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"Further Reasons for the "But for" Defense of a Grant-Back Clause and the Attribute of Innovation"

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Further Reasons for the "But for" Defense of a Grant-Back Clause and the Attribute of Innovation *

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Abstract

This study investigates the effect of grant-back clauses in licensing agreements using a different analytical manner from that of Ambashi, Régibeau, and Rockett (2019) (abbreviated by "ARR"). Both this study and theirs focus on attributes of innovations categorized as either "severable" (noninfringing) or "nonseverable" (infringing). The European Commission's 2004 Technology Transfer Guidelines consider a grant-back clause applied to nonseverable innovation innocuous. In contrast, those guidelines indicate that a grant-back clause that applies to severable innovation should be treated with much greater skepticism. However, this study reveals that this guidance requires further debate concerning prohibitions on territorial restraints and multiple heterogeneous licensees, as well as other factors noted in the work of ARR.

KEYWORDS: Grant-back clause, Patent, Licensing, Severable and nonseverable innovation

JEL CLASSIFICATION: O31; O34

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1 Introduction

Patent-holders may not always be ideally positioned to exploit their technologies within a given market. In particular, while a patent-holder may be quite competitive within its home market, it may not possess the required local expertise to perform well in other geographical markets. Alternatively, using existing production technologies from other firms may be more efficient than serving other markets through export or direct investment in new technologies adjusted for different markets. For these reasons, licensing is a common way to transfer technologies, thereby earning revenue from royalty payments. Furthermore, licensing is generally acknowledged as socially desirable because it disseminates innovations to additional firms.

In addition to conventional licensing agreements, this study focuses on the grant-back clause, as was done in a similar study by Ambashi, Régibeau, and Rockett (2019) (abbreviated by "ARR"). Briefly, a grant-back clause obliges a licensee to grant the right to future advances or improvements in the licensed technology to the licensor of a seed technology (Shapiro, 1985), and its use has become quite popular. Indeed, Cockburn (2007) shows that 43% of the licensing agreements of his sample firms contained such grant-back clauses.

Amidst the widespread use of the grant-back clause, it is worth noting the distinctive practice isolated in the European Commission's so-called 2004 EU Technology Transfer Guidelines (European Commission, 2004) that calls for certain types of grant-backs to come under careful scrutiny. The European Commission (2004) explicitly distinguishes between "severable" and "nonseverable" innovations. Whereas the definition of "severable" innovation means that it can be employed without infringing the licensed technology, "non-severable" innovation cannot be exploited by a licensee in the absence of a licensor's permission. In line with this, the European Commission (2004) prescribes that from the viewpoint of the innovation attributes, grant-back clauses related to severable innovation should be viewed from a more critical standpoint, especially when the grant-backs are exclusive. [1] Hence, the European Commission (2004) maintains that since grant-back clauses for severable innovation are more likely to severely impair a licensee's incentive to innovate than grant-back clauses for nonseverable innovation, they should be regarded as socially undesirable. [2]

[1] Article 109 of the European Commission (2004) states: "Article 5(1)(a) and 5(1)(b) concerns exclusive grant backs or assignments to the licensor of severable improvements of the licensed technology. ⋯ An obligation to grant the licensor an exclusive license to severable improvements of the licensed technology or to assign such improvements to the licensor is likely to reduce the licensee's incentive to innovate since it hinders the licensee in exploiting his improvements, including by way of licensing to third parties. This is the case both where the severable improvement concerns the same application as the licensed technology and where the licensee develops new applications of the licensed technology."

[2] The current Technology Transfer Guidelines (European Commission, 2014) are still somewhat characterized by skepticism toward grant-back clauses materialized in the form of exclusive grant-backs. (An exclusive grant-back is defined as a grant-back that prevents the licensee from exploiting the improvement either for its own production or for licensing out to third parties.) Article 129 of the European Commission (2014) states: "An obligation to grant the licensor an exclusive license to improvements of the licensed technology or to

This study intends to raise a question about the abovementioned critical views and to shed light on the counterargument for including a grant-back clause, namely the "but for" defense, as ARR has probed in detail. More precisely, if there is a concern held by an original licensor that a licensee may stop royalty payments, or in the worst possible scenario, may erode the licensor's profit by using the licensed technology to leapfrog or to invent around the original patent, the licensor is unlikely to provide its original technology without a grant-back clause. Thus, this paper aims to further investigate how the "but for" defense of a grant-back clause can be declared legitimate from the perspective of preserving a licensor's incentive when the analysis explicitly considers the attributes of innovations. Particularly, this study assesses whether the critical approach by the European Commission (2004) to use grant-back clauses for severable innovation can be justified.

The following three questions are addressed in this paper. First, is a grant-back clause always indispensable in facilitating licensing activities? Second, does a grant-back clause affect a licensee's incentive to innovate? Third, is a grant-back likely to allow third parties to gain access to future innovations?

Let me briefly respond to these three questions. For the first question, this study demonstrates that in the case of a licensing agreement with a single licensee, the "but for" argument is applied more firmly to severable innovation than to nonseverable innovation. In other words, whereas a grant-back clause does not further facilitate any licensing activities for nonseverable innovation, it does for severable innovation in some cases. The reason is briefly as follows: although severable innovation, which is not infringing the original patent, makes it difficult for a licensor to recapture the fruit of the follow-on innovation created by a licensee, a grant-back clause ensures the licensor's use of it without any explicit royalty payment.

With regard to the second question, grant-back clauses do not necessarily extinguish a licensee's motivation to innovate. This is because the licensor, who is generally assumed to have total bargaining power over whether to include a grant-back clause, can still expect the licensee to complete the innovation if it is profitable to do so. Consequently, it is reasonable for the licensor to leave monetary motivation with the licensee in anticipation that the licensee is willing to innovate further.

Finally, in order to answer the third question, we need to add another potential licensee to the model. The situation becomes somewhat complicated in this instance. Considering multiple heterogeneous licensees in terms of innovation abilities (that is, the one is capable of innovating, whereas the other is not), we find that a licensor will be unable to license its original technology to both competent and incompetent licensees for severable innovation if territorial restraints are in place. But grant-back clauses can open the door to licensing activities, whereby a competent licensee can innovate while other, incompetent licensees are

assign such improvements to the licensor is likely to reduce the licensee's incentive to innovate since it hinders the licensee in exploiting the improvements, including by way of licensing to third parties."

certain to take advantage of the innovation.

The effect of a grant-back clause has been examined by some authors, but they have not directed their attention to the attribute of innovations other than ARR. Meanwhile, this study does not deal concretely with the problem of "overincentives" to innovate addressed by Ambashi (2021) and van Dijk (2000), which argue that grant-back contracts can lead to a socially desirable reduction in innovation incentives. Contrary to the framework of Choi (2002), this study does not build on asymmetric information between a licensor and a licensee regarding the quality of licensed technologies. While Choi's (2002) results illustrate that grant-back clauses help a licensor retain the incentive to transfer the state-of-the-art technology, the role of asymmetric information in this transfer is not the focus here. This is because many grant-back licensing activities can be observed between firms that are familiar with relevant technologies to their businesses (Zuniga and Guellec, 2009).

The main focus of this study is on the contrasting incentive for innovation according to the different attributes of innovation. By establishing the "but for" defense of a grant-back clause for severable innovation, we reinforce the argument proposed by ARR to critically examine the European Commission (2004), which was more lenient toward nonseverable innovation than severable innovation. To this end, this study proves with further reasons that a licensor is likely to benefit from the grant-back clause as part of technology transfer especially for severable innovation. Thus, the contribution of this study to literature on the economics of intellectual property rights is that new light is shed on the characteristics of a grant-back clause, and thereby, the unique implications are driven for the effect of a grant-back clause on innovation incentives, particularly of a licensor.

After this introduction, Section 2 outlines the model structure in a multistage game. Section 3 investigates the case of a single licensee under the attribute of innovations. Section 4 extends the basic model by changing its assumptions about territorial restraints and the number of licensees. Section 5 presents the conclusion.

2 Model structure

Section 2 established a baseline model with one licensor and one licensee exist, which is also presented by ARR. In Subsection 4.2, the model is extended to two heterogeneous licensees relative to their innovation abilities, with more varied implications.

It is assumed that a licensor (denoted by firm L) already possesses a base technology (denoted by BT) that can be licensed to a licensee (represented by firm A). For descriptive purposes, the set of firms is defined as $F = \{L, A\}$. BT is assumed to be an original vital technology that leads to follow-on innovation. It is posited that only firm A can achieve

innovation and develop the improved technology (denoted by IT) by using BT. [3]

Whereas firms L and A can sell products in their local markets without incurring any costs, they must incur an additional cost, $c > 0$, to sell into other markets. The variable c can be regarded as the market-entry cost, or particularly speaking, a transportation cost based on the distance between the two markets. It is reasonable to assume a limit on the range of c so that the firms can find it profitable to sell in all markets, suggesting that c must be a finite value.

In addition, when an initial licensing agreement is concluded, firm A innovates using BT at the cost of $k \geq 0$. Unlike the work of ARR, this study assumes nil innovation cost, i.e., $k = 0$, for analytical simplicity. This assumption implies that we will concentrate solely on the innovation incentive of a licensor by omitting the recovery effect of a grant-back clause on that of a licensee.

This study postulates that whereas the willingness to pay by consumers in each market is measured as 1 with BT, it rises to $1 + \theta$ (with $\theta > 0$) if the products are supplied to consumers with IT. In this sense, IT adds on an additional value of products by increasing their attractiveness through enhancing the function of the products. To make the interpretation more easily understandable, this model supposes that IT creates a "new market," the value of which is θ. Then, the critical assumption is that since the licensee's technology, IT, is a perfect substitute, but not a complement, firm L has a concern that firm A may "steal its market." Because of this "business-stealing effect," firm L is placed in a disadvantaged position, especially when the innovation is severable, which in turn lends support to the favorable effect of grant-back clauses. Lastly, since the willingness to pay in each market in the absence of IT is normalized to 1, the corresponding range of the market-entry cost is generally limited to $c \in (0, 1)$ from the abovementioned assumption.

The licensing game is structured in what follows. In Stage 0, before the licensing game starts, firm L owns BT, and the attribute of the innovation, severable, or nonseverable, is known to both firm L and firm A. Whether an innovation is severable or nonseverable is not always obvious and is sometimes judged by courts, but the model assumes that its status has already been determined and is common knowledge. That is, this model eliminates all the uncertainty and asymmetric information regarding the innovation to be achieved.

In Stage 1, firm L decides to offer a contract to firm A to license BT and to include a grant-back clause in the contract if available. This initial contract offered by firm L is assumed to be based on a "take-it-or-leave-it offer" in which the contract terms do not allow renegotiation. Since there is a single licensor who possesses vital BT toward follow-on innovation, firm L

[3] As is frequently observed, inventing firms are not necessarily the best entities for making full use of their inventions. Throughout history, follow-on inventors have succeeded in applying the achievements of their predecessors to their interests, thereby contributing to developments in science and industry. For example, steam engines, invented by James Watt in the 19th century, were used in various industrial fields such as steamboats and steam locomotives in the generations that followed.

has complete control over the use of a grant-back clause, which reflects the actual bargaining power of the firms. If an initial licensing agreement is concluded, innovation is achieved by firm A immediately after the agreement, and subsequently, the innovation cost is realized. By contrast, if an initial licensing agreement is not concluded, firm L serves both markets with BT. It is natural to assume that innovation and entry can occur only if the firms find it profitable to undertake such actions.

The important assumption is that the royalty of BT (denoted by r_1) is conditional on its use by firm A. More precisely, when a follow-on innovation occurs, firm A is eligible to "opt out" of the royalty payment by substituting IT as long as the innovation is severable. The background logic is as follows: the innovation instantaneously occurs after the technology transfer of BT, and it can effectively cancel all royalty payments accruing to BT since severable innovation does not ultimately infringe on BT. This assumption enables us to establish a clear argument of the "but for" defense of a grant-back clause.

