Compulsory Licensing and Patent Protection: A North-South Perspective*

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Abstract

In a stylized model involving two agents – a developing country (called South) and a foreign patent-holder – we analyze how the incidence and social value of compulsory licensing (CL) depends upon the South’s patent protection policy. We show that if the South is free to deny patent protection, not only does CL fail to arise in equilibrium, the option to use it makes both parties worse off. Furthermore, being able to use CL reduces the South’s incentive for patent protection. However, if the South is obligated to offer patent protection (say due to its membership in an international organization such as the WTO), CL occurs in equilibrium and can even make both parties better off. CL is more likely to occur if price is negotiated between the two parties compared to when it is set unilaterally by the patent-holder. If the South can impose a price control, the patent-holder is willing to sell at a lower price if its patent is protected relative to when it is not. Thus, the ability to dictate price makes patent protection more attractive to the South while the option to use CL has the opposite effect.

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1 Introduction

The ratification of the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) by the World Trade Organization (WTO) in 1995 was a watershed event in the history of the multilateral trading system. The expansion of the WTO into the sensitive realm of intellectual property had profound implications for both developed and developing countries: post TRIPS, international violations of intellectual property rights (IPRs) can be subject to the potent dispute settlement mechanism of the WTO.\(^1\)

It is no secret that, prior to TRIPS, imitation and piracy of products protected in the West by copyrights, trademarks, and patents – such as DVDs, designer consumer items, software, and pharmaceuticals – was pervasive in the developing world. Indeed, even today most developing countries capable of successfully imitating such products see few advantages, if any, to restricting local imitation and reverse-engineering.

On the other side of the spectrum, developed countries generally argue for stronger IPRs world-wide in order to ensure that holders of IPRs (most of whom reside in the developed world) can profit adequately from their creative efforts and investments in research and development (R&D).\(^2\) Indeed, TRIPS negotiations during the Uruguay Round (1986-1995) were motivated by a deep-rooted sense of dissatisfaction in the United States and major European nations with the lack of IPR protection in major developing countries such as Brazil, India, and China.\(^3\)

To some extent, the clashing interests of developing and developed countries over IPR protection are embodied in the very nature of the TRIPS agreement that eventually emerged from the lengthy Uruguay Round negotiations. On the one hand, TRIPS obligates all WTO members to offer and enforce certain minimum standards of IPR protection (such as twenty years for patents).\(^4\) On the other hand, TRIPS contains some important flexibilities that allow national governments some discretion in the implementation and enforcement of IPRs within their territories. Perhaps the most important such flexibility is contained in Article 31 of TRIPS that provides conditions under which

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\(^1\) Articles 63 and 64 of TRIPS explicitly specify member obligations with respect to dispute prevention and settlement.

\(^2\) See Maskus (2000 and 2012) for comprehensive overviews of the economics of IPRs in a global setting.

\(^3\) Annual reports of the United States Trade Representative (USTR) routinely list countries in which the lack of IPR protection is perceived to be seriously harmful to US interests. A sense of the US perspective prior to the Uruguay Round negotiations can be obtained from US-Chamber of Commerce (1987) and United States International Trade Commission (1988).

\(^4\) In accordance with the notion of special and differential treatment that exists in other parts of the WTO contract, developing countries were given fairly long time horizons within which they had to make their IPR regimes TRIPS compliant, with greatest accommodations being made for the least developed countries.
WTO members can permit the “use of the subject matter of a patent without the authorization of the right holder, including use by the government or third parties”, or what is commonly referred to as the compulsory licensing (CL) of a patent.\(^5\)

CL was not a TRIPS innovation. Indeed, CL was explicitly recognized in the Paris Convention for the Protection of Industrial Property, first ratified in 1883 and then amended several times up until 1979.\(^6\) However, actual incidents of CL in the international context have started to emerge only during the post-TRIPS era. Indeed, during 1995-2011 there were 24 "episodes" of CL of patented foreign medicines (Beall and Kuhn, 2012).\(^7\) By contrast, during the pre-TRIPS era, we observed very little, if any, such international episodes of CL.\(^8\) In a fundamental sense, the lack of CL prior to 1995 is linked to the virtual absence of IPR protection in most developing countries during the pre-TRIPS era: after all, the issuance of a compulsory license is premised on the legal recognition of a patent. If the patent itself is not protected, there is essentially nothing to license. With developing countries increasingly coming under pressure to strengthen their IPR regimes, a greater role for CL as a tool for improving consumer access to patented products in such countries should have naturally emerged during the post-TRIPS era.

As an illustration of the implications of TRIPS for developing countries, consider the case of India’s pharmaceutical industry. Prior to TRIPS, Indian patent law did not recognize product patents in pharmaceuticals; only process innovations were afforded protection and these too were protected only for seven years. As a result, Indian entrepreneurs and firms were free to reverse-engineer and imitate pharmaceuticals that were patented in rest of the world. It is widely acknowledged that the skewed nature of India’s

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\(^5\)The other major TRIPS flexibility (that we do not analyze here) is specified in Article 6 which states that “nothing in this Agreement shall be used to address the issue of the exhaustion of intellectual property rights.” The economic implications of the freedom that WTO members have to implement exhaustion policies of their choice have been widely studied. See, for example, Mahug and Schwarz (1994), Ganslandt and Maskus (2004), Valleti (2006), and Roy and Saggi (2012).

\(^6\)Article II of TRIPS says that “Members shall comply with Articles 1 through 12, and Article 19, of the Paris Convention” and Article 5(2) of the Paris Convention says that “Each country of the Union shall have the right to take legislative measures providing for the grant of compulsory licenses to prevent the abuses which might result from the exercise of the exclusive rights conferred by the patent, for example, failure to work.” See http://www.wipo.int/treaties/en/text.jsp?file_id=288514&P213_35515.

\(^7\)Beall and Kuhn (2012) defined a CL episode to be one where CL was explicitly and publicly discussed between government officials of a country and foreign patent-holders (although it need not have been the end result of such negotiations).

\(^8\)The limited use of CL by developing countries during the pre-TRIPS era likely reflects another aspect of WTO rules pertaining to CL: prior to 2001 a country could only issue a compulsory license to a local producer, requirement that essentially made CL inaccessible to many technologically backward countries. This local production requirement was loosened by the WTO in 2003 by allowing the import of necessary pharmaceuticals via compulsory licenses issued to firms in other countries.
The patent regime during the pre-TRIPS era generated significant benefits for not just Indian consumers but also for consumers in many other countries since India became a cheap source of pharmaceuticals for the developing world. However, to become TRIPS compliant, India was forced to reform its intellectual property law and introduced product patents for pharmaceuticals for the first time in 2005. A recent press article (Chatterjee and Hirschler, Feb 6, 2014) reports that faced with increasing pressure from global pharmaceutical companies to put an end to ongoing imitation of patented drugs, the Indian government is currently reviewing whether compulsory licenses and more stringent price controls should be used to bring down the prices of patented foreign drugs.

