "St"

【2nd Stage-ii) Choice by J】[Table 4]

$$R_J^{ShCh} - R_J^{ShSt} = (b_{Ch} - b_{St})[\pi - (2+\theta)]$$

Given "$b_{Ch} > b_{St}$" (talented Y), it is positive.

➡ J chooses "Ch"

$(R_P, R_J)^{ShSt}$ ⟺ Comparison by J ⟺ $(R_P, R_J)^{ShCh}$

$(R_P, R_J)^{ApSt}$ ⟺ Comparison by J ⟺ $(R_P, R_J)^{ApCh}$

Benchmark

Comparison by P

【1st Stage: Choice by P】[Table 4]

$$\Delta RP_P^{ShCh} = (b_{ch} - \theta)W \gtreqless 0$$

＊ Given "$b_{Ch} \leqq \theta$", then, P chooses "Ap"
["Knowledge Appropriation" takes place]

Comparison by P

Stay　Change

J Executives

Stay　Change

J Executives

Appropriation　Sharing

Promoted HCN

(Source) Author

Fig.10 Impact of “A-1”：To Lower the Value of “a” (Dependence on Personal Skills)

【2nd Stage-i】 Impact of “A-1” on J’s Choice [If $(1-a)(1+\theta)\geqq 1$]

① Basic Model [Table 4, Fig.8]

$$\Delta R_J^{ApCh} = \underbrace{-a\cdot\pi}_{\text{Damage }(--)} + \underbrace{a\cdot(1+\theta)\cdot W}_{\text{Wage Saving }(+)} < 0$$

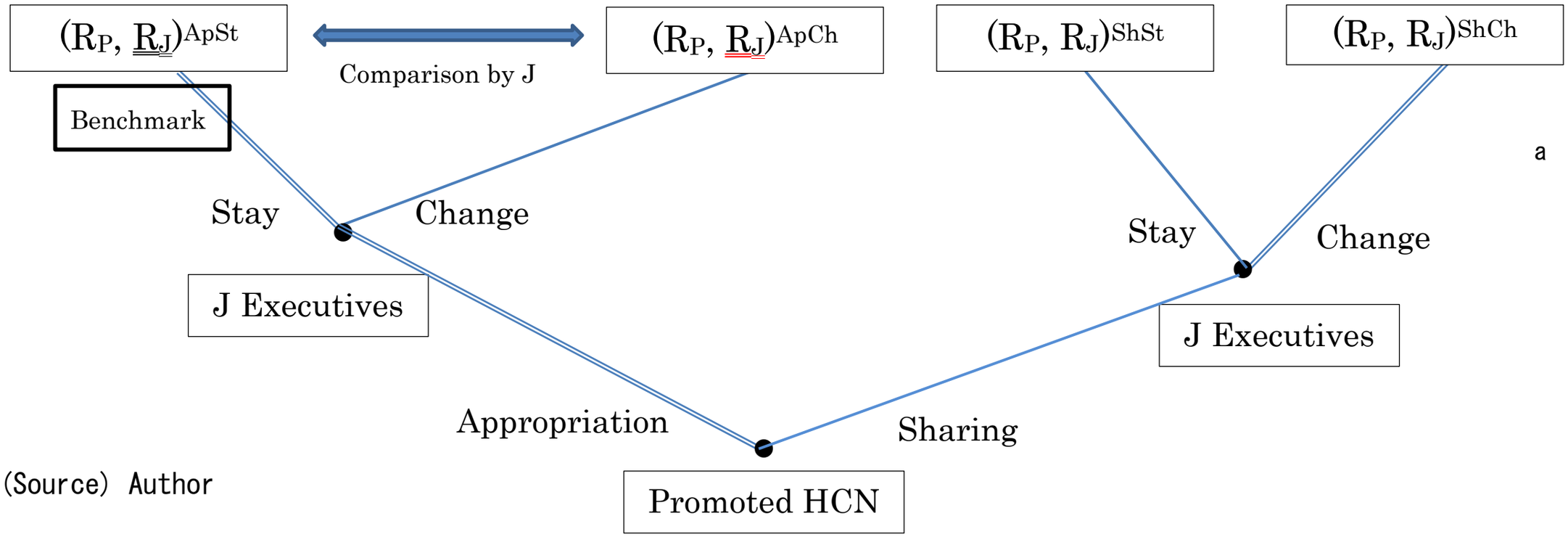
② Use of ″A-1” : $a_1 \rightarrow a_2 = a_1 - \Delta a$ [Table 4, Fig.8]

$$\Delta R_J^{ApCh} = \underbrace{-a_2\cdot\pi}_{\text{Damage }(-)\ \downarrow} + \underbrace{a_2\cdot(1+\theta)\cdot W}_{\text{Wage Saving }(+)} < 0 < \underbrace{j\cdot(\Delta a)^2}_{\text{Cost of “A-2” }(+)} \quad \text{still holds.}$$