In Stage 2, firm A decides to offer a contract regarding the license of IT in return for a royalty payment (denoted by r_2) if a grant-back clause is not exercised. When a grant-back clause is included in the contract in Stage 1, firm A cannot require firm L to pay any royalties of IT (i.e., $r_2 = 0$). [4] Subsequently, upon having completed the above two stages, firms L and A sell their products in the market and the profits are realized. Figure 1 depicts this multistage game.

Let us confirm again how the consequences of the model vary according to severable and nonseverable innovations, following the legal practice of the European Commission (2004). When the innovation is severable, firm A is eligible to sell a product with high quality, $1 + \theta$, not relying on BT, which is transferred from firm L. That is, severable innovation does not infringe on BT, and it is separately patentable. On the other hand, when the innovation is nonseverable, IT cannot be used without infringing on BT. Consequently, the licensing agreement is still fully effective, and firm A owes a royalty payment to firm L under the nonseverable innovation. Moreover, when bargaining over a licensing agreement in Stage 1, firm L considers whether a grant-back clause should be included if available. When a grant-back clause is included, IT reverts back to firm L without any royalty payments, while firm A still retains the right to exploit IT without additional payments to firm L other than r_1. [5] When a grant-back clause is not available, firm A can still decide to grant the license of IT back to firm L while demanding a royalty rate of r_2.

As is the case in ARR, territorial apply to licensing agreements that are in force. This implies that licensing agreements divide up markets between a licensor and a licensee, and that firms licensing the technologies continue to operate under territorial restraints even if

[4] Put simply, this setting supposes that royalties are independent of output (indeed, output is normalized in the model), so that the form of the royalty payment (i.e., fixed or commensurate with usage) is irrelevant.

[5] Exclusive grant-backs are not assumed in this analysis.

licensed firms do not actually use them. In our framework, the absence of territorial restraints is necessarily unfavorable for a licensor because licensing agreements without them inevitably create direct competitors. Afterward, in Subsection 4.1, we extend the investigation to the case in which territorial restraints are prohibited.

Finally, the royalty rates, r_1 and r_2, are determined in each stage based on the Nash bargaining solution (hereafter, NBS). The following multi-stage game (Figure 1) is solved by backward induction.

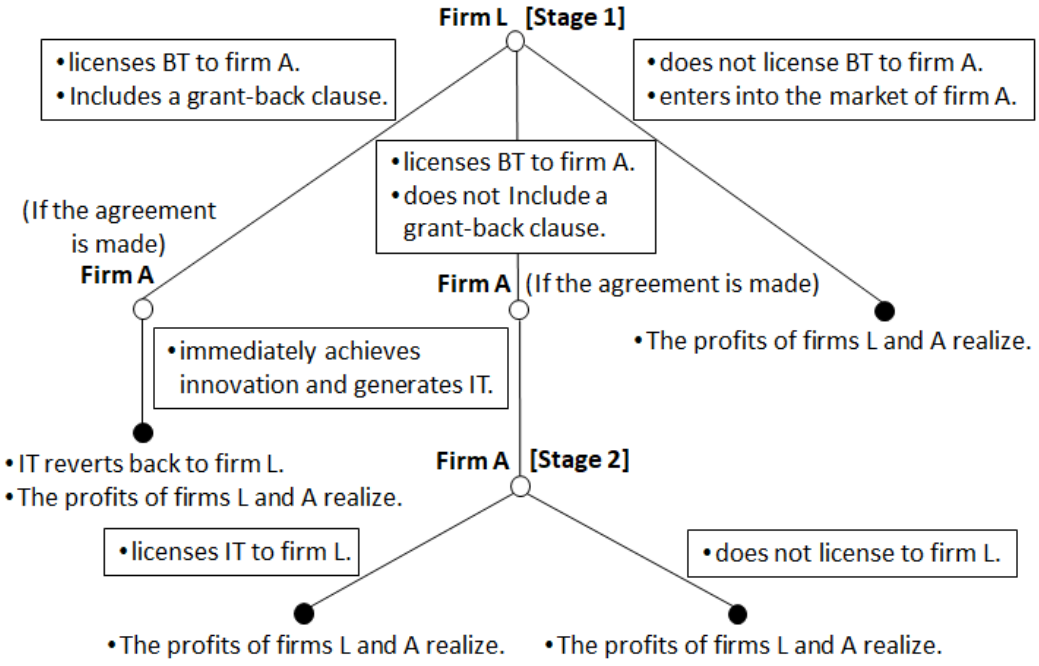

FIGURE 1 Timing of the model

3 Baseline analysis: one potential licensee

In Section 3, there is a single licensee, firm A. We examine the incentives of licensing for both severable and nonseverable innovation. In what follows, we demonstrate how the "but for" defense of a grant-back clause is effective for licensing activities under severable innovation.

3.1 Nonseverable innovation

3.1.1 Nonavailability of grant-back clause

To begin, we consider the case where a grant-back clause is not available to firm L. Assuming that an initial licensing agreement in Stage 1 has been already concluded, we determine a royalty rate in Stage 2, r_2, paid by firm L to firm A. By purchasing the IT license, firm L can

increase the value of its own market from 1 to $1+\theta$. As a result, we obtain the NBS in Stage 2 by maximizing the following "Nash product" for r_2:

$$\max_{r_2} \underbrace{[(1+\theta+r_1-r_2)-(1+r_1)]}_{\text{Profit difference of Firm L}} \underbrace{[(1+\theta-r_1+r_2)-(1+\theta-r_1)]}_{\text{Profit difference of Firm A}}$$
$$= \max_{r_2}(\theta-r_2)r_2. \Rightarrow r_2^{NN} = \frac{\theta}{2}.$$

The order of the terms concerning firms L and A is from left to right. (This order is maintained hereafter.) This provides the NBS, namely, $r_2^{NN} = \frac{\theta}{2}$.

Let us revert to Stage 1. Since nonseverable innovation always infringes on BT, the royalty rate, r_1, should be paid by firm A to firm L. We represent the reservation profits of firms L and A as $\pi_L^R = 2-c$ and $\pi_A^R = 0$, respectively, when the initial licensing agreement is not concluded in Stage 1. Then, the initial royalty rate, r_1, is the solution to the following problem:

$$\max_{r_1}[(1+\theta+r_1-r_2^{NN})-\pi_L^R][(1+\theta-r_1+r_2^{NN})-\pi_A^R]$$
$$= \max_{r_1}\left(-1+\frac{\theta}{2}+c+r_1\right)\left(1+\frac{3\theta}{2}-r_1\right). \Rightarrow r_1^{NN} = 1+\frac{\theta}{2}-\frac{c}{2}.$$

Firm L earns a net royalty of $r_1^{NN} - r_2^{NN} = 1-\frac{c}{2}$. The profits firms L and A earn are $\pi_L^{NN} = 2+\theta-\frac{c}{2} > \pi_L^R$ and $\pi_A^{NN} = \theta+\frac{c}{2} > \pi_A^R$, respectively. This implies that the "participation conditions" of both firm L and firm A in an initial licensing agreement are satisfied. (They are denoted as "PCL" and "PCA," respectively, for a descriptive purpose.) Accordingly, the two firms prefer to conclude a contract even when a grant-back clause is unavailable. We can also find that firm L benefits from the follow-on innovation achieved by firm A as its profit increases in θ. Although firm L needs to incur one half of the market-entry cost ($\frac{c}{2}$), which is not actually realized, the entire gain of θ from IT is still retained by firm L.

Assuming that social welfare is simply viewed as a total profit of the two firms, [6] it amounts to $W^{NN} = \sum_{f\in F}\pi_f^{NN} = 2+2\theta$. Note that this social welfare achieves the first-best level, and therefore, the "social optimality condition" (denoted by "SC") is satisfied. Unambiguously, $W^{NN} = 2+2\theta$ exceeds $W^R = 2-c$, which is obtained without any licensing agreements.

3.1.2 Availability of grant-back clause

How does the result change when firm L is allowed to include a grant-back clause in an initial licensing agreement? As stated earlier, firm A can no longer demand a royalty in return for IT in Stage 2 due to the grant-back clause (i.e., $r_2 = 0$). The NBS of r_1 in Stage 1 is determined

[6] We postulate that consumers' willingness to pay is entirely included in the profits of the two firms through extraction by firms, for example, price discrimination. This implies that the demand curve of consumers is perfectly inelastic. In this simplified case, private values of firms can be considered equivalent to social values.

by the following equation:

$$\max_{r_1}[(1+\theta+r_1)-(2-c)][(1+\theta-r_1)-0]$$
$$=\max_{r_1}(-1+\theta+c+r_1)(1+\theta-r_1). \Rightarrow r_1^{NA}=1-\frac{c}{2}.$$

$r_1^{NA}=1-\frac{c}{2}$ is equivalent to the "net royalty" earned by firm L without any grant-backs. Not surprisingly, the profits of firm L and firm A, as well as social welfare, are exactly the same as in the case where a grant-back clause is unavailable: $\pi_L^{NA}=2+\theta-\frac{c}{2}$, $\pi_A^{NA}=\theta+\frac{c}{2}$, and $W^{NA}=\sum_{f\in F}\pi_f^{NA}=2+2\theta$. With regard to nonseverable innovation and a single licensee, we can derive the following lemma:

Lemma 1 (nonseverable innovation and a single licensee). We can propose the following statements regardless of the availability of a grant-back clause for nonseverable innovation:
(1) Innovation is achieved, and the improved technology is shared by firms L and A.
(2) First-best social welfare is generated.
(3) A grant-back clause does not affect profits or social welfare.

Since an initial licensing agreement is essential to facilitating IT, both firm L and firm A can potentially benefit from it. The reason why the benefit of firm L is produced by licensing is that even without a grant-back clause, the initial royalty rate, r_1, is determined to capture future gains from an innovation resulting from the anticipated follow-on licensing activity. More generally, the net royalty, $r_1^{NN}-r_2^{NN}$, earned by firm L can be established to the same level as r_1^{NA} by adjusting r_1^{NN} in an appropriate manner. This is why these two ways of capturing the outcome of the innovation should be equivalent; however, the only observable difference is the one-way or two-way flow of royalty payments between the two firms.

3.2 Severable innovation

Under severable innovation, firm L cannot extract any royalty payment from firm A in return for transferring BT in Stage 1. It follows that after granting a license in Stage 1, firm L holds BT only with a value of 1 while firm A holds IT with a value of $1+\theta$. In light of the attribute of severable innovation, it is reasonably natural that the territorial restraint still applies to the "original market" (the value of which is 1), but not to the "new market" (the value of which is θ) created by the innovation. Consequently, firm A can potentially earn $\theta-c$ (if θ is greater than c) in the new market of firm L in addition to $1+\theta$ in its own market.

3.2.1 Nonavailability of grant-back clause

Whether firm A enters the new market of firm L depends on the value of the innovation (θ) relative to the market-entry cost (c). This market-entry behavior made by firms is not explicitly assumed in ARR, which means that this study has its own analytical point.

First, suppose that the innovation is relatively major ($\theta > c$), so that firm A is likely to enter the new market of firm L. Given that firm L issues a license of BT in Stage 1, we obtain the NBS in Stage 2 in the following equation:

$$\begin{aligned}&\max_{r_2}[(1+\theta-r_2)-1][(\underbrace{1+\theta}_{\text{Market A}}+r_2)-(\underbrace{1+\theta}_{\text{Market A}}+\underbrace{\theta-c}_{\text{Market L}})]\\&=\max_{r_2}(\theta-r_2)(-\theta+c+r_2).\Rightarrow r_2^{SN}=\theta-\frac{c}{2}.\end{aligned}$$

Notably, firm L cannot demand a royalty payment in Stage 1 for severable innovation. Hence, the profits of firm L and firm A are $\pi_L^{SN}=1+\frac{c}{2}>1$ and $\pi_A^{SN}=1+2\theta-\frac{c}{2}>1+2\theta-c$, respectively. Consequently, firms L and A agree with the licensing of IT. But we also need to check whether firm L intends to grant the licensing of BT in Stage 1. Comparing $\pi_L^{SN}=1+\frac{c}{2}$ with $\pi_L^R=2-c$, we can easily see that PCL is satisfied if $\pi_L^{SN}>\pi_L^R\Leftrightarrow\frac{2}{3}<c<1$. In other words, if the market-entry cost is sufficiently high (close to 1), firm L grants firm A a license to BT. This occurs because when the market-entry cost is high, firm A can retain a relatively low profit by an entry in Stage 2 ($\pi_A^{SN}=1+2\theta-\frac{c}{2}$), and the profit of firm L increases ($\pi_L^{SN}=1+\frac{c}{2}$) relative to firm L's profits in the absence of licensing BT. As a result, firm L has a clear motive to grant a license to BT.