With imitation becoming increasingly difficult to sustain during the post-TRIPS era, CL has naturally become more attractive to developing countries as means for ensuring access to patented products at low prices. In this paper, we develop a simple model that captures this insight and use it to evaluate the costs and benefits of CL as well as those of strengthening patent protection in developing countries. Our stylized model involves two parties: a developing country (called South) and a Northern firm who owns a patent over its product that lasts for $T$ periods. In the first period, the South chooses whether or not to protect the patent-holder from imitation while the patent-holder decides whether or not to enter the Southern market. If the South protects the patent and the patent-holder chooses not to enter in the first period, for the remaining duration ($T-1$ periods) of the patent the South has the authority to issue a compulsory license to a local producer who is required to set price equal to marginal cost. If the South does not protect the patent, a competitive local industry producing an imitated version of the patented good comes into existence. Due to the limited technological capability of the South, the quality of production under imitation (as well as CL) is lower than that of the patent-holder.

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9 For supporting empirical evidence regarding the effects of patent protection and price controls on the entry incentives of pharmaceutical companies and on the welfare of consumers in developing countries (especially India), see Lanjouw (1998 and 2005), Chaudhuri et. al. (2006), Dutta (2011), Duggan and Goyal (2012), Berndt and Cockburn (2014), and Cockburn et. al. (2014).

10 Similarly, patent protection was strengthened in China in 1997 and in Brazil during 2002. As per the popular Ginarte-Park index of patent protection (see Park 2008) TRIPS induced major changes in the degree of patent protection in India and China: the value of the index for India increased sharply from 1.03 in 1995 to 3.76 in 2005 while that for China almost doubled from 2.12 to 4.08 over the same time period. We thank Walter Park for providing us the most updated version of this index.

11 In 2012, frictions between India and the pharmaceutical company Bayer flared up when India decided to issue a compulsory license for Bayer’s cancer drug Nexavar. Bayer challenged the compulsory license in Indian courts but was unsuccessful in getting it over turned. More recently, the National Pharmaceutical and Pricing Authority of India has expanded the list of medicines subject to price controls by imposing new controls on the anti-diabetes and cardiovascular segments of the pharmaceutical market (see Dey, Business Standard, October 24, 2014).

12 The qualitative nature of our results is unaffected by allowing for an arbitrary delay period before a CL can be issued by the South.

13 Bond and Saggi (2014a) provide an extensive discussion of the problems that developing countries
If the patent-holder chooses to enter despite the lack of patent protection, it competes with the imitative industry—an outcome under which Southern consumers enjoy the highest surplus due to greater variety and competition in the local market.

We first analyze a benchmark scenario similar to Saggi (2013) where the option to use CL does not exist. This benchmark model delivers an interesting insight: the South grants patent protection if and only if doing so is necessary to induce the patent-holder to sell locally and the quality of local production under imitation is quite low. Thus, both the size of the local market (relative to the fixed cost of entry) and the technological capability of the local economy determine Southern incentives for patent protection. The South lacks the incentive to offer patent protection both when its local market is lucrative for the patent-holder as well as when it is too small to induce entry. Similarly, if local imitation is of sufficiently high quality, the South has little to gain from patent protection. In order to draw out the implications of TRIPS, we also identify circumstances under which forcing the South to offer patent protection increases or decreases joint welfare in the benchmark model.

We next build on the benchmark model to incorporate CL. In accordance with WTO rules which require that a patent-holder be given an opportunity to work its patent before a CL can be issued, we assume that the South can invoke CL only if the patent-holder does not sell the South in the first period. We show that the option to use CL reduces the South’s willingness to offer patent protection, i.e., there exist parameter regions under which the South offers patent protection only if CL is unavailable. The intuition for this result follows from a two-step logic. First, the royalties involved under CL increase the patent-holder’s payoff from not entering the South (and letting CL occur). Second, imitation dominates CL from the Southern viewpoint since it does not incur royalties and also avoids the (one-period) delay involved under CL. As a result, whenever the patent-holder prefers CL to entry, the South chooses not to offer patent protection since it prefers imitation to CL.

In the model, the patent-holder has too weak an incentive to enter since it ignores the benefits of its entry to Southern consumers while the Southern government has have in implementing CL. In particular, they note that the available case-study evidence shows that even countries such as Brazil and Thailand have found it difficult to produce world class products under CL. See also Baron (2008) and Daemmrich and Musacchio (2011) for further discussion.

Our model suggests a non-monotonic relationship between a country’s level of development and its degree of patent protection. Countries that are poor imitators have incentives to offer patent protection in order to obtain access to high quality foreign products. Countries that can imitate well but are not yet competitive in innovation, will prefer not to offer patent protection since doing so transfers local consumer surplus to foreign patent-holders without inducing much in the way of local innovation. Finally, countries with the ability to innovate will choose to provide patent protection. Evidence of a U-shaped relationship between per capita GDP and the strength of intellectual property rights, as suggested by our results, is reported by Maskus (2000) and Chen and Puttitanun (2005).
an inadequate incentive for patent protection because it does not take into account the profitability of the patent-holder. These twin distortions imply that there exist circumstances where the patent-holder stays out but entry is socially efficient just as there are cases where the South should offer patent protection but it does not. However, from a joint welfare perspective, the South never offers patent protection when it should not do so. Thus, if the South is free to deny patent protection, not only does CL fail to arise in equilibrium, the option to use it makes both parties worse off since the possibility of CL further reduces the South’s incentive to offer patent protection thereby undermining the patent-holder’s incentive to enter.

We also consider the consequences of requiring the South to implement patent protection (i.e. shutting down local imitation) when CL is an available option. As expected, such forced patent protection benefits the patent-holder at the expense of the South. However, more interestingly, CL now emerges as an equilibrium outcome. This result formally confirms the insight that with imitation becoming difficult, developing countries have an incentive to turn towards CL as a means for accessing patented products at low prices. Furthermore, we also identify circumstances where joint welfare of the two parties decreases (as well as when it increases) due to the shutting down of Southern imitation. As in Bond and Saggi (2014a), we find that given patent protection, the option to use CL can even make both parties better off.

Since patent-holders may be unable to exercise unrestricted monopoly power in developing countries due to government intervention, we extend the model to allow for price negotiations between the patent-holder and the South. We find that if the patent-holder can make it a take-it-or-leave-it price offer to the South, incorporating price negotiations does not alter the South’s optimal patent protection policy. But price negotiations do matter in an important sense: given that the South offers patent protection, CL is more likely to arise in equilibrium when the two parties negotiate over price relative to when the patent-holder sets it unilaterally.