「a↓→Damage↓」, but still $\Delta R_J < 0$ → <u>“A-1”alone cannot induce “Shift for J’s Choice”</u>

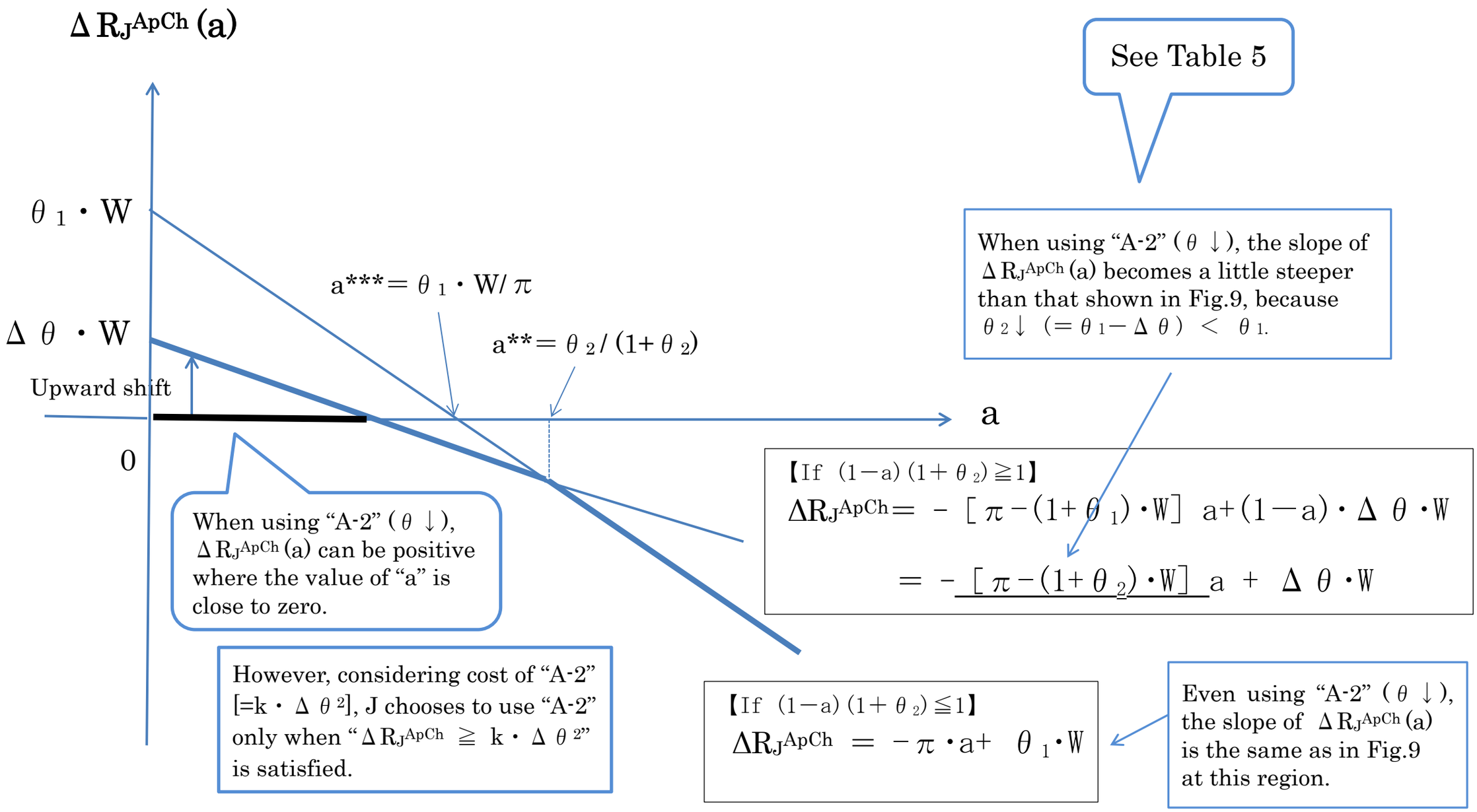
However, <u>if “A-1 & A-2” are combined,</u> 「$\Delta R_J > 0$」 might be possible [Fig.11]