Next, when the innovation is relatively minor ($\theta < c$), firm A will not choose to enter a new market of firm L. In that case, the NBS in Stage 2 is provided by:

$$\max_{r_2}[(1+\theta-r_2)-1][(1+\theta+r_2)-(1+\theta)]=\max_{r_2}(\theta-r_2)r_2.\Rightarrow r_2^{SN}=\frac{\theta}{2}.$$

The profits of firm L and firm A are $\pi_L^{SN}=1+\frac{\theta}{2}$ and $\pi_A^{SN}=1+\frac{3\theta}{2}$, respectively. Comparing firm L's profits of $\pi_L^{SN}=1+\frac{\theta}{2}$ and $\pi_L^R=2-c$, we see that PCL is satisfied if $\pi_L^{SN}>\pi_L^R\Leftrightarrow\theta>2(1-c)$. This indicates that $\frac{2}{3}<c<1$ is absolutely necessary. [7] By contrast, if $0<c<\frac{2}{3}$ holds, PCL is never satisfied. The intuition for the condition, $\theta>2(1-c)$, is straightforward. Although the profit of firm L ($\pi_L^{SN}=1+\frac{\theta}{2}$) does not directly depend on a market-entry cost, c, its profit earned by entry into the market of firm A without an initial licensing agreement ($\pi_L^R=2-c$) will be decreased as c becomes large. This makes firm L recognize that if the value of innovation, θ, is sufficiently high relative to the market-entry cost, licensing BT to firm A and encouraging innovation results in greater profit for firm L.

[7] Because $\theta<c$, the relation $2-2c<\theta<c$ provides $\frac{2}{3}<c<1$.

The shaded area of (c, θ) in Figure 2 indicates where both PCL and PCA are satisfied (which means that an initial licensing agreement is possible), [8] and thereby, social welfare attains the first-best level (SC is satisfied), $W^{SN} = \sum_{f \in F} \pi_f^{SN} = 2 + 2\theta$.

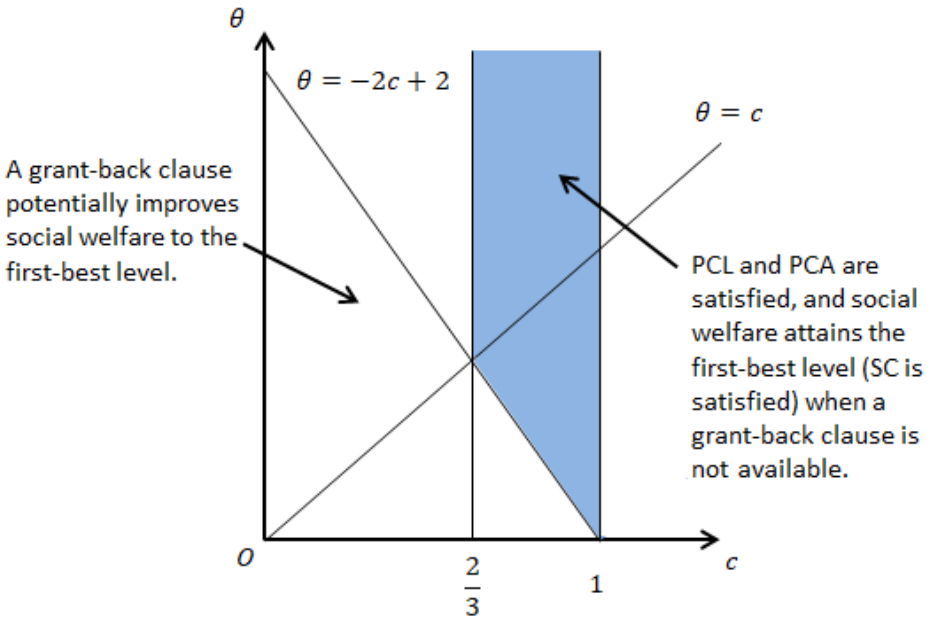

FIGURE 2 Diagram of (c, θ) (severable innovation)

Lemma 2 (severable innovation and a single licensee). Suppose that a grant-back clause is not available. We can propose the following statements:
(1) Innovation is not achieved for $0 < c < \frac{2}{3}$ regardless of the value, θ.
(2) Innovation is achieved, and therefore, first-best social welfare is generated if both $\frac{2}{3} < c < 1$ and $\theta > 2(1 - c)$ hold.

3.2.2 Availability of grant-back clause

We need to note that when a grant-back clause is used, firm L earns $\pi_L^{SA} = 2 + \theta - \frac{c}{2}$ regardless of whether the innovation is severable or nonseverable. Despite the severable innovation, the grant-back clause still enables firm L (a licensor) to make firm A (a licensee) pay a royalty for BT and be exempted from making its royalty payment for IT through the patent right accruing to such a clause. The profit of firm L is compared for π_L^{NN}, π_L^{NA}, π_L^{SN}, and π_L^{SA}, as summarized in Table 1. We can demonstrate that if firm L has complete control over whether to include a grant-back clause in the licensing agreement, the grant-back contract will be the preferred conduct for firm L irrespective of the relation between θ and c. [9]

[8] PCA is obviously satisfied for every θ and c.

[9] We need to account for the assumption that firm L provides a take-it-or-leave-it offer, and renegotiation is eliminated. Since the total bargaining power over whether to include a grant-back clause lies on the side of firm L, firm A is compelled to accept the offer as long as PCA is satisfied. If we accept the situation where firm A has the right to refuse a grant-back clause, the following argument would no longer be feasible.

	Nonlicense	NN	NA	SN		SA
				$\theta > c$	$\theta < c$	
π_L	$2-c$	$2+\theta-\frac{c}{2}$	$2+\theta-\frac{c}{2}$	$1+\frac{c}{2}$	$1+\frac{\theta}{2}$	$2+\theta-\frac{c}{2}$
π_A	0	$\theta+\frac{c}{2}$	$\theta+\frac{c}{2}$	$1+2\theta-\frac{c}{2}$	$1+\frac{3\theta}{2}$	$\theta+\frac{c}{2}$
W	$2-c$	$2+2\theta$	$2+2\theta$	$2+2\theta$	$2+2\theta$	$2+2\theta$

TABLE 1 Profits and social welfare

Proposition 1 (severable innovation and a single licensee):
(1) Firm L prefers to include a grant-back clause in an initial licensing agreement.
(2) Firm A accepts it, and innovation is necessarily achieved.
(3) A grant-back clause improves social welfare to the first-best level when $\frac{2}{3} < c < 1$ and $\theta > 2(1-c)$ are not satisfied.

Proof: (1) With regard to $\theta > c$, $\pi_L^{SA} - \pi_L^{SN} = (2+\theta-\frac{c}{2}) - (1+\frac{c}{2}) = 1+(\theta-c) > 0 \Leftrightarrow \pi_L^{SA} > \pi_L^{SN}$. With regard to $\theta < c$, $\pi_L^{SA} - \pi_L^{SN} = (2+\theta-\frac{c}{2}) - (1+\frac{\theta}{2}) = (1-\frac{c}{2}) + \frac{\theta}{2} > 0 \Leftrightarrow \pi_L^{SA} > \pi_L^{SN}$ (because $c \in (0,1)$ is assumed). Hence, $\pi_L^{SA} > \pi_L^{SN}$ holds for every (c,θ).
(2) It is quite obvious that $\pi_A^{SA} = \theta + \frac{c}{2} > \pi_A^R = 0$.
(3) When $\frac{2}{3} < c < 1$ and $\theta > 2(1-c)$ are not satisfied, innovation is not achieved, and social welfare remains as $W^R = 2-c$. However, a grant-back clause brings about innovation for every (θ, c), and thereby, $W^{SA} = 2+2\theta$ is larger than $W^R = 2-c$. ■

The implication of Proposition 1 is quite clear; innovation is always achieved, and social welfare attains the first-best level through a grant-back clause, even for severable innovation, when firm L is originally in a more disadvantaged position than nonseverable innovation regarding the royalty of BT. This proposition overturns Lemma 2, which indicated that an initial licensing agreement might not be concluded in some configurations of (c,θ) with no grant-back clauses, as illustrated by the nonshaded area in Figure 2. It is now represented as a potential configuration where a grant-back clause can improve social welfare to the first-best level. On the other hand, while the profit of firm A is still greater than zero (which is the level obtained in the absence of the license of BT), it is subject to a decline due to the grant-back clause. [10] This suggests that since first-best social welfare is also attained by a grant-back clause, the surplus is redistributed from firm A to firm L along with the grant-back. Therefore, even when PCL is not satisfied with severable innovation, a contract with a grant-back clause enables firm L to grant BT to firm A, and at the same time, to encourage firm A to still further innovate. Accordingly, social welfare is recovered to the first-best level.

[10] With regard to $\theta > c$, $\pi_A^{SA} - \pi_A^{SN} = (\theta+\frac{c}{2}) - (1+2\theta-\frac{c}{2}) = (c-1) - \theta < 0 \Leftrightarrow \pi_A^{SA} < \pi_A^{SN}$. With regard to $\theta < c$, $\pi_A^{SA} - \pi_A^{SN} = (\theta+\frac{c}{2}) - (1+\frac{3\theta}{2}) = (\frac{c}{2}-1) - \frac{\theta}{2} < 0 \Leftrightarrow \pi_A^{SA} < \pi_A^{SN}$. Hence, $\pi_A^{SA} < \pi_A^{SN}$ holds for every (θ, c).

The abovementioned result, which supports the inclusion of a grant-back clause under severable innovation, is almost the same as the one that ARR showed in their analysis. But the different point is that while omitting a positive innovation cost, this study deals with the decisions by firms to enter other markets that consider the business-stealing benefits and the market-entry costs.

It is also worthwhile to compare the insight provided by Scotchmer (1991, 1996). She investigates the incentive of a second inventor to further innovate in cases where bargaining is conducted *ex post* and *ex ante* innovation, respectively. The problem with *ex post* bargaining is that since sunk innovation costs cannot be considered in a license negotiation, a licensee is subject to "holdup". If a licensee is not sufficiently compensated for innovation costs, socially beneficial innovation led by the licensee may not occur within its framework. In this regard, Scotchmer (1991, 1996) proposes that *ex ante* bargaining can successfully solve the difficulty in maintaining the licensee's incentive, as a licensor commits to paying the innovation cost up front.

This study finds that if innovation is severable, it occurs with a grant-back clause, but may not be without it. The underlying mechanism is that whereas a royalty rate is set *ex ante* to innovation by a licensor when a grant-back clause is available, it is eventually set *ex post* innovation by a licensee when a grant-back clause is not available. The mechanism presented here is entirely different from that used by Scotchmer (1991, 1996). More precisely, while the *ex post* bargaining reduces the incentive of a licensee through a "holdup" problem in her model, it reduces that of the licensor under severable innovation in our model. Additionally, although her model requires a positive innovation cost for the analysis to be applicable, this study suggests that even if an innovation cost is zero, socially efficient follow-on innovation may not evolve without grant-back clauses for severable innovation. The reason why the incentive of a licensor falls short of the socially optimal level for severable innovation is that a licensor is threatened in the first stage by a licensee, who may potentially avoid an *ex ante* royalty payment for BT and may erode the licensor's new market. Such prior concerns held by a licensor culminate in rescinding the initial licensing agreement.