We also show that if the South has the ability to control the price, the patent-holder is willing to sell in its market at a lower price when it receives patent protection relative to when it does not. This result implies that the strengthening of patent protection should make it possible for developing countries to tighten their price controls on foreign patent-holders as opposed to having to weaken them. Furthermore, while the ability to dictate price makes patent protection more attractive to the South, the option to use CL makes it less so. Thus, while both CL and price controls can help improve consumer access in developing countries to patented foreign products (such as pharmaceuticals), the two instruments have rather different affects on their incentives to protect foreign patents.
2 Benchmark model

We study the decision of a patent-holder regarding entry into a developing country (South) where its technology is potentially subject to imitation. The benchmark model is a two stage game between the patent-holder and the South. In the first stage, the South chooses whether or not to allow imitation (denoted by subscript $I$), where imitation generates local competition for the patent-holder. Next, the patent-holder decides whether to enter the South by incurring the fixed cost $\varphi$.\footnote{Any fixed costs involved under local production (either via CL or imitation) are normalized to zero. The parameter $\varphi$ should be interpreted as the additional fixed costs that are faced by the patent-holder relative to local producers. Such additional costs could arise from not just production activities but also from having to secure approval from the local government prior to selling locally and/or from having to establish a marketing and distribution network in an unfamiliar environment.}

Later, we extend this model by adding a third stage at which the South can issue a compulsory license to a local firm in order to ensure that the patented good is supplied locally. As per WTO rules, we assume that the South has the authority to issue a compulsory license only if the patent-holder chooses not to sell in its market.

2.1 Demand and payoffs

There are a continuum of Southern consumers of measure 1, each of whom buys (at most) one unit of the product. If a consumer buys the product at price $p$, his utility is given by $U = \theta q - p$ where $q$ measures quality and $\theta \geq 0$ is a taste parameter that captures the willingness to pay for quality. For simplicity, we assume that $\theta$ is uniformly distributed over the interval $[0, 1]$.

The patent-holder’s patent lasts for $T$ periods provided it is protected by the South. Let $\beta \in [0, 1)$ be the per period discount factor and let the marginal cost of production equal zero. Normalizing utility under no purchase to zero, the per-period demand $d(p, q)$ in the South for the patented product in the absence of imitation equals $d(p, q) = 1 - p/q$. Over the life of the patent, in each period the patent-holder chooses its price $p$ to maximize

$$\max \pi_E(p) = p \left(1 - \frac{p}{q}\right)$$

The present value of the patent-holder’s entry profits (gross of fixed costs) as a function of its price $p$ equals

$$v_E(p) = (1 + \Omega)\pi_E(p) \text{ where } \Omega = \sum_{t=1}^{T} \beta^t$$
The per-period consumer surplus that accrues to the South from purchasing the patented product at price $p$ equals

$$s_E(p) = \int_{p/q}^{1} (q \theta - p) d\theta = \frac{(p - q)^2}{2q}$$  \hspace{1cm} (3)

which implies that Southern welfare over the duration of the patent under entry at price $p$ equals

$$w^S_E(p) = (1 + \Omega)s_E(p)$$  \hspace{1cm} (4)

Solving the problem in (1) yields the patent-holder’s optimal monopoly price $p_m = q/2$. Thus, the maximized payoff from entry to the patent-holder when its patent is protected equals

$$v_E(p_m) = (1 + \Omega)p^m (1 - p^m/q)$$  \hspace{1cm} (5)

while that to the South equals

$$w^S_E(p_m) = (1 + \Omega)s_E(p_m)$$  \hspace{1cm} (6)

When the South does not protect the patent-holder’s patent, imitation results in the emergence of a competitive industry that produces a lower quality version of the patented product. Quality of the Southern imitation is denoted by $q$ where $0 < q < 1$. Southern consumers are assumed to have complete information in the sense that they can fully distinguish between the original patented product and the imitative version produced by the local industry.\(^{16}\)

Competition within the Southern industry ensures that the imitated good is sold at marginal cost. When two different qualities are available for purchase at prices $p$ (high quality) and $0$ (low quality), Southern consumers can be partitioned into two groups: those in the range $[0, \theta_h(p; \gamma)]$ buy the low quality whereas those in $[\theta_h(p; \gamma), 1]$ buy the high quality where

$$\theta_h(p; \gamma) = p/q(1 - \gamma)$$

When facing competition from imitation, the patent-holder chooses its price $p$ to maximize

$$\max \pi_I(p; \gamma) = p[1 - \theta_h(p; \gamma)]$$

\(^{16}\)It is worth emphasizing that in the context of the pharmaceutical industry the imitated product is best viewed as a generic that can only be sold in the South. The quality differential between the two products then represents the value consumers associate with the brand of the patent-holder.
with the associated value $v_I(p) = (1 + \Omega)\pi_I(p)$. The patent-holder’s profit maximizing price when facing competition from the imitative industry equals

$$p^m_I(\gamma) = q(1 - \gamma)/2 = (1 - \gamma)p^m$$

Observe that $p^m_I < p^m$ since $0 < \gamma \leq 1$. At the price $p^m_I$, we have $\theta_h(p; \gamma) = \frac{p^m_I}{q(1-\gamma)} = 1/2$. Thus, competition from imitation lowers the patent-holder’s gross entry payoff to

$$v_I(p^m_I; \gamma) = (1 + \Omega)(1 - \gamma)p^m = (1 - \gamma)v_E(p^m) \tag{7}$$

where $\gamma \leq 1$.

If the South permits imitation and the patent-holder does not enter then local consumers obtain access (only) to the lower quality imitated good at a price equal to marginal cost (set to zero). Under this scenario, Southern welfare equals

$$w^S_N(\gamma) = (1 + \Omega)s_N(\gamma) \text{ where } s_N(\gamma) = \int_0^1 \gamma q \theta d\theta \tag{8}$$

However, if the patent-holder enters the Southern market despite imitation, Southern welfare equals

$$w^S_I(p^m_I; \gamma) = (1 + \Omega)s_I(p^m_I; \gamma) \text{ where } s_I(p^m_I; \gamma) = \int_0^{1/2} \gamma q \theta d\theta + \int_{1/2}^1 [q \theta - p^m_I] d\theta \tag{9}$$

Note that $w^S_I(p^m_I; \gamma) - w^S_E(p^m) = 3q\gamma/8 > 0$. Thus, provided the patent-holder enters, Southern welfare increases due to imitation. When the South permits imitation, those Southern consumers that are unwilling to pay the price for the higher quality product sold by the patent-holder gain access to a lower quality version that sells at a lower price. This *variety enhancing effect of imitation* is one reason the South benefits from imitation. The second reason, of course, is that the imitated product competes with the patented product and this competition lowers the price of the high quality.

In the absence of competition form imitation, in equilibrium, only half of the market in the South is covered since $\theta_h(p^m) = p^m/q = 1/2$. By contrast, when imitation occurs, all those consumers that buy the high quality in the absence of imitation continue to do so although they now pay a lower price for it. In addition, all consumer in the range $[0, 1/2]$ end up buying the low quality imitative good so that the entire Southern market ends up being covered when the South permits imitation.
2.2 Equilibrium

The patent-holder’s entry decision depends upon the South’s policy regarding patent protection. Given patent protection, the patent-holder sells in the South iff

\[ v_E(p^m) - \varphi \geq 0 \iff \varphi \leq \varphi_E \equiv v_E(p^m) \]  

(10)

Similarly, when facing imitation, the patent-holder chooses to enter iff

\[ v_I(p^m_I; \gamma) - \varphi \geq 0 \iff \varphi \leq \varphi_I \equiv v_I(p^m_I; \gamma) \]  

(11)

Since \( \varphi_I \leq \varphi_E \), the lack of patent protection makes the patent-holder less willing to sell in the South.