➡ Then, “Shift” can take place (J chooses ”Ch” at the 2nd Stage) [Fig.12]



(Source) Author

Fig.11　Use of“A-2”：Support from J parent & to Lower the Value of “θ”



(Source) Author

Fig.12　Impact of “A-2”：Support from J parent & To Lower Value of “θ”(Wage Premium)

【2nd Stage-i】 Impact of “A-2” on J’s Choice　[If $(1-a)(1+\theta)\geqq 1$]

① Basic Model　[Table 4, Fig.8]

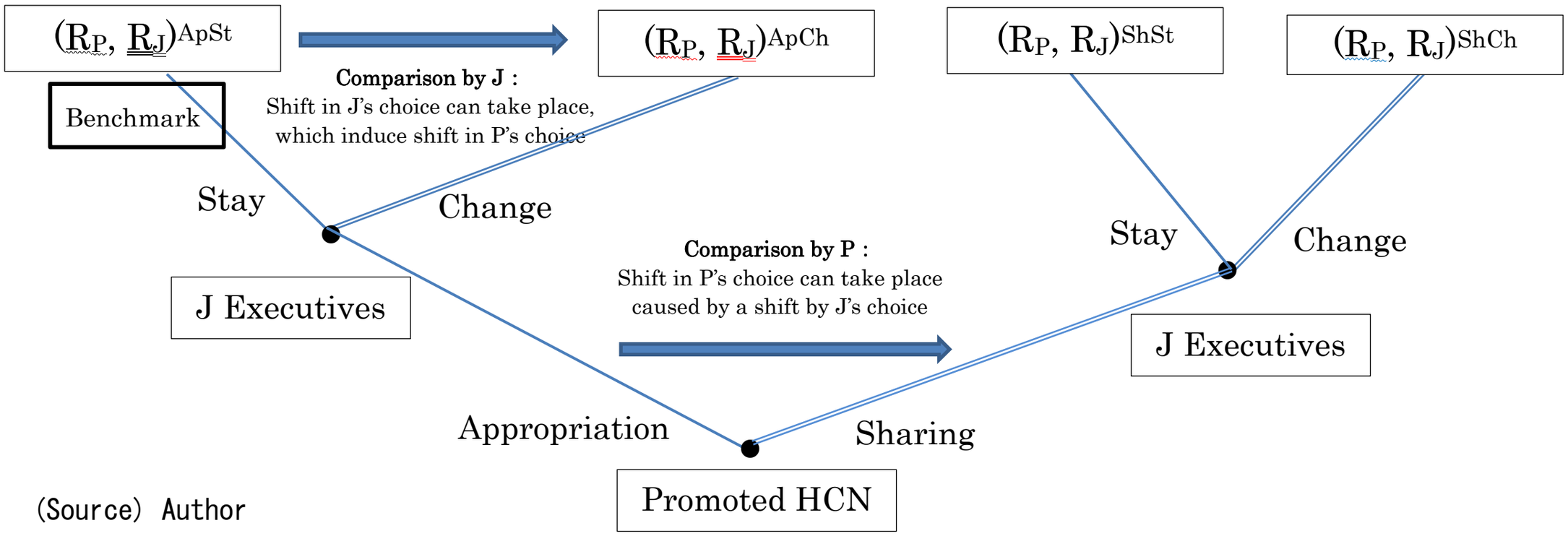
$$\Delta R_J^{ApCh} = \underbrace{-a\cdot\pi}_{\text{Damage }(--)} + \underbrace{a\cdot(1+\theta)\cdot W}_{\text{Wage Saving }(+)} < 0$$

② Use of ″A-2”：　$\theta_1 \rightarrow \theta_2 \downarrow = \theta_1 - \Delta\theta$　[Table 5, Fig.11]

$$\Delta R_J^{ApCh} = \underbrace{-a\cdot\pi}_{\text{Damage }(--)} + \underbrace{[a\cdot(1+\theta_1)\cdot W + (1-a)\cdot\Delta\theta\cdot W]}_{\text{Wage Saving }(+++)} \gtrless \underbrace{k\cdot(\Delta\theta)^2}_{\text{Cost of “A-2” }(+)}$$