To sum up, a grant-back clause not only guarantees that a licensor is entitled to receive a royalty payment from a licensee in the first stage, but also prevents a licensee from entering the licensor's new market, which can provide a licensor with an incentive to transfer its BT under severable innovation. While this analysis is closely related to the "but for" defense of a grant-back clause in terms of a licensor's innovation incentive concerning severable innovation, the superiority of *ex ante* bargaining still exists, as demonstrated by Scotchmer (1991, 1996).

4 Extension

To confirm the robustness of our analysis that suggests the effectiveness of a grant-back clause, the model is extended in the two directions. The first case prohibits territorial restraints by a competition authority, and the second case includes multiple licensees with different innovation abilities. We can determine if the "but for" defense of grant-back clauses is still an essential element to spur follow-on innovation that is severable in these two cases.

4.1 Prohibition of territorial restrictions

This subsection is a brief attempt to investigate how eliminating the assumption of territorial restraints affects the results discussed so far. This analysis is noteworthy for reflecting the recent tendency in competition policies that have attached more importance to the total prohibition of territorial restraints. [11]

Four cases are reviewed as a whole: (i) "non-severable innovation and nonavailability of a grant-back clause" (NN); (ii) "nonseverable innovation and availability of a grant-back clause" (NA); (iii) "severable innovation and nonavailability of a grant-back clause" (SN); and (iv) "severable innovation and availability of a grant-back clause" (SA).

4.1.1 Nonseverable innovation and availability of a grant-back clause

To facilitate the later analysis, we place some assumptions on a territorial restraint. First, if the territorial restraint between firm L and firm A is invalid, firm A can unilaterally enter both the original and the new markets of firm L after achieving innovation with the use of IT. Second, it is reasonable to think that firm A, which develops IT, possesses relatively a competitive advantage over firm L in both these markets, because firm A is considered more familiar with BT and IT than firm L through learning in the innovation process.

Accordingly, when IT is licensed to firm L, the total market scale of firm L is assumed to decrease from $1+\theta$ to $x(1+\theta)$ with $x \in (0,1)$, due to the direct market competition against firm A. The parameter x denotes the degree of disadvantage firm L faces in a competitive position relative to firm A. On the other hand, firm A is assumed to obtain the market of firm L, of which the value is $(1-x)(1+\theta)$. We also posit that if firm L is not the recipient of IT, it earns only x from the original market of firm L, but firm A can earn a total of $1-x+\theta$ from both the original $(1-x)$ and the new (θ) markets of firm L. In other words, while direct competition occurs in the original market of firm L, firm A is placed in an exclusively

[11] Until recently, the attitude of the EU toward territorial restraints in licensing agreements was fairly relaxed. In a nutshell, European antitrust law generally tolerated agreements that prevent a licensee from competing in the market of a licensor, or equally, a licensor from competing in the market of a licensee. However, the European Commission has recently become more concerned about territorial restraints because they may decrease positive economic effects induced by competition.

advantageous position in the new market. Moreover, for the purpose of analytical simplicity, this subsection temporarily assumes that revenue obtained from entry is always higher than the cost ($1 > 1 - x > c$ and $\theta > x\theta > c$).

Based on these settings, the NBS in Stage 2 is provided by

$$\max_{r_2} \underbrace{[x(1+\theta) + r_1 - r_2 - (x + r_1)]}_{\text{Profit difference of firm L}}$$

$$\underbrace{[\underbrace{1+\theta}_{\text{Market A}} + \underbrace{(1-x)(1+\theta)}_{\text{Market L}} - 2c - r_1 + r_2\} - \{\underbrace{1+\theta}_{\text{Market A}} + \underbrace{(1-x+\theta)}_{\text{Market L}} - 2c - r_1]}_{\text{Profit difference of firm A}}$$

$$= \max_{r_2}(x\theta - r_2)(-x\theta + r_2). \Rightarrow r_2^{NN} = x\theta.$$

Moving back to Stage 1, we determine the NBS in Stage 1 as follows:

$$\max_{r_1}[x(1+\theta) + r_1 - r_2^{NN} - (2-c)][1 + \theta + (1-x)(1+\theta) - 2c - r_1 + r_2^{NN} - 0]$$

$$= \max_{r_1}(-2 + x + c + r_1)(2 - x + 2\theta - 2c - r_1). \Rightarrow r_1^{NN} = 2 + \theta - \frac{3c}{2}.$$

From these solutions, the profits are $\pi_L^{NN} = 2 + \theta - \frac{3c}{2}$ and $\pi_A^{NN} = \theta - \frac{c}{2}$, respectively. In addition, social welfare amounts to $W^{NN} = \sum_{f \in F} \pi_f^{NN} = 2 + 2\theta - 2c$.

Surprisingly, the profit of firm A remains at only $\theta - \frac{c}{2}$, which is exactly the same as the profit obtained with the territorial restraint. This means that even when firm A is eligible to enter both the original and the new markets of firm L, it cannot earn a higher profit than what is projected. The reason for this is that firm L imposes a high royalty on firm A in Stage 1, anticipating that firm A will invade its markets and will deprive the potential consumers that firm L is expected to retain. While firm L still keeps the incentive to provide an initial license of BT, [12] its profit is reduced because of the market entry by firm A. [13] Additionally, since there is always a market entry and associated competition between the firms, social welfare, $W^{NN} = 2 + 2\theta - 2c$, is smaller than the first-best level, $2 + 2\theta$, as the market-entry cost, $2c$, is deducted.

The result critically relies on the setting. This model abstracts from a "positive competition effect" such as an increase in the innovation value (the willingness to pay of consumers, θ) induced, for example, by a decrease in the price of products. Nevertheless, prohibiting territorial restraints is undesirable for nonseverable innovation in the absence of a grant-back clause unless competition between firms manages to produce some positive economic effects.

[12] $\pi_L^{NN} = 2 + \theta - \frac{3c}{2} > \pi_L^R = 2 - c$ because $\pi_L^{NN} - \pi_L^R = \theta - \frac{c}{2} > 0$ for $\theta > c$.

[13] Indeed, these profits do not depend on what assumptions we make about a market entry. Even if it is assumed that firm L can earn 0, instead of $x \in (0, 1)$, within its own market, the profits of firms L and A become $\pi_L^{NN} = 2 + \theta - \frac{3c}{2}$ and $\pi_A^{NN} = \theta - \frac{c}{2}$, respectively.

The discussion of positive competition effects will be developed later in this subsection.

4.1.2 Nonseverable innovation and availability of a grant-back clause

Even if territorial restraints are prohibited, a grant-back clause does not allow firm A to exploit IT in the markets of firm L because the patent right exclusively accrues to firm L by the nature of that clause. However, firm A is eligible to enter the original market of firm L, being more accustomed with BT than firm L, as assumed before. [14]

The problem in Stage 1 is modified as

$$\begin{aligned}&\max_{r_1}[(1-x+\theta+r_1)-(2-c)][(1+\theta+x-r_1)-0]\\&=\max_{r_1}(-1-x+\theta+c+r_1)(1+x+\theta-r_1).\Rightarrow r_1^{NA}=1+x-c.\end{aligned}$$

The profits of firm L and firm A are $\pi_L^{NA}=2+\theta-c$ and $\pi_A^{NA}=\theta$, respectively. Since we derive $\pi_L^{NA}=2+\theta-c>\pi_L^{NN}=2+\theta-\frac{3c}{2}$, firm L is certain to include a grant-back clause in the contract if available. That is how grant-back clauses play a significant role in restoring social welfare to $W^{NA}=\sum_{f\in F}\pi_f^{NA}=2+2\theta-c$, by potentially saving the market-entry cost for firm A to seek entry into the new market of firm L. And yet, since firm A actually enters the original market of firm L at the cost of c, social welfare is reduced by deducting this cost from the first-best level, $2+2\theta$. Even so, the inclusion of a grant-back clause is desirable even for nonseverable innovation.

4.1.3 Severable innovation and nonavailability of a grant-back clause (SN)

The NBS in Stage 2 is provided by

$$\begin{aligned}&\max_{r_2}[\{x(1+\theta)-r_2\}-x]\\&[\{(1+\theta)+(1-x)(1+\theta)-2c+r_2\}-\{(1+\theta)+(1-x+\theta)-2c\}]\\&=\max_{r_2}(x\theta-r_2)(-x\theta+r_2).\Rightarrow r_2^{SN}=x\theta.\end{aligned}$$

The profits of firm L and firm A in terms of Stage 2 are $\tilde{\pi}_L^{SN}=x$ and $\tilde{\pi}_A^{SN}=2-x+2\theta-2c$, respectively. In view of severable innovation, prohibiting territorial restraints results in a severe consequence for firm L, which can earn a small positive profit ($x<1$). Then, firm L will never conclude an initial licensing agreement with firm A because the license of BT creates a strong competitor without any expectation that firm L can charge and receive a royalty payment from firm A. Unlike the previous analyses of Cases 1 and 2, there is not

[14] Despite the prohibition of territorial restraints, firm L is assumed not to enter the new market of firm A to simplify this analysis. We can think that since firm L is less familiar with IT than firm A, it might lose an incentive to compete in this market.

even the slightest possibility that innovation will be achieved within the parameters of (c, θ) because $\tilde{\pi}_L^{SN} = x < \pi_L^R = 2 - c$. [15] Consequently, the profits of firm L and firm A boil down to $\pi_L^{SN} = \pi_L^R = 2 - c$ and $\pi_N^{SN} = \pi_A^R = 0$, respectively, in the absence of a licensing agreement. In addition, social welfare achieves the lowest level, that is, $W^{SN} = \sum_{f \in F} \pi_f^{SN} = 2 - c$.

4.1.4 Severable innovation and availability of a grant-back clause

Similar to the analysis in Section 3, the results are identical to Case 2 due to the effectiveness of a grant-back clause, even for severable innovation: by enforcing a royalty payment for BT and nullifying it for IT. In the end, grant-back clauses enable innovation to be realized and social welfare to be restored to the second-best level, $W^{SA} = \sum_{f \in F} \pi_f^{SA} = 2 + 2\theta - c$.

Proposition 2 (prohibition of territorial restraints and a single licensee):
(1) Even if a grant-back clause is not available for nonseverable innovation, innovation is achieved, and the improved technology is shared by firm L and firm A. However, first-best social welfare is not generated.
(2) If a grant-back clause is not available for severable innovation, innovation is not achieved so that the lowest social welfare is generated.
(3) A grant-back clause allows social welfare to restore the second-best level for both nonseverable and severable innovation.

Profits and social welfare are presented in Table 2. Indeed, severable innovation without territorial restraints causes firm L to entirely lose the incentive to license BT. But the same mechanism works as before in the use of a grant-back clause that recovers the incentive of firm L to transfer BT for severable innovation. Moreover, while including a grant-back clause under nonseverable innovation in the case where territorial restraints are permitted is neither an advantage nor a disadvantage, it contributes to improvements in social welfare when territorial restraints are prohibited. More generally, grant-back clauses avoid the welfare loss that can potentially be caused by the threat of direct competition in a new market under nonseverable innovation. Hence, a stronger stance can be taken in support of the "but for" defense of a grant-back clause to encompass both severable and nonseverable innovations when territorial restraints are prohibited.

[15] $\pi_L^R - \tilde{\pi}_L^{SN} = 2 - x - c > 1 - c > 0 \Leftrightarrow \pi_L^R > \tilde{\pi}_L^{SN}$ because $0 < c < 1$ and $0 < x < 1$ are assumed.