Consider now the South’s decision regarding patent protection. Suppose the South protects the patent-holder. Then, if \( \varphi \leq \varphi_E \), the patent-holder enters and Southern welfare equals \( w^S_E(p^m) \). But if \( \varphi > \varphi_E \), the patent-holder does not enter and Southern welfare equals zero. If the South permits imitation, the patent-holder enters provided \( \varphi < \varphi_I \) in which case its welfare equals \( w^S_I(p^m_I; \gamma) \). This trade-off generates the following optimal policy for the South:

**Proposition 1:** In the benchmark model (where compulsory licensing is not possible), the South offers patent protection if and only if (i) \( \varphi_I < \varphi \leq \varphi_E \) and (ii) \( \gamma \leq \gamma^S \equiv 1/4 \).

When \( \varphi < \varphi_I \), the patent-holder’s fixed entry cost is so low that it enters the market even if imitation occurs in the South. Given that, shutting down imitation simply lowers local consumer surplus by reducing competition and variety. When \( \varphi > \varphi_E \), the patent-holder’s fixed entry cost is so high that it does not sell in the South even when its patent is protected. In such a scenario, the South clearly has no incentive to grant patent protection since doing so eliminates even the low quality version of the patented product from the local market.

Now consider the more interesting case where \( \varphi_I < \varphi \leq \varphi_E \). Here, the Southern policy matters to the patent-holder: it enters the Southern market iff the South offers patent protection. Under such a situation, the South faces a trade-off: imitation provides consumers access to the low quality product while simultaneously denying access to the high quality. As a result, the South’s decision is determined by the quality gap \( (1/\gamma) \) between products. When this gap is large (i.e. \( \gamma \leq \gamma^S \)) , the South offers patent protection; when it is small, it does not. Thus, the main insight behind Proposition 1 is that the South grants patent protection iff such protection is necessary to induce the patent-holder to sell locally and the quality of local production under imitation is quite low so that shutting down local imitation to ensure access to the high quality product becomes welfare-improving.
Figure 1 illustrates Proposition 1. Only in region B that is defined by the horizontal line (that plots $\varphi_E$), the downward sloping line (that plots $\varphi_I$), and the dashed line (that shows $\gamma^S$) does the South chooses to offer patent protection to induce entry. Everywhere else, the South allows imitation. Below the downward sloping line (region A), the patent-holder enters even though imitation is permitted whereas above the horizontal line (region D) it does not even if it is prohibited.

To investigate the welfare properties of the equilibrium, define the joint welfare of the two parties as the sum of their individual welfare levels. One basic property of the model is that the patent-holder’s decision-making fails to take into account the surplus its entry generates for Southern consumers. Thus, in general, its incentive to enter the South is too weak from the perspective of joint welfare of the two parties. On the other hand, the Southern government’s decision regarding patent protection does not take into account the welfare of the patent-holder. As a result, the South’s incentive for patent protection is weaker than what joint optimality requires. The tension between these two distortions drives the welfare analysis that follows.

Given that the South offers patent protection, joint welfare under entry equals

$$w_E(p^m) = (1 + \Omega) s_E(p^m) + v_E(p^m) - \varphi$$

Given patent protection, if the patent holder does not enter (which it does not whenever $\varphi > \varphi_E$), the welfare of each party equals zero. Therefore, entry is jointly optimal iff

$$w_E(p^m) \geq 0 \iff \varphi \leq \varphi_E^m = 3q (1 + \Omega) / 8$$

where $\varphi_E^m > \varphi_E$ which reflects the fact that the patent-holder ignores local consumer surplus. Throughout the paper we assume that $\varphi < \varphi_E^m$.

Similarly, we have

$$w_I(p_I^m; \gamma) = (1 + \Omega) s_I(p_I^m) + v_I(p_I^m) - \varphi$$

Given that the patent-holder enters, imitation raises joint welfare by generating competition and increasing variety:

$$w_I(p_I^m; \gamma) - w_E(p^m) = q\gamma (1 + \Omega) / 8 \geq 0$$

Thus, for all $\varphi < \varphi_I$, the South’s decision to not offer patent protection is socially optimal (even though it makes the patent-holder worse off).
It is clear that whenever the South chooses to offer patent protection (i.e. for \( \varphi_I < \varphi \leq \varphi_E \) and \( \gamma < \gamma_S \)), it is jointly optimal do so. However, there are instances where the South should offer patent protection but it fails to do so. Using

\[
w_N(\gamma) = (1 + \Omega)s_N(\gamma)
\]

we have

\[
w_I(p^m_I; \gamma) \geq w_N(\gamma) \text{ iff } \varphi \leq \varphi_I^w = 3q(1 - \gamma)(1 + \Omega)/8
\]

i.e. given imitation, entry raises joint welfare iff \( \varphi \leq \varphi_I^w \).

Next note that

\[
w_E(p^m) \geq w_N(\gamma) \text{ iff } \varphi \leq \varphi_E^w = q(3 - 4\gamma)(1 + \Omega)/8
\]

i.e. joint welfare is higher if only the high quality product is sold at the monopoly price relative to when only the imitated good is available at the competitive price so long as the fixed cost of entry lies below \( \varphi_E^w \). Observe that if \( \gamma \geq 3/4 \) then it can never be jointly optimal to offer patent protection to induce entry. Here, the quality disadvantage of imitated production is rather small and allowing imitation to occur is jointly efficient even if it induces the patent-holder to stay out of the South.

A welfare comparison of the various outcomes is as follows:

**Proposition 2:** (i) \( w_I(p^m_I; \gamma) \geq w_E(p^m) \) iff \( \varphi \leq \varphi_I^w \) and (ii) \( w_I(p^m_I; \gamma) \geq w_N(\gamma) \) iff \( \varphi \leq \varphi_E^w \).

To gain further insight into the welfare properties of the equilibrium of the benchmark model, it is useful to consider a comparison of the various cost thresholds that determine the social desirability of each regime vis-à-vis those that determine the South’s equilibrium decision:

**Lemma 1:** (i) \( \varphi_E^w \geq \varphi_E \text{ iff } \gamma \leq \gamma_S = 1/4 \); (ii) \( \varphi_E^w \geq \varphi_I \text{ iff } \gamma \leq \gamma_I^w = 1/2 \); (iii) \( \varphi_I^w \geq \max\{\varphi_E^w, \varphi_I\} \) and (iv) \( \varphi_I^w \geq \varphi_E \text{ iff } \gamma \leq \gamma_I^w = 1/3 \).