Due to a New Term of $\Delta\theta\cdot W$, Wage Saving Effect ↑

「$\Delta R_J^{ApCh} \geqq k\cdot(\Delta\theta)^2$」 might be the case, and then, J chooses ”Ch” at the 2nd Stage



(Source) Author

Fig. 13 Impact of “B”：Payment of B (Merit Bonus)

【1st Stage】Impact of “B” on P’s Choice

① Basic Model: Knowledge Appreciation if 「$b_{ch} \leqq \theta$」

$$\Delta R_P^{ShCh} = (b_{Ch} - \theta)W \leqq 0$$

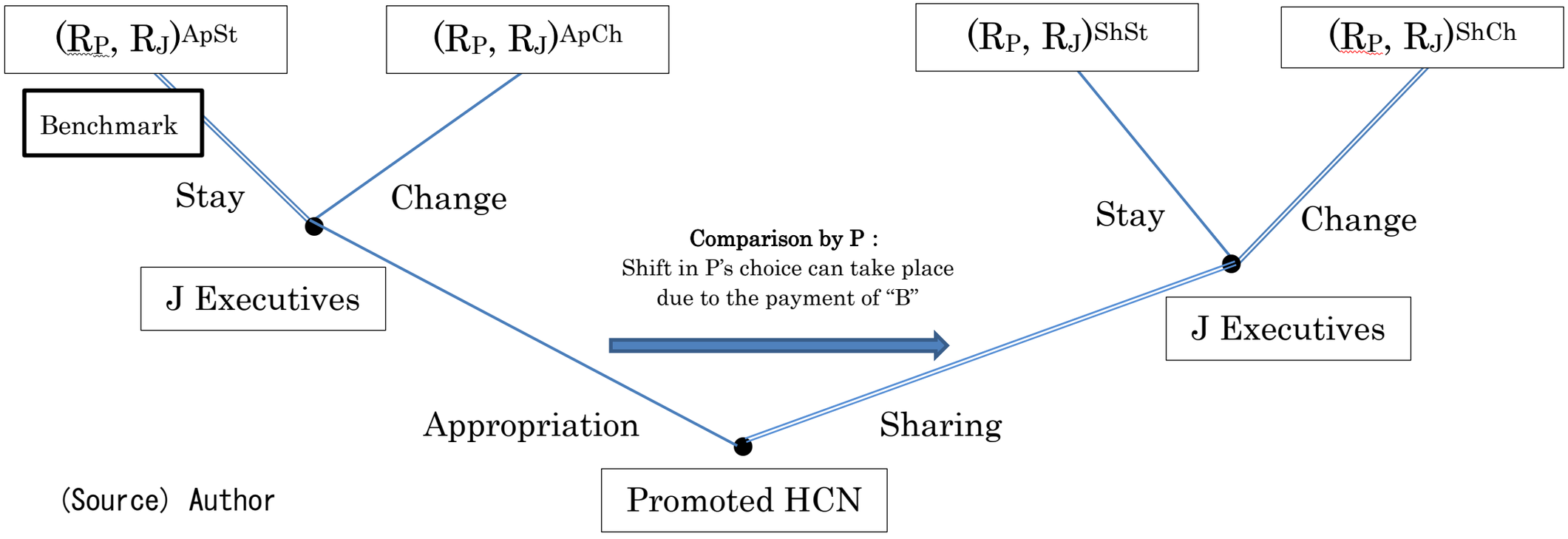
[”Growing Opportunity (+)” is not sufficient to cover the ”Loss in Wage Premium (－－)”.]