	NN	NA	SN	SA
π_L	$2+\theta-\frac{3c}{2}$	$2+\theta-c$	$2-c$	$2+\theta-c$
π_A	$\theta-\frac{c}{2}$	θ	0	θ
W	$2+2\theta-2c$	$2+2\theta-c$	$2-c$	$2+2\theta-c$

TABLE 2 Profits and social welfare (territorial restraints prohibited)

4.1.5 Positive competition effect

The "but for" defense of a grant-back clause under nonseverable innovation discussed above is based on the assumption that direct competition between firm L and firm A never creates additional value to innovation that follows. Instead, suppose that the innovation value, θ, increases to $\hat{\theta} > \theta$ through competition under nonseverable innovation (that is, a positive competition effect is generated). The possible ground for this is that the firms intend to win over their competitors in a new market by creating attractive products using enhanced IT. In this situation, social welfare also increases to $\hat{W}^{NN} = 2 + 2\hat{\theta} - 2c$.

Comparing social welfare of $\hat{W}^{NN}$ and W^{NA}, we find that the use of a grant-back clause is desirable if $W^{NA} = 2 + 2\theta - c > \hat{W}^{NN} = 2 + 2\hat{\theta} - 2c \Leftrightarrow c > 2(\hat{\theta} - \theta)$. This result implies that saving a market-entry cost through a grant-back clause (c) overwhelms the gain of a positive competition effect from the new markets of both firm L and firm A ($2(\hat{\theta} - \theta)$). It should be also noted that firm L uses a grant-back clause under the same condition as above, namely $\hat{\pi}_L^{NA} = 2 + \hat{\theta} - c > \pi_L^{NN} = 2 + \theta - \frac{3c}{2} \Leftrightarrow c > 2(\hat{\theta} - \theta)$. Hence, these findings can be summarized as follows.

Proposition 3: Suppose that competition between firm L and firm A due to the prohibition of territorial restraints enhances the innovation value from θ to $\hat{\theta}$ in the new markets of firms L and A. When the innovation is nonseverable, we obtain:
(1) A grant-back clause is socially desirable in generating second-best social welfare if a market entry cost is higher than an increase in the total innovation value (i.e., $c > 2(\hat{\theta} - \theta)$); and
(2) Firm L concludes a licensing agreement that includes a grant-back clause only if it will improve social welfare.

4.2 Two heterogeneous licensees

When there is more than a single licensee, innovation achieved by one of the licensees jeopardizes the markets of both the licensor and the other licensees. This has a feedback effect on profits through bargaining over royalty payments between the licensor and licensees. To highlight this effect, we assume that there are two heterogeneous licensees and that only a single licensee can afford to innovate once it has been granted the license of BT. This "competent"

licensee is labeled as firm A and the other "incompetent" licensee as firm B. Now the set of the firms is denoted as $F = \{L, A, B\}$. We have to take note that the royalty rates of BT paid to firm L may vary between firm A and firm B, so r_1^A (the royalty rate of firm A) need not be equivalent to r_1^B (the royalty rate of firm B).

The purpose of this subsection here is to mere illustrate some degree of the robustness of our results obtained so far based on simple assumptions. To come right to the point, the "but for" defense of a grant-back clause under severable innovation is still valid even if multiple heterogeneous licensees in terms of innovation abilities are introduced in the model.

4.2.1 Nonseverable innovation

The timing of the game is modified in what follows. In Stage 0, firm L already possesses BT, and the attribute of innovations is known to firm L, firm A, and firm B. In Stage 1, firm L offers both firm A and firm B contracts regarding the license of BT. In Stage 2, firm A offers both firm L and firm B contracts regarding the acquisition of the license of IT. After these stages, firm L, firm A, and firm B sell their products, and profits are realized. As described later, the results are not affected by the timing determined in each stage.

An additional assumption is made that firm B, which is eligible to acquire the license of IT from firm A in Stage 2, can have full control of IT only when being granted a license for BT by firm L in Stage 1. In this sense, mastering BT is considered indispensable for firm B to employ IT in its new market, on the grounds that it is impossible for firm B to apply the result of innovation achieved by firm A without learning BT. Moreover, as assumed before, if firm A and firm B conclude a contract with firm L for the licensing of BT in Stage 1, their markets are mutually bounded by the territorial restraints that comprised as an integral element of licensing agreements.

Nonavailability of grant-back clause

Suppose that a grant-back clause is not available for nonseverable innovation. The cases are separated in accordance with how firm L provides a licensing agreement in Stage 1. There are four possible cases: (i) "firm L does not conclude a contract with firm A and firm B" (Case NN-1), (ii) "firm L concludes a contract only with firm B" (Case NN-2), (iii) "firm L concludes a contract only with firm A" (Case NN-3), and (iv) "firm L concludes contracts with both firm A and firm B (Case NN-4). Table 3 summarizes the royalties exchanged between the three firms.

r_{1A}	Firm L transfers BT to firm A in Stage 1
r_{1B}	Firm L transfers BT to firm B in Stage 1
r_{2L}	Firm A transfers IT to firm L in Stage 2
r_{2B}	Firm A transfers IT to firm B in Stage 2

TABLE 3 Royalty rates exchanged between firms

■ **Case NN-1**: Firm L does not conclude a contract with firm A and firm B.
With restraints in place preventing firm A from innovating in the absence of BT, firm L, firm A, and firm B never proceed to Stage 2. Firm L earns $\pi_L^{NN1} = 1 + (1 - c) + (1 - c) = 3 - 2c$ by entering other markets at the expense of the market-entry cost, c, each. By contrast, the earnings of firm A and firm B amount to zero: $\pi_A^{NN1} = \pi_B^{NN1} = 0$. Hence, social welfare is pushed down to the lowest level, $W^{NN1} = \sum_{f \in F} \pi_f^{NN1} = 3 - 2c$.

■ **Case NN-2**: Firm L concludes a contract only with firm B.
It sounds somewhat odd that firm L comes to a contract agreement with firm B but not with firm A because the former firm does not have the competence to innovate further. But such a licensing agreement can be interpreted as establishing a "virtual" territorial restraint and saving the market-entry cost incurred by firm L. [16] We obtain the NBS between firm L and firm B in Stage 1 from the following (Stage 2 is omitted).

$$\begin{aligned} &\max_{r_{1B}}[(1 + 1 - c + r_{1B}) - (3 - 2c)][(1 - r_{1B}) - 0] \\ &= \max_{r_{1B}}(-1 + c + r_{1B})(1 - r_{1B}). \Rightarrow r_{1B}^{NN2} = 1 - \frac{c}{2}. \end{aligned}$$

This NBS implies that the market-entry cost is shared equally between firm L and firm B. The profits of the firms and social welfare are summarized as: $\pi_L^{NN2} = 3 - \frac{3c}{2}$, $\pi_A^{NN2} = 0$, $\pi_B^{NN2} = \frac{c}{2}$, and $W^{NN2} = 3 - c$, respectively.

■ **Case NN-3**: Firm L concludes a contract only with firm A.
A reasonable assumption is made that firm A is not allowed to transfer BT to firm B due to possible infringement of the patent right that is attached only to firm L. Since IT is not a significant technology for firm B in the absence of BT, firm A and firm B cannot conclude a contract regarding IT in Stage 2.

By backward induction, we first consider whether firm A licenses IT to firm L in Stage 2.

[16] This kind of a territorial restraint is at risk for being deemed to be against a competition policy. Eliminating Case NN-2 from a series of the analysis slightly changes the result that is derived later, but the fundamental implication for the "but for" defense remains the same.

The NBS in Stage 2 is determined by the following problem:

$$\max_{r_{2L}}[(1+\theta+r_{1A}-r_{2L}+1-c)-(1+r_{1A}+1-c)][(1+\theta+r_{2L}-r_{1A})-(1+\theta-r_{1A})]$$
$$=\max_{r_{2L}}(\theta-r_{2L})r_{2L}. \Rightarrow r_{2L}^{NN3}=\frac{\theta}{2}. \tag{1}$$

Next, the NBS between firm L and firm A in Stage 1 is provided by

$$\max_{r_{1A}}[(1+\theta+r_{1A}-r_{2L}^{NN3}+1-c)-(3-2c)][(1+\theta+r_{2L}^{NN3}-r_{1A})-0]$$
$$=\max_{r_{1A}}\left(-1+\frac{\theta}{2}+c+r_{1A}\right)\left(1+\frac{3\theta}{2}-r_{1A}\right). \Rightarrow r_{1A}^{NN3}=1+\frac{\theta}{2}-\frac{c}{2}. \tag{2}$$

From Equations (1) and (2), the profits of the firms and social welfare are summarized as $\pi_L^{NN3}=3+\theta-\frac{3c}{2}$, $\pi_A^{NN3}=\theta+\frac{c}{2}$, $\pi_B^{NN3}=0$, and $W^{NN3}=3+2\theta-c$, respectively. Since $\pi_L^{NN3}>\pi_L^{NN2}$ holds, firm L prefers to conclude an initial licensing agreement with firm A rather than with firm B. Social welfare increases due to the innovation of IT and its use in the markets of both firm L and firm A.

■ **Case NN-4**: Firm L concludes contracts with both firm A and firm B.
We first focus on the NBS between firm A and firm B in Stage 2, where they conclude a contract regarding the license of IT. The NBS in Stage 2 is provided by

$$\max_{r_{2B}}\underbrace{[(1+\theta+r_{2L}+r_{2B}-r_{1A})-(1+\theta+r_{2L}-r_{1A})]}_{\text{Profit difference of firm A}}\underbrace{[(1+\theta-r_{1B}-r_{2B})-(1-r_{1B})]}_{\text{Profit difference of firm B}}$$
$$=\max_{r_{2B}}r_{2B}(\theta-r_{2B}). \Rightarrow r_{2B}^{NN4}=\frac{\theta}{2}.$$

Firm A may be capable of entering the market of firm B by employing IT when they do not conclude a contract, because the territorial restraint to be in place between them has not been established. However, it is no surprise that firm L never provides a contract that would place it in a disadvantaged position, especially when the innovation is nonseverable. Hence, we assume that firm L offers firm A with the license of BT in Stage 1 on the "condition" that firm A never actively engages within the market of firm B. Since the following analysis relies on this assumption, only firm L is a threat to firm B. Likewise, the NBS between firms L and A in Stage 2 is provided by

$$\max_{r_{2L}}[(1+\theta+r_{1A}+r_{1B}-r_{2L})-(1+r_{1A}+r_{1B})][(1+\theta-r_{1A}+r_{2L}+r_{2B}^{NN4})-(1+\theta-r_{1A}+r_{2B}^{NN4})]$$
$$=\max_{r_{2L}}(\theta-r_{2L})r_{2L}. \Rightarrow r_{2L}^{NN4}=\frac{\theta}{2}.$$

In Stage 1, the NBS between firm L and firm B is provided as follows:

$$\max_{r_{1B}}[(1+\theta+r_{1A}-r_{2L}^{NN4}+r_{1B})-(1+\theta+r_{1A}-r_{2L}^{NN4}+1-c)][(1+\theta-r_{1B}-r_{2B}^{NN4})-0]$$
$$=\max_{r_{1B}}(-1+c+r_{1B})\left(1+\frac{\theta}{2}-r_{1B}\right).\Rightarrow r_{1B}^{NN4}=1+\frac{\theta}{4}-\frac{c}{2}.$$

Lastly, the NBS between firm L and firm A is considered. The important point is that the reservation profit of firm L must be $1+(1-c)+(1-\frac{c}{2})=3-\frac{3c}{2}$ (but not $3-2c$) since firm L simultaneously can offer firm B with a contract that could constitute a virtual territorial restraint. Consequently, the NBS between firms L and A in Stage 1 is determined by

$$\max_{r_{1A}}\left[(1+\theta+r_{1A}-r_{2L}^{NN4}+r_{1B}^{NN4})-\left(3-\frac{3c}{2}\right)\right][(1+\theta+r_{2L}^{NN4}-r_{1A}+r_{2B}^{NN4})-0]$$
$$=\max_{r_{1A}}\left(-1+\frac{3\theta}{4}+c+r_{1A}\right)(1+2\theta-r_{1A}).\Rightarrow r_{1A}^{NN4}=1+\frac{5\theta}{8}-\frac{c}{2}.$$

The profits of the firms and social welfare are summarized as $\pi_L^{NN4}=3+\frac{11\theta}{8}-c$, $\pi_A^{NN4}=\frac{11\theta}{8}+\frac{c}{2}$, $\pi_B^{NN4}=\frac{\theta}{4}+\frac{c}{2}$, and $W^{NN3}=3+3\theta$, respectively.