Using this lemma and Proposition 2 we can conclude the following. First, as noted earlier, the South’s decision to deny patent protection is jointly optimal for all \( \varphi \in [0, \varphi_I] \) (region A in Figure 2) as well as for \( \varphi > \varphi_E \) (region D). For parameters in region A, the outcome is socially optimal because the patent-holder enters even though the South does not offer patent protection; for parameters in region D, the patent-holder would not enter the South even if its patent were protected which makes it socially optimal for the South to not protect it. Second, for \( \varphi \in [\varphi_I, \varphi_E] \) and \( \gamma < \gamma_S \) (region B in Figure 2),
patent protection is socially optimal and the South chooses to offer it. Here, even though the patent-holder acts as a monopolist, its quality advantage over Southern imitators (if allowed to operate) is so large that it is optimal to restrict competition from imitation. Third, for $\varphi \in [\varphi_I, \varphi_E]$ and $\gamma \in [\gamma^S, \gamma^u]$ (region C1 in Figure 2), the South chooses not to give patent protection even though it is jointly optimal to do so. Here, from the South’s perspective, the technological superiority of the patent-holder is outweighed by the cost to the Southern consumers of allowing it monopoly power. But taking account of the profits earned by the patent-holder (which the South ignores) tips the balance in favor of patent protection. Fourth, for $\max\{\varphi_I, \varphi_E\} < \varphi < \varphi_E$ and (region C2 in Figure 2), the South’s decision to deny patent protection is again optimal. Here, the quality of the imitated product is high enough to render monopoly pricing for the patented product socially suboptimal and the costs of entry are low enough that the patent-holder enters despite imitation.

We now extend the benchmark model study the interaction between the South’s incentive for patent protection and its ability to use compulsory licensing.

3 Model with compulsory licensing

In the benchmark model, if the patent-holder does not enter and the South lacks the freedom to allow imitation then local consumers have no means for accessing the product. As noted earlier, WTO rules permit the issuance of a compulsory license if a patent-holder chooses not to work its patent locally. Accordingly, we now extend the model to include a third stage where the South decides whether or not to grant a compulsory license. If the product has not been sold in the market in the first period, the South can issue a compulsory license to a local firm who pays the per-period royalty \( R \) to the patent-holder for the duration of the patent. The royalty fee \( R \) reflects the TRIPS requirement of a “adequate remuneration” to the patent-holder.

Under CL, the Southern government requires the local firm to set price equal to marginal cost (in order to maximize local consumer surplus).\(^{17}\) Furthermore, as under imitation, the quality of production under CL equals $\gamma q$, where $\gamma < 1$ captures the quality disadvantage of CL. Thus, in terms of the product market, the outcome under CL mirrors imitation in our model.

\(^{17}\)Thus, we assume that under CL the South subsidizes the local firm to cover the royalty payments made to the patent-holder.
A compulsory license granted at stage three provides the licensee with the right to produce the good for $T - 1$ periods. With these assumptions, the welfare of the South under a compulsory license equals:

$$w^S_{CL}(\gamma, R) = \Omega [s_N(\gamma) - R]$$  \hspace{1cm} (12)

CL is a credible threat for $w^S_{CL}(\gamma, R) \geq 0 \iff \gamma \geq \gamma_m = \frac{R}{p^m}$. Thus, CL is a credible threat so long as the quality of licensed production is not so low that the total surplus generated for Southern consumers is insufficient to cover the royalty $R$ paid to the patent-holder.

### 3.1 How CL changes the equilibrium

When making its entry decision the patent-holder now takes the possibility of CL into account. If given patent protection by the South, the patent-holder has to decide whether to (a) incur the fixed cost $\varphi$ and collect the payoff $v_E(p^m)$ or (b) to not enter and wait for CL to occur in the next period under which its payoff is $\Omega R$. The patent-holder prefers entry to CL iff

$$v_E(p^m) - \varphi \geq \Omega R \iff \varphi \leq \varphi_E(R) \equiv v_E(p^m) - \Omega R$$  \hspace{1cm} (13)

Thus, the patent-holder chooses entry for all $\varphi \leq \varphi_E(R)$ whereas it waits for CL if $\varphi > \varphi_E(R)$. Observe that,

$$\varphi_E(R) = \varphi_E - \Omega R$$

i.e., the possibility of CL makes the patent-holder less willing to enter the Southern market by allowing it to collect royalty payments for the duration of the compulsory license if it chooses to stay out. Observe also that $\varphi_E(R) = \varphi_I \iff v_E(p^m) - \Omega R = (1 - \gamma)v_E(p^m)$ which holds when $\gamma v_E(p^m) = \Omega R$.

As before, if imitation is allowed by the South, the patent-holder’s payoff from entry falls to $(1 - \gamma)v_E(p^m) - \varphi$. Furthermore, since imitation precludes CL, the patent-holder’s decision becomes trivial: it prefers entry to staying out iff $\varphi \leq \varphi_I$. Foreseeing the patent-holder’s decision, the South sets the following patent protection policy:

**Proposition 3:** When compulsory licensing is an available option, the South chooses to extend patent protection iff (i) $\varphi_I < \varphi \leq \varphi_E(R)$ and (ii) $\gamma \leq \gamma^S$.

Observe that for $R > 0$, $\varphi_E(R) < \varphi_E$: given that CL yields a strictly positive royalty payment to the patent-holder, the South is less willing to offer patent protection when it has the option to use CL. More specifically, over the parameter region $\max\{\varphi_E(R), \varphi_I\} < \varphi < \varphi_E$ (the shaded region B1 in Figure 3) the option to use CL leads the South to not offer patent protection since, over this set of parameter values, the patent-holder would
prefer to stay out to collect royalties under CL even if it is protected from imitation. It is important to note that though CL does not arise in equilibrium, by raising the patent-holder’s payoff from staying out the possibility of CL increases the likelihood that the South denies patent protection.

[Figure 3 here]

3.2 Welfare effects of CL

How does the option of CL affect the two parties? The result here is surprising and clear:

**Proposition 4:** Given that the South is free to allow imitation, not only does CL fail to arise in equilibrium but the option to use CL makes both parties worse off.18

The intuition for this result is as follows. We noted above that when \( \max\{\varphi_E(R), \varphi_I\} < \varphi < \varphi_E \) and \( \gamma \leq \gamma^S \) the possibility of CL induces the South to not offer patent protection since, for this set of parameter values, the patent-holder prefers to stay out of the South in order to collect royalty payments under CL if its patent is protected. This, in turn, makes patent protection counter-productive for the South: since Southern welfare under imitation dominates that under CL (due to the delay involved and the royalties incurred), the South is better off permitting imitation to preclude CL. But the important point is that for this set of parameter values, the South is actually better off if only the patented product were to be sold in its market since the local industry’s product is of fairly low quality (\( \gamma \geq \gamma^S \)). Similarly, the patent-holder is strictly better off under entry since \( v_E(p^m) > \varphi \) for \( \varphi < \varphi_E \). It follows then that if imitation is possible then a credible commitment on the part of the South to not use CL makes both parties better off when \( \max\{\varphi_E(R), \varphi_I\} < \varphi < \varphi_E \) and \( \gamma \leq \gamma^S \). As we shall see below, the option to use CL can never make both parties worse off if the South cannot allow local imitation.