② Use of “B” : “B” (Merit Bonus) is paid to P

$$\Delta R_P^{ShCh} = (b_{Ch} - \theta)W + B \gtrless 0$$

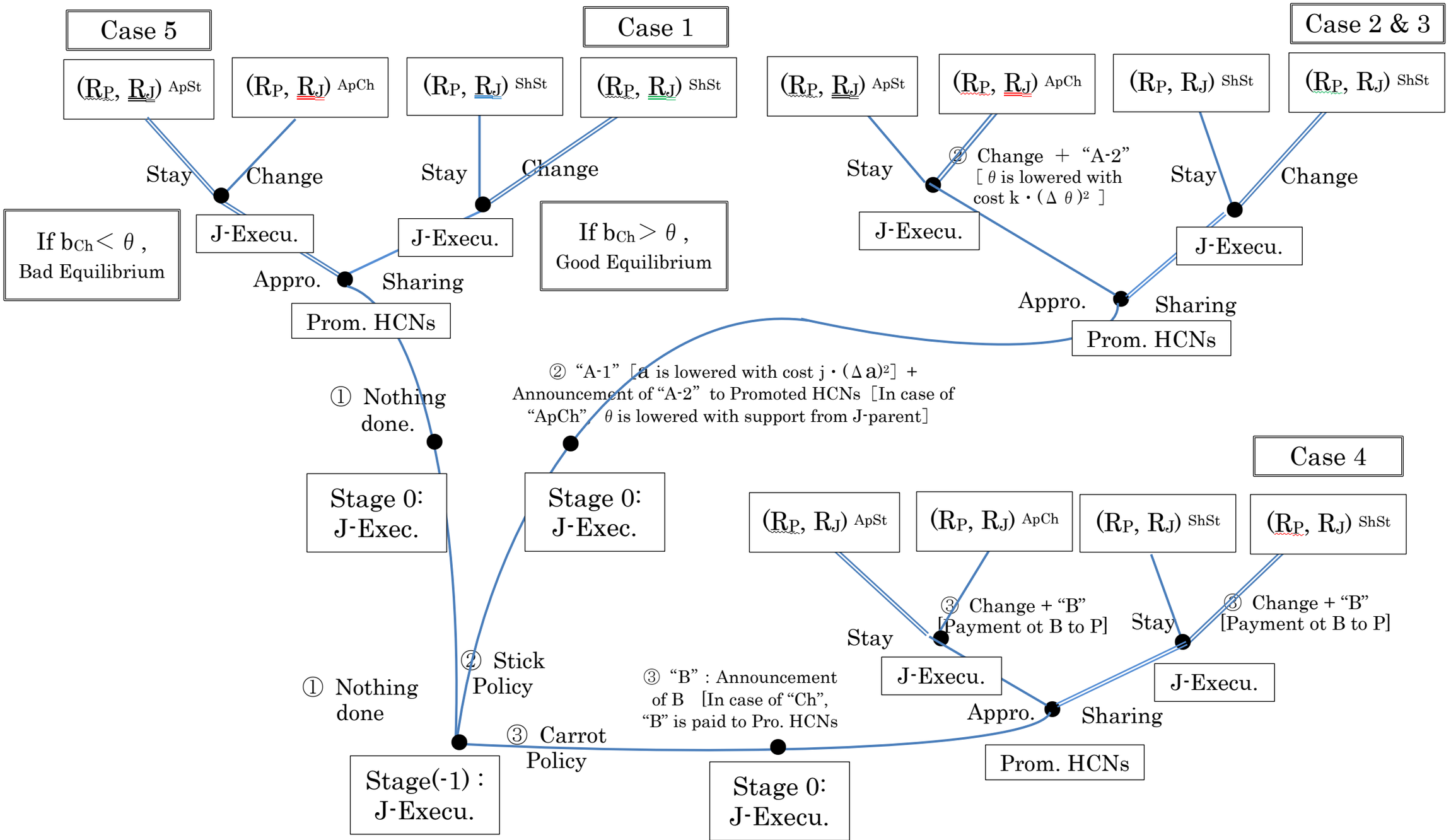
[”M” is paid to cover the “Loss in Wage Premium”]

Due to payment of B,「$\Delta R_P^{ShCh} \geqq 0$」→ P chooses “Sh” to achieve “Knowledge Sharing”.