Table 4 represents the profits of the firms and social welfare from Cases NN-1 to NN-4. Comparing these cases makes it clear that preference would be given to Case 4-NN by firm L, firm A, and firm B.

	Case 1-NN	Case 2-NN	Case 3-NN	Case 4-NN
π_L	$3-2c$	$3-\frac{3c}{2}$	$3+\theta-\frac{3c}{2}$	$3+\frac{11\theta}{8}-c$
π_A	0	0	$\theta+\frac{c}{2}$	$\frac{11\theta}{8}+\frac{c}{2}$
π_B	0	$\frac{c}{2}$	0	$\frac{\theta}{4}+\frac{c}{2}$
W	$3-2c$	$3-c$	$3+2\theta-c$	$3+3\theta$

TABLE 4 Profits and social welfare (NN)

Lemma 3 (nonseverable innovation and two heterogeneous licensees). When a grant-back clause is not included in a licensing agreement, we conclude the following:
(1) Innovation is achieved, and the improved technology is shared among firm L, firm A, and firm B through the licensing agreements concluded between them;
(2) First-best social welfare is generated.
(3) The distribution of profits is Pareto optimal.

Proof: (1) $\pi_L^{NN4}-\pi_L^{NN3}=(3+\frac{11\theta}{8}-c)-(3+\theta-\frac{3c}{2})=\frac{3\theta}{8}+\frac{c}{2}>0\Leftrightarrow\pi_L^{NN4}>\pi_L^{NN3}$. This means that firm L prefers Case NN-4 to Case NN-3. It is also clear that $\pi_L^{NN4}>\pi_L^{NN3}>\pi_L^{NN2}>\pi_L^{NN1}$. It can be easily shown that $\pi_A^{NN4}=\frac{11\theta}{8}+\frac{c}{2}>\pi_A^{NN2}=\pi_A^{NN1}=0$ and

$\pi_B^{NN4} = \frac{\theta}{4} + \frac{c}{2} > \pi_B^{NN3} = \pi_B^{NN1} = 0$. Hence, firm A and firm B both prefer to accept the series of the contracts offered by firm L in Case NN-4.
(2)(3) It is clear that $W^{NN4} > W^{NN3} > W^{NN2} > W^{NN1}$, $\pi_L^{NN4} > \pi_L^{NN3} > \pi_L^{NN2} > \pi_L^{NN1}$, $\pi_A^{NN4} > \pi_A^{NN3} > \pi_A^{NN2} = \pi_A^{NN1}$, and $\pi_B^{NN4} > \pi_B^{NN2} > \pi_B^{NN3} = \pi_B^{NN1}$. While Case NN-4 generates first-best social welfare, the distribution is certain to maintain Pareto optimal. ■

The net royalties of firm L, firm A, and firm B are represented by $r_L^{NN4} = r_{1A}^{NN4} - r_{2L}^{NN4} + r_{1B}^{NN4} = 2 + \frac{3\theta}{8} - c$, $r_A^{NN4} = r_{2L}^{NN4} - r_{1A}^{NN4} + r_{2B}^{NN4} = -1 + \frac{3\theta}{8} + \frac{c}{2}$, and $r_B^{NN4} = -r_{1B}^{NN4} - r_{2B}^{NN4} = -1 - \frac{3\theta}{4} + \frac{c}{2}$, respectively. Obviously, the sum of these net royalties always amounts to zero ($r_L^{NN3} + r_A^{NN3} + r_B^{NN3} = 0$), [17] and bargaining over the royalty payments does not exacerbate any social value. The underlying mechanism is basically the same as in the case of a single licensee for nonseverable innovation. Anticipating that follow-on innovation creates benefits in new markets of firm A and firm B, firm L can in advance capture them through imposing the royalties of the initial licensing agreements that are offered for both firm A and firm B in Stage 1. Firm L is, therefore, likely to provide the license of BT to all licensees, which leads to the follow-on innovation and its sharing among all firms.

Availability of a grant-back clause

In the case where a grant-back clause is used, firm A can no longer freely provide firm B with IT due to the patent right that belongs to firm L. There are two directions that firm L can take if it intends to disseminate IT to firm B. First, firm L directly offers a contract regarding the license of IT to firm B in Stage 2 without involving other parties based on the nature of a grant-back clause (that is, the patent right of IT belongs solely to firm L). Second, firm L delegates firm A with the task of transferring IT to firm B by including such an obligation in the initial licensing agreement. In other words, the use of IT is conditional on disseminating it to other firms and on granting back to the original licensor. In what follows, we show that it is profitable for firm L to opt for the second direction.

In accordance with the first direction, the timing of the game is slightly modified as follows. In Stage 1, firm L offers firm A and firm B a contract regarding the license of BT, and in Stage 2, firm L offers firm B with a contract regarding the license of IT. In a similar way, the cases should be classified. The discussions of Cases NA-1 and NA-2, which are equivalent to the previous analyses, are omitted. Instead, Case NA-5 (Firm L concludes contracts with firm A and firm B in Stage 1 but not with firm B in Stage 2) should be added.

■ **Case NA-3**: Firm L concludes a contract only with firm A.
This case implies that while firm A achieves innovation in Stage 1, firm L is reluctant to share

[17] Whereas $r_L^{NN4} > 0$ and $r_B^{NN4} < 0$ always hold, the sign of r_A^{NN4} is indecisive. The condition for $r_A^{NN4} > 0$ is provided by $\theta > \frac{4}{3}(2 - c)$.

both BT and IT with firm B. The NBS between firm L and firm A in Stage 1 is provided by

$$\max_{r_{1A}}[(1+\theta+r_{1A}+1-c)-(3-2c)][(1+\theta-r_{1A})-0]$$
$$=\max_{r_{1A}}(-1+\theta+c+r_{1A})(1+\theta-r_{1A}).\Rightarrow r_{1A}^{NA3}=1-\frac{c}{2}.$$

The profits of the firms and social welfare are summarized as $\pi_L^{NA3}=3+\theta-\frac{3c}{2}$, $\pi_A^{NA3}=\theta+\frac{c}{2}$, $\pi_B^{NA3}=0$, and $W^{NA3}=3+2\theta-c$, respectively. We obtain $\pi_L^{NA3}=\pi_L^{NN3}$ because firm L can charge the same net royalty rate in the absence of a grant-back clause, as it is equal to the royalty rate induced by a grant-back clause for nonseverable innovation.

■ **Case NA-4**: Firm L concludes contracts with both firm A and firm B.
Option 1: Firm L offers a contract regarding the license of IT directly to firm B.
By assuming that firm L has already concluded contracts with firm A and firm B regarding the license of BT in Stage 1, we consider the NBS between firms L and B in Stage 2:

$$\max_{r_{2B}}[(1+\theta+r_{1A}+r_{1B}+r_{2B})-(1+\theta+r_{1A}+r_{1B})][(1+\theta-r_{1B}-r_{2B})-(1-r_{1B})]$$
$$=\max_{r_{2B}}r_{2B}(\theta-r_{2B}).\Rightarrow r_{2B}^{NA4(1)}=\frac{\theta}{2}.$$

We also consider the NBS between firm L and firm B in Stage 1: [18]

$$\max_{r_{1A}}[(1+\theta+r_{1A}+r_{1B}+r_{2B}^{NA4(1)})-(1+\theta+r_{1A}+1-c)][(1+\theta-r_{1B}-r_{2B}^{NA4(1)})-0]$$
$$=\max_{r_{1A}}\left(-1+\frac{\theta}{2}+c+r_{1B}\right)\left(1+\frac{\theta}{2}-r_{1B}\right).\Rightarrow r_{1B}^{NA4(1)}=1-\frac{c}{2}.$$

$r_{1B}^{NA4(1)}=1-\frac{c}{2}$ (but not $1-c$) is the potential profit of firm L related to the handling of negotiations with firm B. Finally, the NBS between firm L and firm A in Stage 1 is provided by

$$\max_{r_{1A}}[(1+\theta+r_{1A}+r_{1B}^{NA4(1)}+r_{2B}^{NA4(1)})-(1+1-c+r_{1B}^{NA4(1)})][(1+\theta-r_{1A})-0]$$
$$=\max_{r_{1A}}\left(-1+\frac{3\theta}{2}+c+r_{1A}\right)(1+\theta-r_{1A}).\Rightarrow r_{1A}^{NA4(1)}=1-\frac{\theta}{4}-\frac{c}{2}.$$

Hence, the profits of the firms and social welfare are summarized as $\pi_L^{NA4(1)}=3+\frac{5\theta}{4}-c$, $\pi_A^{NA4(1)}=\frac{5\theta}{4}+\frac{c}{2}$, $\pi_B^{NA4(1)}=\frac{\theta}{2}+\frac{c}{2}$, and $W^{NA4(1)}=3+3\theta$, respectively. Since both BT and IT are transferred to every firm, social welfare amounts to the first-best level.

[18] The following result does not depend on the timing of the contracts in Stage 1.

Option 2: Firm L delegates firm A with the task of transferring IT to firm B.
Given that firm A and firm B are licensed BT in Stage 1, we consider the NBS regarding the license of IT between the two firms in Stage 2 as follows:

$$\begin{aligned}&\max_{r_{2B}}[(1+\theta+r_{2B})-(1+\theta)][(1+\theta-r_{1B}-r_{2B})-(1-r_{1B})]\\&=\max_{r_{2B}} r_{2B}(\theta-r_{2B}).\Rightarrow r_{2B}^{NA4(2)}=\frac{\theta}{2}.\end{aligned}$$

Let us revert to Stage 1, where firm L transfers BT to firm A and firm B. In the first place, we derive the NBS between firm L and firm B in Stage 1 as follows:

$$\begin{aligned}&\max_{r_{1A}}[(1+\theta+r_{1A}+r_{1B})-(1+\theta+r_{1A}+1-c)][(1+\theta-r_{1B}-r_{2B}^{NA4(2)})-0]\\&=\max_{r_{1A}}(-1+c+r_{1B})\left(1+\frac{\theta}{2}-r_{1B}\right).\Rightarrow r_{1B}^{NA4(2)}=1+\frac{\theta}{4}-\frac{c}{2}.\end{aligned}\tag{3}$$

Next, the NBS between firm L and firm A is provided by

$$\begin{aligned}&\max_{r_{1A}}\left[(1+\theta+r_{1A}+r_{1B}^{NA4(2)})-\left(1+1-c+1-\frac{c}{2}\right)\right][(1+\theta-r_{1A}+r_{2B}^{NA4(2)})-0]\\&=\max_{r_{1A}}\left(-1+\frac{5\theta}{4}+c+r_{1A}\right)\left(1+\frac{3\theta}{2}-r_{1A}\right).\Rightarrow r_{1A}^{NA4(2)}=1+\frac{\theta}{8}-\frac{c}{2}.\end{aligned}\tag{4}$$

From Equations (3) and (4), the profits of the firms and social welfare are summarized as $\pi_L^{NA4(2)}=3+\frac{11\theta}{8}-c$, $\pi_A^{NA4(2)}=\frac{11\theta}{8}+\frac{c}{2}$, $\pi_B^{NA4(2)}=\frac{\theta}{4}+\frac{c}{2}$, and $W^{NA4(2)}=3+3\theta$. The result is exactly the same as that of Case NN-4. The reason is that, as described before, firm L can deliberately set royalty rates to secure benefits in the timing of the initial contracts. By comparing the profit of firm L, we can demonstrate that firm L prefers to choose Option 2.

Lemma 4: Suppose firm L can require firm A to transfer IT to firm B by a grant-back contract in return for the use of IT. Then, firm L prefers to conclude such a contract rather than directly transfer IT to firm B by itself.