4 If South must offer patent protection

What are the consequences of forcing the South to offer patent protection, say due to an international agreement such as TRIPS? When imitation is not permitted, the patent-holder chooses entry for all \( \varphi \leq \varphi_E(R) \) whereas it waits for CL to occur when \( \varphi > \varphi_E(R) \).

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18 Both parties strictly lose when \( \max\{\varphi_E(R), \varphi_I\} < \varphi < \varphi_E \) and \( \gamma \leq \gamma^S \) whereas they are unaffected otherwise.
If $\varphi > \max\{\varphi_E(R), \varphi_I\}$, (regions B1, C3, and D in Figure 4) in the absence of TRIPS, the South permits imitation whereas the patent-holder stays out of the South. Shutting down imitation converts the market outcome from one where a competitive local industry supplies the low quality product to one where the same product is supplied by the local licensee (at price equal to marginal cost) under CL. While the price and quality under CL and imitation are the same, CL occurs with delay since, as per WTO rules, the South is required to give the patent-holder a chance to work its patent. Furthermore, the South has to pay royalties under CL whereas it does not compensate the patent-holder under imitation. The delay involved under CL and the compensation paid to the patent-holder make the South worse off. The patent-holder obviously benefits: absent CL, it stays out and collects no profit from the Southern market.

Next consider the parameter range where $\varphi_E(R) < \varphi < \varphi_I$ (region A1 in Figure 4). Over this range, in the absence of TRIPS, the patent-holder enters the South despite the fact that South permits imitation. With TRIPS in place, the patent-holder chooses to stay out and wait for CL to occur since the value of royalty payments under CL exceeds its payoff under entry (even though entry is profitable in an absolute sense). When this happens, the South loses because the high quality product is eliminated from the market (i.e. variety declines). It is worth noting here that for $\varphi_E(R) < \varphi < \varphi_I$ it is patent protection that induces the patent-holder to stay out of the Southern market, as opposed to the lack of such protection. This happens because the payoff under CL to the patent-holder exceeds that under entry even though it chooses to enter when patent protection is missing. The key insight is that when the South does not offer patent protection, the option of CL is automatically taken off the table since imitation makes CL redundant from the Southern viewpoint. Indeed, patent protection is a necessary precondition for CL: once a patent has been violated (via imitation), CL is no longer an option.

Over the range $\varphi_I < \varphi < \varphi_E(R)$ the consequences of requiring South to extend patent protection depend upon whether or not $\gamma \leq \gamma^S$. When this inequality holds (i.e. region B2 in Figure 4), local production suffers from a large enough quality gap that the South willingly offers patent protection in order to induce the patent-holder to sell locally. Thus, the South is coerced to offer patent protection only when $\gamma > \gamma^S$ (i.e. regions C11 and C2 in Figure 4). Suppose this inequality holds. Then, forcing the South to implement patent protection converts the local market from a competitive imitative industry selling the low quality product to one where the patent-holder sells the high quality at its optimal monopoly price. This switch benefits the patent-holder at the expense of the South (who does not find it worthwhile to offer such protection due to the relatively small quality gap between the patented and the imitated product). Furthermore, this switch also increases joint welfare for $\varphi \in [\varphi_I, \varphi_E]$ and $\gamma \in [\gamma^S, \gamma^U]$ (region C11 in Figure 2). But for parameters outside these ranges (i.e. in region C2 in
Finally, over the range where \( \varphi < \min\{\varphi_I, \varphi_E(R)\} \) (i.e. region A2 in Figure 4) the patent-holder enters the South regardless of whether or not its patent is protected. Under such a scenario, shutting down local imitation hurts the South because it reduces competition as well variety in the local market. For the same reasons, joint welfare declines. Of course, the patent-holder benefits from these changes.

We summarize this discussion below:

**Proposition 5:** Requiring the South to offer patent protection benefits the patent-holder at the expense of the South. In addition, it has the following effects:

- (i) If \( \varphi > \max\{\varphi_E(R), \varphi_I\} \), imitation is replaced by CL and joint welfare of the two parties declines.

- (ii) If \( \varphi_E(R) < \varphi < \varphi_I \), CL replaces a market structure where the patent-holder competes with the imitative industry and joint welfare declines.

- (iii) Over the range \( \varphi_I < \varphi < \varphi_E(R) \), when \( \gamma > \gamma^S \), the low quality Southern imitative industry is replaced by the high quality patent-holder and joint welfare increases iff \( \varphi \in [\varphi_I, \varphi_E^w] \) and \( \gamma \in [\gamma^S, \gamma^w] \).

- (iv) For \( \varphi < \min\{\varphi_E(R), \varphi_I\} \), joint welfare declines because competition from the imitative industry is eliminated.

An important insight provided by Proposition 5 is that when forced to offer patent protection, the South turns towards CL as a means for securing the product at a low price. Indeed, recall that when imitation is possible, CL does not even arise in equilibrium since, from the Southern viewpoint, it is dominated by imitation. Thus even though CL predates the TRIPS agreement, our model shows that one should expect it to be observed more frequently during the post TRIPS era during which member countries of the WTO have had to clamp down on imitation.

In light of Proposition 5, it is worth asking how the option to use CL affects the two parties when the South can no longer avail of imitation. For \( \varphi \leq \varphi_E(R) \), the patent-holder enters with and without CL so neither party is affected. For \( \varphi \in (\varphi_E(R), \varphi_E^w] \) the possibility of CL induces the patent-holder to stay out of the market in order to collect

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19 The two parties are unaffected if \( \gamma \leq \gamma^S \) since the South willingly offers patent protection and the patent-holder chooses to enter.
royalty payments under CL. While the patent-holder necessarily gains from this switch, the South is better off iff

\[(1 + \Omega)s_E(p^m) \leq \Omega [s_N(\gamma) - R]\]

which is the same as

\[\gamma \geq \gamma^S_{CL} = \theta \gamma^S\]  \hspace{1cm} (14)

where \(\theta = \frac{1}{\alpha} + \frac{8R}{q} > 1\) and \(\alpha = \frac{\Omega}{1 + \Omega} < 1\). Note that \(\theta > 1\) because CL involves delay (captured by \(\alpha\)) as well as royalty payments – both of which are absent under imitation. Finally, for \(\varphi \leq \varphi_E(R)\), the patent-holder enters whether or not CL is an available option for the South. Of course, for \(\gamma \geq \gamma^S_{CL}\), the South is actually better off under CL but the patent-holder preempts it by entering. We can now state:

**Proposition 6:** Given that the South offers patent protection, the option of using CL has the following effects:

(i) For \(\varphi \leq \varphi_E(R)\), entry occurs whether or not the South can use CL. However, for \(\gamma \geq \gamma^S_{CL}\) the South is better off with CL but the patent-holder preempts it via entry.

(ii) When \(\varphi \in (\varphi_E(R), \varphi_E]\), the patent-holder chooses to stay out and wait for CL. If \(\gamma < \gamma^S_{CL}\) the patent-holder gains while the South loses; otherwise, both parties gain.