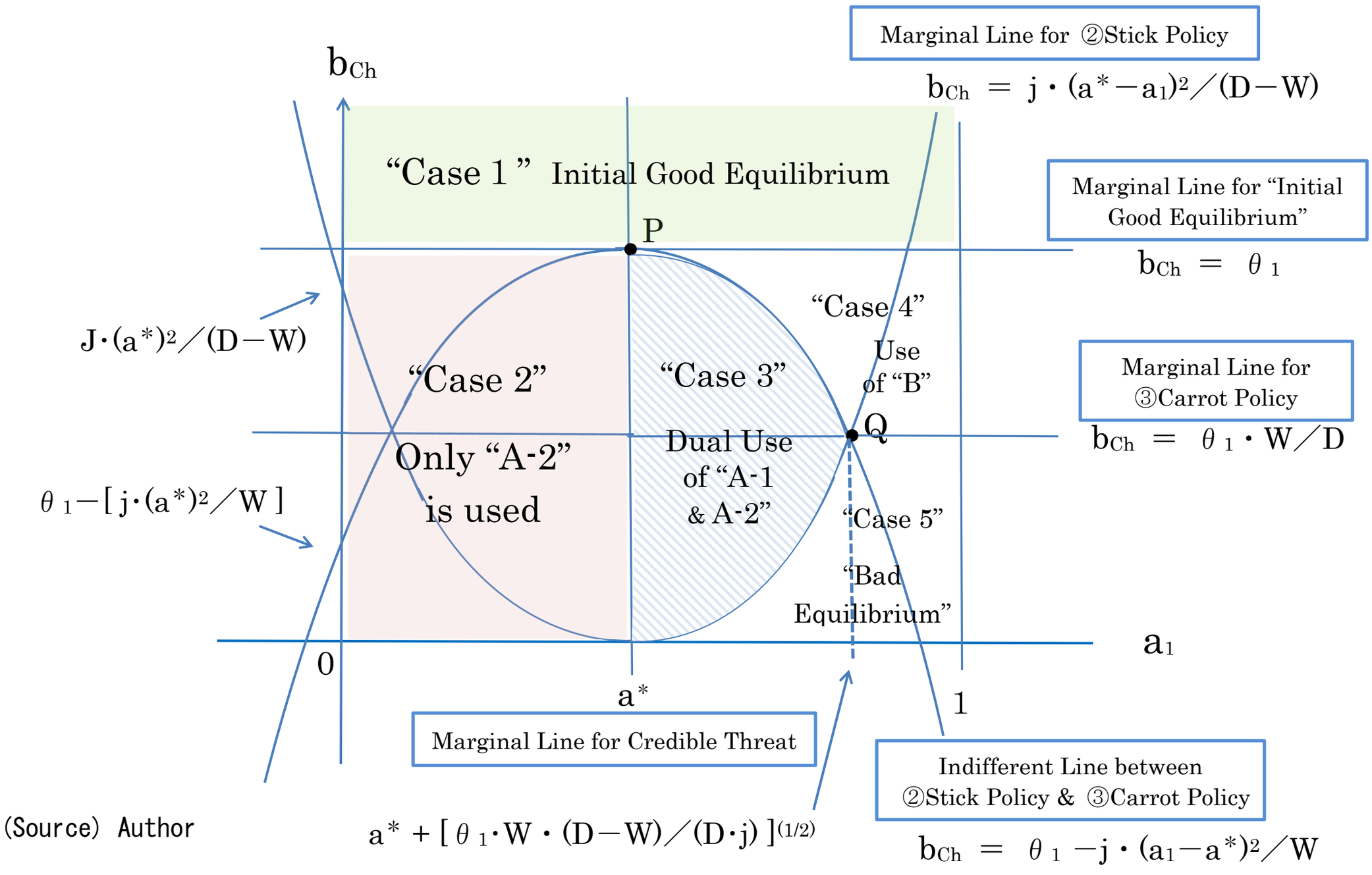
(Source) Author

Fig. 14 Game Tree in the Extended Model



(Source) Author

Fig.15　Illustration of “Five Cases”: Extended Model



(Source) Author

Table 1. Gray Areas vs. Well-defined Engagement Model

Major Characteristics		G-Model	W-Model
Manners of Tasks & Job Assignment	1) Gray (not clearly defined) areas	Greater	Smaller
	2) Borderline of individual tasks and their authority & responsibility	Vague	Clear
Mode of Skill & Knowledge	3) Sharing among members & neighboring sections	High	Low
	4) Relative importance in context specific knowledge & experiences	High	Low
	5) Relative explicitness in the form of documentation & illustration	Tacit	Explicit
Manners of Coordination & Collaboration	6) Horizontal vs. vertical coordination	Horizontal	Vertical
	7) Intensity in coordination & collaboration with neighboring sections	High	Low