Proof: Since $\pi_L^{NA4(2)}-\pi_L^{NA4(1)}=(3+\frac{11\theta}{8}-c)-(3+\frac{5\theta}{4}-c)=\frac{\theta}{8}>0$, we obtain $\pi_L^{NA4(2)}>\pi_L^{NA4(1)}$. Hence, firm L prefers to choose Option 2. ■

Intuitively, since firm L can save a bargaining cost concerning the contract regarding the license of IT with firm B through delegating this task to firm A, it can earn a higher profit. Put it differently, when firm L needs to directly incur a bargaining cost by negotiating with firm B to license IT, the profit of firm L is likely to fall by contrary. It should be noted that firm A is also expected to increase its profit by this grant-back contract because it should

receive a royalty payment from firm B in return for its IT. [19]

For descriptive purposes, using the result of Lemma 4, we represent the profits and social welfare as follows: $\pi_L^{NA4} = 3 + \frac{11\theta}{8} - c$, $\pi_A^{NA4} = \frac{11\theta}{8} + \frac{c}{2}$, $\pi_B^{NA4} = \frac{\theta}{4} + \frac{c}{2}$, and $W^{NA4} = 3 + 3\theta$.

■ **Case NA-5**: Firm L concludes contracts with firm A and firm B in Stage 1 but not with firm B in Stage 2.

In this case, firm L intends to establish a territorial restraint with firm B to save a market-entry cost but is reluctant to make firm A share the outcome of innovation with firm B. First, the NBS between firm L and firm B in Stage 1 is provided by [20]

$$\begin{aligned} &\max_{r_{1B}}[(1+\theta+r_{1A}+r_{1B}) - (1+\theta+r_{1A}+1-c)][(1-r_{1B})-0] \\ &= \max_{r_{1B}}(-1+c+r_{1B})(1-r_{1B}). \Rightarrow r_{1B}^{NA5} = 1 - \frac{c}{2}. \end{aligned} \tag{5}$$

Next, the NBS between firm L and firm A in Stage 1 is provided by

$$\begin{aligned} &\max_{r_{1A}}[(1+\theta+r_{1A}+r_{1B}^{NA5}) - (1+1-c+r_{1B}^{NA5})][(1+\theta-r_{1A})-0] \\ &= \max_{r_{1A}}(-1+\theta+c+r_{1A})(1+\theta-r_{1A}). \Rightarrow r_{1A}^{NA5} = 1 - \frac{c}{2}. \end{aligned} \tag{6}$$

From Equations (5) and (6), the profits of the firms and social welfare are summarized as $\pi_L^{NA5} = 3 + \theta - c$, $\pi_A^{NA5} = \theta + \frac{c}{2}$, $\pi_B^{NA5} = \frac{c}{2}$, and $W^{NA5} = 3 + 2\theta$, respectively.

Proposition 4 (nonseverable innovation and two heterogeneous licensees): Suppose the grant-back clause as assumed in Lemma 4 is available in a licensing agreement. Then, we can achieve the same results as indicated in Lemma 3 by using a contract that includes the grant-back clause. Hence, the grant-back clause does not affect profits or on social welfare.

Proof: Firm L prefers Case NA-4 to Case NA-5 when a grant-back clause is available because $\pi_L^{NA4} - \pi_L^{NA5} = (3 + \frac{11\theta}{8} - c) - (3 + \theta - c) = \frac{3\theta}{8} > 0 \Leftrightarrow \pi_L^{NA4} > \pi_L^{NA5}$. Similarly, it can be easily shown that Case NA-4 generates the highest profit for firm L among the five cases. Comparing the maximum profits of firms and social welfare between when a grant-back clause is available and when it is not, we obtain $\pi_L^{NA4} = \pi_L^{NN4}$, $\pi_A^{NA4} = \pi_A^{NN4}$, $\pi_B^{NA4} = \pi_B^{NN4}$, and $W^{NA4} = W^{NN4}$. Consequently, Lemma 3 (parts 1 to 3) directly applies. ■

Table 5 presents firms' profits and social welfare when a grant-back clause is available that stipulates an obligation to transfer IT to firm B. Proposition 4 demonstrates that when there are multiple heterogeneous licensees for nonseverable innovation, the availability of a

[19] Since $\pi_A^{NA4(2)} - \pi_A^{NA4(1)} = (\frac{11\theta}{8} + \frac{c}{2}) - (\frac{5\theta}{4} + \frac{c}{2}) = \frac{\theta}{8} > 0$, we obtain $\pi_A^{NA4(2)} > \pi_A^{NA4(1)}$.

[20] As observed from Equations (5) and (6), the following result does not depend on the timing of the contracts in Stage 1.

grant-back clause does not affect firms' profits and social welfare. This argument is exactly identical to Lemma 1, which maintains that a grant-back clause does not affect any results when there is a single competent licensee for nonseverable innovation. In other words, the "equivalence" of using a grant-back clause applies to both a single competent licensee and multiple heterogeneous licensees.

	Case NA-1	Case NA-2	Case NA-3	Case NA-4	Case NA-5
π_L	$3-2c$	$3-\frac{3c}{2}$	$3+\theta-\frac{3c}{2}$	$3+\frac{11\theta}{8}-c$	$3+\theta-c$
π_A	0	0	$\theta+\frac{c}{2}$	$\frac{11\theta}{8}+\frac{c}{2}$	$\theta+\frac{c}{2}$
π_B	0	$\frac{c}{2}$	0	$\frac{\theta}{4}+\frac{c}{2}$	$\frac{c}{2}$
W	$3-2c$	$3-c$	$3+2\theta-c$	$3+3\theta$	$3+2\theta$

TABLE 5 Profits and social welfare (NA)

This result depends on the assumption that a grant-back clause is modified to include the new obligation indicated in the above. Otherwise, firm L chooses to make an initial licensing agreement that does not include a grant-back clause even if it is available. [21] Although one may doubt the true feasibility of such a grant-back clause, firm L and firm A benefit from it, as demonstrated. Thus, it stands to reason that they will agree to allow firm L to delegate firm A with the task of transferring IT to firm B. Hence, we note that because the grant-back clause allows a competent licensee to freely use and license its improved technology to other firms, social welfare is improved.

4.2.2 Severable innovation

Nonavailability of a grant-back clause

We classify the cases based on whether the value of innovation (θ) is higher or lower than the market-entry cost (c). The discussions of Cases SN-1 and SN-2 are omitted to save space because they are equivalent to Cases NN-1 and NN-2 discussed earlier.

■ **Case SN-3**: Firm L concludes a contract only with firm A.
Both firm L and firm A are determined to enter the original and new markets of firm B, given that no territorial restraints whatsoever have been established with firm B. On this point, an assumption is somehow required regarding the consequence of competition in the markets of firm B. One hypothesis is that firm L obtains the original market (value of 1) while firm A does the new market created by the innovation (value of θ). This division of the whole market

[21] Let us focus on the profit of Case NA-4 in Option 1. We can then derive $\pi_L^{NA4(1)}-\pi_L^{NN4}=(3+\frac{5\theta}{4}-c)-(3+\frac{11\theta}{8}-c)=-\frac{\theta}{8}<0\Leftrightarrow\pi_L^{NA4(1)}<\pi_L^{NN4}$. In this environment, firm L will therefore choose an initial licensing agreement that does not include a grant-back clause even if it is available.

of firm B is exactly a mirror to the competition in the markets of firm L, where both firm L and firm A possess IT. That is, the way firm L and firm A divide the original and new markets of firm B is determined by the market power in the original market (firm L obtains 1) and new market (firm A obtains θ) of firm L under severable innovation. Although this assumption seems a bit arbitrary, it is the most reasonable choice. Therefore, we posit that since this market power precisely reflects the relationship between firm L and firm A, firm L retains the original market, and firm A gains entry into the new market.

When $\theta > c$, the NBS between firms L and A in Stage 2 is provided by

$$\begin{aligned}&\max_{r_{2L}}[(1+\theta-r_{2L}+1-c)-(2-c)][(1+\theta+r_{2L}+\theta-c)-(1+\theta+\theta-c+\theta-c)]\\&=\max_{r_{2L}}(\theta-r_{2L})(-\theta+c+r_{2L}).\Rightarrow r_{2L}^{SN3}=\theta-\frac{c}{2}.\end{aligned}$$

Since the innovation is severable, firm L cannot demand any royalty payments in return for BT from firm A in Stage 1. The profits of the firms and social welfare are summarized as $\pi_L^{SN3}=2-\frac{c}{2}$, $\pi_A^{SN3}=1+3\theta-\frac{3c}{2}$, $\pi_B^{SN3}=0$, and $W^{SN3}=3+3\theta-2c$, respectively.

When $\theta < c$, firm A cannot foresee any advantage of entering the new markets of both firm L and firm B. The NBS between firm L and firm A is provided by

$$\begin{aligned}&\max_{r_{2L}}[(1+\theta-r_{2L}+1-c)-(2-c)][(1+\theta+r_{2L})-(1+\theta)]\\&=\max_{r_{2L}}(\theta-r_{2L})r_{2L}.\Rightarrow r_{2L}^{SN2}=\frac{\theta}{2}.\end{aligned}$$

The profits of the firms and social welfare are summarized as $\pi_L^{SN3}=2+\frac{\theta}{2}-c$, $\pi_A^{SN3}=1+\frac{3\theta}{2}$, $\pi_B^{SN3}=0$, and $W^{SN3}=3+2\theta-c$, respectively.

With regard to social welfare, although innovation is achieved by firm A for any (θ, c), the market-entry cost, c or $2c$, must be deducted from social welfare.

■ **Case SN-4**: Firm L concludes contracts with firm A and firm B.

It is plausible to assume that firm L cannot employ IT that has been licensed by firm A in the new market of firm B for severable innovation. A presupposition is that firm A does not allow firm L to use IT anywhere else other than its new market by laying claim to its patent right when bargaining over the license of IT.

When $\theta > c$, the NBS between firm A and firm B in Stage 2 is provided by

$$\begin{aligned}&\max_{r_{2B}}[(1+\theta+r_{2L}+r_{2B})-(1+\theta+r_{2L}+\theta-c)][(1+\theta-r_{2B})-1]\\&=\max_{r2B}(-\theta+c+r_{2B})(\theta-r_{2B}).\Rightarrow r_{2B}^{SN4}=\theta-\frac{c}{2}.\end{aligned}\tag{7}$$

It is necessary to bear in mind that the use of IT by firm B in Stage 2 does not generate any

royalty payments associated with BT in severable innovation. In addition, we derive the NBS between firm L and firm A in Stage 2 for $\theta > c$ as follows:

$$\begin{aligned}&\max_{r_{2L}}[(1+\theta-r_{2L})-1]][(1+\theta+r_{2L}+r_{2B}^{SN4})-(1+\theta+\theta-c+r_{2B}^{SN4})]\\&=\max_{r_{2L}}(\theta-r_{2L})(-\theta+c+r_{2L}).\Rightarrow r_{2L}^{SN4}=\theta-\frac{c}{2}.\end{aligned}\tag{8}$$

From Equations (7) and (8), the profits and social welfare are summarized as $\pi_L^{SN4}=1+\frac{c}{2}$, $\pi_A^{SN4}=1+3\theta-c$, $\pi_B^{SN4}=1+\frac{c}{2}$, and $W^{SN4}=3+3\theta$, respectively. Whereas firm A relishes the value of innovation in every market with an additional market entry-cost, c, the earning of firm L is generated only from its original market.