(iii) For \(\varphi > \varphi_E(R)\), the option of CL benefits both parties.

In part (i), when \(\gamma \geq \gamma^S_{CL}\) the South has sufficient technological capability that it is better off producing the product under CL but the patent-holder’s entry costs are low enough that it chooses to enter thereby precluding CL. In part (ii), the possibility of CL can hurt the South when its technological capability is relatively weak (i.e. \(\gamma < \gamma^S_{CL}\)) but the costs of entry are high enough for the patent-holder to prefer royalty payments under CL to entry. Figure 5 illustrates how the option of CL affects the two parties given that the South offers patent protection.

Since the interests of the two parties can conflict, it is worth asking when CL yields higher joint welfare than entry. We have:

**Lemma 2:** (i) \(w^w_{CL}(\gamma, R) > w_E(p^m)\) iff \(\varphi > \varphi_{CL} = \frac{q(1+\Omega)-4\Omega R}{8}\) and (ii) \(\varphi_{CL} > \varphi_E\) iff \(\gamma < \gamma^w_{CL} = \frac{1+\Omega}{4\Omega}\).

Our analysis has shown that the desirability of the CL option hinges very much on whether or not the South is free to deny patent protection. When the South can do so, CL is essentially counter-productive – not only does it not arise in equilibrium, but the
option to use it makes both parties worse off; when South must offer patent protection, CL can play a much more useful role and can even make both parties better off.

Thus far, our analysis has assumed that the patent-holder is free to charge its optimal monopoly price $p^m$ when selling in the South. We now extend our analysis to the scenario where the price under entry is negotiated between the patent-holder and the South.

5 Entry with price negotiations

So far it has been assumed above that if the firm chooses to enter the South market, it sets the profit-maximizing price in each period. However, as noted in the Introduction, entry by patent-holders in developing countries is often associated with price negotiations.\footnote{In Bond and Saggi (2014b) we analyze a finite-horizon alternating offers game in which the patent-holder bargains with the South over the local price of its patented good. The focus of that paper is on how the presence of international price spillovers (between the South and the patent-holder’s home market) and the threat of CL alter the equilibrium of the bargaining game.}

Therefore, we conclude by extending the model to allow for price negotiations between the Southern government and the patent-holder.

5.1 Price negotiations without CL

We begin by analyzing a two stage game in which the South does not have the option of issuing a compulsory license. In the first stage, the South chooses whether or not to offer patent protection. In the second stage the South negotiates with the patent holder over the price of the product if the patent-holder wishes to enter. The set of feasible prices for this bargaining problem results in a concave payoff frontier reflecting payoffs to the respective parties as a function of the negotiated price. Rather than assuming a specific bargaining protocol for these price negotiations, we illustrate the impact of negotiations on the South’s incentive for patent protection by comparing the case where the patent holder achieves its most preferred outcome on the frontier (i.e. the case considered thus far in the paper) with that when the South achieves its best outcome.

If the South chooses to grant patent protection, the minimum price at which the patent holder will enter the market is the solution to

$$v_E(p) = \varphi$$

which yields

$$p_E^{\text{min}}(\varphi) = p^m \left(1 - \sqrt{1 - \frac{4\varphi}{q(1 + \Omega)}}\right)$$

(15)
Observe that $p^\text{min}_E(\varphi)$ is increasing in $\varphi$, and equals the optimal monopoly price $p^m$ at the highest level of fixed cost at which the patent-holder is willing to enter: i.e. $p^\text{min}_E(\varphi) = p^m$ when $\varphi = \varphi_E$. In general, we have $p^\text{min}_E(\varphi) \leq p^m$.

Recall that the payoff to the South from entry at price $p$ equals

$$w_E^S(p) = (1 + \Omega)s_E(p) = \frac{(1 + \Omega)(p - q)^2}{2q}$$

which is monotonically decreasing in $p$ over $[0, q)$.

Given patent protection, the set of prices that is consistent with entry and is not Pareto dominated is given by the interval $[p^\text{min}_E(\varphi), p^m]$. For $\varphi < \varphi_E$, the patent holder and the South negotiate over the range of feasible prices $[p^\text{min}_E(\varphi), p^m]$, which generates a strictly concave payoff frontier.\footnote{We can invert the South’s payoff function to express the negotiated price $p$ as a function of the South’s welfare, $p(w^S) = q \left( 1 - \sqrt{\frac{2w^S}{q(1+\Omega)}} \right)$. This price can then be substituted into the patent holder’s profit function to obtain the payoff frontier $v = v_E(p(w^S)) = -2w^S + \sqrt{2w^S q(1+\Omega)}$. This frontier is strictly concave in $w^S$, and is downward sloping for $w^S \geq w_E(p^m)$. The maximum payoff that the South can obtain is $w_E(p^\text{min}_E(\varphi))$, in which case the patent holder’s net return is driven to 0.}

The analysis of the previous sections, in which the patent-holder sets the monopoly price $p^m$, is the outcome when the patent-holder has all of the bargaining power, as when it can make a take-it-or-leave-it offer to the South. If on the other hand the South has all of the bargaining power (i.e. it makes a take or leave it offer to the patent-holder), the outcome will be the minimum price $p^\text{min}_E(\varphi)$.

In general, depending upon the allocation of bargaining power between the two parties, price negotiations yield a price $p^B_E(\varphi) \in [p^\text{min}_E(\varphi), p^m]$.

Now consider price negotiations in the absence of patent protection. Without patent protection, the minimum price at which the patent holder would enter is

$$p^\text{min}_I(\varphi, \gamma) = p^m I \left( 1 - \sqrt{\frac{4\varphi}{q(1 - \gamma)(1 + \Omega)}} \right) \quad (16)$$

where $p^m I = (1 - \gamma)p^m$. In the absence of patent protection, the range of feasible prices over which the South and the patent holder negotiate is $[p^\text{min}_I(\varphi, \gamma), p^m I]$. Observe that since the patent holder sells fewer units at any given price when there is imitation with $\gamma > 0$, we have $p^\text{min}_I(\varphi, \gamma) > p^\text{min}_E(\varphi)$ for $\gamma > 0$: i.e. the patent-holder requires a higher minimum price to enter in the absence of patent protection.

Observe that since $p^\text{min}_I(\varphi, \gamma) > p^\text{min}_E(\varphi)$ while $p^m_I < p^m$ the range of prices over which the two parties can potentially agree is smaller in the absence of patent protection.
feasible agreement exists for \( \varphi > \varphi_f \), so the range of fixed costs for which entry will occur is the same as in the case without price negotiation. Thus, the lack of patent protection reduces the likelihood of entry occurs even in the presence of price negotiations.