Source: Hayashi (2004)

Table 2. Stepwise Hybrid Modification

Major Characteristics		Static Modification	Dynamic Modification
Manners of Tasks & Job Assignment	1) Gray (not clearly defined) areas	Small	Responsibility : □ … Smaller Possi. Support : ○ … Greater
	2) Borderline	Clear	Responsibility : □ … Clear Possi. Support : ○ … Flexible
Mode of Skill & Knowledge	1) Sharing among members & sections	Low	+○ : Higher
	4) Context specificity	Low	○&□ : dynamic feedback of tacit & explicit knowledge
	5) Explicitness	Explicit	
Manners of Coordination & Collaboration	6) Horizontal vs. vertical coordination	Vertical	○&□ : horizontal coordination backed up by vertical checking mechanism
	7) Coordination and collaboratsection	Less important	
Workers' Mentality in facing Problems		Well-defined commitment	+○ : Flexible support & cooperation
Human Resource Management		Higher speed in picking up for promotion	○ : Opportunities for self-fulfillment → steady progress in localization → prosperous circle can start

Source: Hayashi (2004)

Table 3　Pay-Offs for Each Combination of Options for P,Y,& J

Combination of Options for P & J	Total Return	R_p (Pay-Off for P) [Promoted HCN]	R_Y (Pay-Off for Y) [Young HCN]	R_J (Pay-Off for J) [Japanese Executives]
(Ap, St) 【Benchmark】	π	$(1+\theta)\cdot W$	W	$\pi-(2+\theta)\cdot W$
(Ap, Ch) 【if $(1-a)(1+\theta)\geqq 1$】	$(1-a)\cdot\pi$	W	$(1-a)(1+\theta)\cdot W$	$(1-a)\pi-[1+(1-a)(1+\theta)]\cdot W$
(Ap, Ch) 【if $(1-a)(1+\theta)<1$】	$(1-a)\cdot\pi$	W	W	$(1-a)\pi-2W$
(Sh, St)	$(1+b_{St})\cdot\pi$	$(1+b_{St})(1+\theta)\cdot W$	$(1+b_{St})\cdot W$	$(1+b_{St})\cdot[\pi-(2+\theta)]\cdot W$
(Sh, Ch)	$(1+b_{Ch})\cdot\pi$	$(1+b_{Ch})\cdot W$	$(1+b_{Ch})(1+\theta)\cdot W$	$(1+b_{Ch})\cdot[\pi-(2+\theta)]\cdot W$

(Source) Author

Table 4　Difference in Pay-Offs for P & J from the Benchmark
[(Ap, St): Benchmark Combination of Options]

Combination of Optionsfor P & J	ΔR_P	ΔR_J
(Ap, Ch) 【if $(1-a)(1+\theta)\geqq 1$】	$-\theta \cdot W$	$-a\cdot\pi+a\cdot(1+\theta)\cdot W$
(Ap, Ch) 【if $(1-a)(1+\theta)<1$】	$-\theta \cdot W$	$-a\cdot\pi+\theta\cdot W$
(Sh, St)	$b_{St}\cdot(1+\theta)\cdot W$	$b_{St}\cdot[\pi-(2+\theta)]\cdot W$
(Sh, Ch)	$(b_{Ch}-\theta)\cdot W$	$b_{Ch}\cdot[\pi-(2+\theta)]\cdot W$

(Source) Author

Table 5　Impact of"A-2":　Difference in Pay Offs for J
by the Shift from "Knowledge Appropriation" to "Knowledge Sharing"

	R_J [As in Table 3]	ΔR_J
(Ap,St) 【Benchmark】	$\pi-(2+\theta_1)\cdot W$	
(Ap,Ch) 【if $(1-a)(1+\theta)\geqq 1$】	$(1-a)\,\pi-$ $[1+(1-a)(1+\theta_2)]\cdot W$	$-[\pi-(1+\theta_1)\cdot W]\cdot a$ $+(1-a)\cdot\Delta\theta\cdot W$ ＝ $-[\pi-(1+\theta_2)\cdot W]\cdot a$ $+\Delta\theta\cdot W$
(Ap,Ch) 【if $(1-a)(1+\theta)<1$】	$(1-a)\,\pi-2W$	$-a\cdot\pi+\theta_1\cdot W$

(Source) Author