When $\theta < c$, the NBS between firm A and firm B in Stage 2 is provided by

$$\begin{aligned}&\max_{r_{2B}}[(1+\theta+r_{2B}+r_{2L})-(1+\theta+r_{2L})][(1+\theta-r_{2B})-1]\\&=\max_{r_{2B}}r_{2B}(\theta-r_{2B}).\Rightarrow r_{2B}^{SN4}=\frac{\theta}{2}.\end{aligned}\tag{9}$$

Lastly, we derive the NBS between firm L and firm A in Stage 2 for $\theta < c$ as follows:

$$\begin{aligned}&\max_{r_{2L}}[(1+\theta-r_{2L})-1][(1+\theta+r_{2L}+r_{2B}^{SN4})-(1+\theta+r_{2B}^{SN4})]\\&=\max_{r_{2L}}(\theta-r_{2L})r_{2L}.\Rightarrow r_{2L}^{SN4}=\frac{\theta}{2}.\end{aligned}\tag{10}$$

From Equations (9) and (10), the profits and social welfare are summarized as $\pi_L^{SN4}=1+\frac{\theta}{2}$, $\pi_A^{SN4}=1+2\theta$, $\pi_B^{SN4}=1+\frac{\theta}{2}$, and $W^{SN4}=3+3\theta$, respectively. Contrary to the case of $\theta > c$, firm L earns profits in both its original and new markets; particularly, half the innovation value comes from the latter market. On the other hand, firm A can reap the rewards in each market, obtaining entirety of its markets $(1+\theta)$ and one-half of the new market $(\frac{\theta}{2})$ of firm L and firm B. The profits and social welfare from Cases SN-1 to SN-4 are presented in Table 6.

	Case SN-1	Case SN-2	Case SN-3		Case SN-4	
			$\theta > c$	$\theta < c$	$\theta > c$	$\theta < c$
π_L	$3-2c$	$3-\frac{3c}{2}$	$2-\frac{c}{2}$	$2+\frac{\theta}{2}-c$	$1+\frac{c}{2}$	$1+\frac{\theta}{2}$
π_A	0	0	$1+3\theta-\frac{3c}{2}$	$1+\frac{3\theta}{2}$	$1+3\theta-c$	$1+2\theta$
π_B	0	$\frac{c}{2}$	0	0	$1+\frac{c}{2}$	$1+\frac{\theta}{2}$
W	$3-2c$	$3-c$	$3+3\theta-2c$	$3+2\theta-c$	$3+3\theta$	$3+3\theta$

TABLE 6 Profits and social welfare (SN)

Lemma 5 (severable innovation and two heterogeneous licensees): Suppose a grant-back clause is not available, we conclude the following:
(1) An initial licensing agreement between firm L and firm A cannot be concluded, and innovation is not achieved.
(2) First-best social welfare is never generated.

Proof: (1) In the first place, it should be demonstrated that $\pi_L^{SN2} > \pi_L^{SN3}$. With regard to $\theta > c$, $\pi_L^{SN2} - \pi_L^{SN3} = (3 - \frac{3c}{2}) - (2 - \frac{c}{2}) = 1 - c > 0 \Leftrightarrow \pi_L^{SN2} > \pi_L^{SN3}$. In addition, with regard to $\theta < c$, $\pi_L^{SN2} - \pi_L^{SN3} = (3 - \frac{3c}{2}) - (2 + \frac{\theta}{2} - c) = 1 - \frac{\theta}{2} - \frac{c}{2} > 1 - c > 0 \Leftrightarrow \pi_L^{SN2} > \pi_L^{SN3}$. Subsequently, we compare π_L^{SN3} and π_L^{SN4}. With regard to $\theta > c$, $\pi_L^{SN3} - \pi_L^{SN4} = (2 - \frac{c}{2}) - (1 + \frac{c}{2}) = 1 - c > 0 \Leftrightarrow \pi_L^{SN3} > \pi_L^{SN4}$. In addition, with regard to $\theta < c$, $\pi_L^{SN3} - \pi_L^{SN4} = (2 + \frac{\theta}{2} - c) - (1 + \frac{\theta}{2}) = 1 - c > 0 \Leftrightarrow \pi_L^{SN3} > \pi_L^{SN4}$. From these relations, we obtain $\pi_L^{SN2} > \pi_L^{SN3} > \pi_L^{SN4}$ for every (c, θ). We can also easily show that $\pi_L^{SN2} > \pi_L^{SN1}$. Hence, firm L prefers Case SN-2 to all other cases presented.
(2) $W^{SN4} = 3 + 3\theta$ is the first-best social welfare. However, $W^{SN2} < W^{SN3} < W^{SN4}$ for every (c, θ). ■

Lemma 5 suggests that regardless of the relationship between the value of innovation and the market-entry cost, firm L is unlikely to conclude an initial licensing agreement with firm A. More precisely, firm L prefers to institute only a virtual territorial restraint with firm B (Case SN-2) rather than to license BT to firm A, which could lead to further innovation (Case SN-3). The reason, intuitively, is as follows. Even if the value of innovation is larger than the market-entry cost ($\theta > c$), firm L fails to earn any profit from its own new market due to the entry of firm A under severable innovation. By contrast, given the relatively smaller value of innovation ($\theta < c$), the innovation value falls below the potential profit for firm L obtained from forming a territorial restraint with firm B. Therefore, it can be concluded that no innovation is undertaken by firm A due to not being licensed by firm L, and as a result, social welfare remains extremely low.

Availability of a grant-back clause

If a grant-back clause is available defining that firm L can delegate firm A to transfer IT to firm B, the situation under severable innovation can be improved. Remember that the firms' profits obtained from a grant-back are unchanged from the case of nonseverable innovation. Thus, firms' profits and social welfare are essentially identical to those shown in Table 4. The following proposition signifies that a grant-back clause certainly improves social welfare under severable innovation.

Proposition 5 (severable innovation and two heterogeneous licensees): If a licensing agree-

ment with the inclusion of a grant-back clause between firm L and firm A is used,
(1) Innovation is achieved, and the improved technology is shared among firm L, firm A, and firm B through the license contracts concluded between them. In particular, firm B is also allowed to access the improved technology possessed by firm L.
(2) First-best social welfare is generated.

Proof: (1)(2) We can derive $\pi_L^{SA4} - \pi_L^{SN2} = (3 + \frac{5\theta}{4} - c) - (3 - \frac{3c}{2}) = \frac{11\theta}{8} + \frac{c}{2} > 0 \Leftrightarrow \pi_L^{SA4} > \pi_L^{SN2}$. Hence, since firm L has total control over the contract, it concludes a grant-back contract. In addition, it is clear that innovation is achieved, the improved technology is shared among firm L, firm A, and firm B, and first-best social welfare, $W^{SA4} = 3 + 3\theta$, is generated. ■

A licensing agreement that includes a grant-back clause restores a licensor's incentive both to encourage a competent licensee to innovate and to share the improved technology with all other firms, including incompetent licensees. In this sense, grant-back clauses are socially desirable for severable innovation, while it is generally anticipated that innovation ceases to unfold without them. In a nutshell, we can still claim the "but for" defense of a grant-back clause under severable innovation convincingly even with multiple heterogeneous licensees.

5 Concluding remarks

This study investigated the effect of a grant-back clause in a licensing agreement according to the attribute of innovations categorized as either "severable" (noninfringing) or "nonseverable" (infringing). The European Commission (2004) indicated that while a grant-back clause applied to nonseverable innovation is considered innocuous, one applied to severable innovation should be treated with much greater skepticism. However, this study revealed that this guideline rule is subject to debate with further reasons in addition to those demonstrated in ARR.

Like the work of ARR, this study first confirmed that a grant-back clause does not further increase the original licensor's incentive to license its BT for nonseverable innovation by assuming a single licensee under territorial restraints. By contrast, this study showed an evident increase in its incentive to license, including a grant-back clause, for severable innovation. As a result, follow-on innovation that enhances social welfare can be followed. This finding suggested that the "but for" defense with a particular focus on a licensor is valid for severable innovation but not for nonseverable innovation, which is the polar opposite of the claim made by the European Commission (2004).

Then, to check the robustness of the "but for" defense, the model was extended on two points: prohibition of territorial restraints and multiple heterogeneous licensees. First, when territorial restraints are prohibited, first-best social welfare is not generated for either sevrable

or nonseverable innovation (in particular, innovation is not achieved in the case of severable innovation). We demonstrated that social welfare is recovered if a licensor uses a grant-back clause in an initial licensing agreement for both innovation attributes. Second, when two heterogeneous licensees have different innovation abilities, we proved that a grant-back clause could improve the licensor's incentive to encourage follow-on innovation and to share it with all licensees. All things considered, the "but for " defense of a grant-back clause for severable innovation is by and large robust to variations in the model.

The result of the "but for" defense, focusing on a licensor's incentive, can be supported by the following background arguments. [22] First, a major concern about a licensor's strong market power may be very limited to the case in which it is a monopolist or very close to being labeled as one. Rather, when a licensor is a relatively small firm, market competition is expected to work much better due to an equal footing enabled by a grant-back. More importantly, the second background regards a licensee's incentive to further innovate. If a licensee is a rational economic agent, it will weigh the advantage of using a grant-back clause (i.e., it can employ an original patent to achieve innovation) against the disadvantage of not using it (i.e., it cannot achieve innovation because the patent is absent), when contemplating a licensing agreement that has a grant-back clause. That is, since a licensee incorporates the "pros and cons" concerning a grant-back clause in its decision-making process in concluding a licensing agreement, the mere statement that grant-backs may potentially discourage a licensee's incentive does not seem persuasive. As this study indicates, potential contracts can likely be concluded, including a grant-back clause for severable innovation based on the voluntary decision of a licensor and a licensee. Thus, while a grant-back clause may be a measure of abuse of a licensor's dominant position, it seems overemphasized that it discourages a licensee's incentive to innovate for severable innovation.

There remains a further challenging investigation in this study – the assumption that severable innovation entirely cancels out the royalty payments from a licensee should be re-examined. Alternatively, we may need to assume that some royalty payments can accrue conditional on the actual use of BT possessed by a licensor, even for severable innovation. By this modified assumption, the robustness of the "but for" defense of a grant-back clause for severable innovation may be somewhat restricted.

References

Ambashi (2021), "Technology Competition, Cumulative Innovation, and Technological Development Schemes", KIER Discussion Paper Series, 1065, Institute of Economic Research, Kyoto University.

[22] The following argument makes references to Uemura (2010).

Ambashi, M., Regibeau, P., and Rockett, K.E. (2019), "Grantbacks, Territorial Restraints, and Innovation", *International Journal of Industrial Organization*, 67.

Choi, J. P. (2002), "A Dynamic Analysis of Licensing: The 'Boomerang' Effect and Grant-Back Clauses", *International Economic Review*, 43(3), 803-829.

Cockburn, I. M. (2007), "Is the Market for Technology Working? Obstacles to Licensing Inventions, and Ways to Licensing Inventions, and Ways to Reduce Them", paper presented at the Conference on Economics of Technology Policy, Monte Verità, June 2007.

European Commission (2004), "Commission Note: Guidelines on the Application of Article 81 of the EC Treaty to Technology Transfer Agreements", *Official Journal of the European Union*, 2004/C 101/02.

European Commission (2014), "Communication from the Commission: Guidelines on the Application of Article 101 of the Treaty on the Functioning of the European Union to Technology Transfer Agreements", *Official Journal of the European Union*, 2014/C 89/03.

OECD (2004), *Policy Roundtables: Intellectual Property Right*, DAF/COMP(2004)24, Paris.

Scotchmer, S. (1991), "Standing on the Shoulders of Giants: Cumulative Research and the Patent Law", *Journal of Economic Perspectives*, 5(1), 29-41.

Scotchmer, S. (1996), "Protecting Early Innovators: Should Second-Generation Products Be Patentable?", *RAND Journal of Economics*, 27(2), 322-331.

van Dijk, T. (2000), "License Contracts, Future Exchange Clauses, and Technological Competition", *European Economic Review*, 44(8), 1431-1448.

Uemura, K. (2010), "The True Reason why Assignbacks are Illegal", Koya Uemura's official blog, *Your Antitrust Law*. 14 October 2010 (in Japanese).

Zuniga, M. P. and Guellec, D. (2009), "Who Licenses out Patents and Why?: Lessons from a Business Survey", OECD Science, Statistical Analysis of Science, Technology and Industry Working Papers, DSTI/DOC(2009)5, OECD.