We are now ready to derive the South’s optimal patent policy in the presence of price negotiations. It is clear that the South does not offer patent protection if \( \varphi > \varphi_E \) and negotiations yield a price \( p^B_I(\varphi, \gamma) \in [p^\text{min}_I(\varphi, \gamma), p^m_I] \) as the outcome. For \( \varphi \in [\varphi_f, \varphi_E) \), the patent holder does not enter in the absence of patent protection. Over this range of fixed costs, the South must choose between implementing patent protection to induce entry at price \( p^B_E(\varphi) \) or allowing imitation to make only the imitated product available to consumers at zero price. Thus, for \( \varphi \in [\varphi_f, \varphi_E) \), patent protection is preferred by the South iff

\[
s_E(p^B_E(\varphi)) \geq s_N(\gamma) \Leftrightarrow \int_{p^B_E(\varphi)/q}^{1} (q - p^B(\varphi))d\theta \geq \int_{0}^{1} \gamma q d\theta
\]

which is the same as

\[
p^B_E(\varphi) \leq q(1 - \sqrt{\gamma}) \quad (17)
\]

Since \( p^B_E(\varphi) < p^m \), for all \( \varphi \in [\varphi_f, \varphi_E) \), price negotiations expand the range of \( \gamma \) for which the South prefers patent protection provided the South has some degree of bargaining power. If the South has all of the bargaining power then \( p^B_E(\varphi) = p^\text{min}_E(\varphi) \) and inequality (17) can be written as

\[
\varphi \leq \varphi^E(\gamma) \equiv q(\sqrt{\gamma} - \gamma)(1 + \Omega) \quad (18)
\]

where \( \varphi^E(\gamma) \geq \varphi_f \) iff \( \gamma \geq \gamma^S \).

Now consider the range \( \varphi \in [0, \varphi_f] \). Recall that here the patent holder’s fixed costs are sufficiently low that it would choose to enter even without patent protection if it can charge its profit-maximizing price \( p^m_I \). However, when price is negotiated the patent-holder’s can only charge \( p^B_I(\varphi) \) when it has patent protection and \( p^B_I(\varphi, \gamma) \) when it does not. The South will prefer providing patent protection if the consumer surplus it obtains from the patented product at price \( p^B_E(\varphi) \) exceeds that obtained from having both the patented product at price \( p^B_I(\varphi, \gamma) \) and the imitated product at zero price. Since the absence of patent protection provides the option of buying the low quality product from imitators, a necessary condition for the South to prefer patent protection is that it be able to negotiate a lower price with patent protection than without, i.e., it must be that \( p^B_I(\varphi, \gamma) > p^B_E(\varphi) \). Otherwise, lack of patent protection is strictly preferable from the South’s viewpoint: not only does it yield the high quality product at a lower price (since \( p^B_I(\varphi, \gamma) < p^B_E(\varphi) \)) it also provides consumers access to the low quality product at zero price.

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Recall that if the patent-holder has all the bargaining power, patent protection necessarily raises the local price of the high quality product (since $p_I^m < p^m$) and the South therefore chooses not to implement patent protection for all $\phi \leq \phi_I$ as established in Proposition 1. However, as noted above, if the South has all the bargaining power, the negotiated price in the absence of patent protection exceeds that under patent protection (i.e. $p^\text{min}_I(\phi, \gamma) > p^\text{min}_E(\phi)$ for $\gamma > 0$). It is shown in the Appendix that when the South has all the bargaining power, for all $\phi < \phi_I$, the negotiated price under patent protection is sufficiently low relative to when such protection is absent that the South is better off providing protection.

We can now state our main result for the case where the South has all the bargaining power:

**Proposition 7**: Suppose that the South can make a take-it-or-leave-it price offer for the patented product and compulsory licensing is not an option. Then, the South provides patent protection if (i) $\gamma \leq \gamma^S$ and $\phi < \phi_E$ or (ii) $\gamma > \gamma^S$ and $\phi < \phi^B(\gamma)$ where $\frac{d\phi^B(\gamma)}{d\gamma} < 0$. Furthermore, the market outcome where the patent-holder competes with the imitative industry does not arise in equilibrium.

To isolate the effect price negotiations have on the South’s incentive for patent protection, it is useful to compare the case where all the bargaining power lies with patent-holder (as is true in our core model) to one where it lies with the South. Proposition 1 describes the South’s equilibrium policy in the former case while Proposition 7 does so for the latter case. A comparison of Propositions 1 and 7 illustrates that the South’s ability to drive the patent holder to its minimum acceptable price can enter significantly expands the parameter region over which it chooses to provide patent protection. When the patent-holder unilaterally sets the price, the South’s decision regarding patent protection is determined solely by the quality gap parameter $\gamma$ whereas when the South controls the price, both the quality gap $\gamma$ and the fixed cost of entry $\phi$ matter. In particular, the South offers patent protection over the second region specified in Proposition 7 (i.e. $\gamma > \gamma^S$ and $\phi < \phi^B(\gamma)$) only when it can get the patent-holder to sell at its minimum acceptable price. When all of the bargaining power resides with the South, price negotiations drive the patent-holder’s net profits down to zero both with and without patent protection. Thus, while the patent-holder is indifferent to patent protection, the South has greater tolerance for it because the minimum price needed to induce entry is higher in its absence: i.e. $p^\text{min}_I(\phi, \gamma) > p^\text{min}_E(\phi)$.

Figure 6 illustrates how price negotiations affect Southern incentives for patent protection by comparing the two polar cases where all the bargaining power lies with the South.
In Figure 6, the South has all the bargaining power and it offers patent protection over regions A, B, and C1. This contrasts with the case where the patent holder has all of the bargaining power, which results in patent protection being provided by the South only over region B.

5.2 Price negotiations with CL

We now extend the bargaining game to the case in which the South has the option of issuing a compulsory license if no agreement is reached after the first period. For the case where the South does not provide patent protection, the possibility of CL has no bearing on price negotiations between the South and the patent-holder. Due to the presence of imitators, the South can obtain a product that is equivalent to that under CL without delay and without the necessity of paying royalties when there is no patent protection. Therefore, in what follows, we need to only consider price negotiations for the case where the South offers patent protection.

When CL is an option, the patent-holder enters only if it earns a return of at least $\varphi + \Omega R$ from sales in the South market. From (15), the minimum price the patent-holder is willing to accept when it has patent protection is $p_{E}^{\min}(\varphi + \Omega R)$. Since $p_{E}^{\min}(\varphi + \Omega R)$ is increasing in $R$, the possibility of CL raises the minimum price that the South must pay to induce entry.

The existence of CL also affects the maximum price that the South is willing to pay under patent protection, since it can ensure itself a surplus of $w_{CL}^{S} = \Omega [s_{N}(\gamma) - R]$ under CL. The price that makes the South indifferent between entry and CL solves the following equation:

$$(1 + \Omega)s_{E}(p) = \Omega [s_{N}(\gamma) - R] \Leftrightarrow \int_{p/q}^{1} (q\theta - p) d\theta = \frac{\Omega}{1 + \Omega} \left[ \int_{0}^{1} \gamma q \theta d\theta - R \right]$$

which yields

$$p_{E}^{\max}(\gamma, R) = q \left( 1 - \sqrt{\frac{(\gamma - R\Omega)}{2\gamma}} \right) \Omega \right) \right)$$

Observe that $p_{E}^{\max}(\gamma, R)$ is decreasing in $\gamma$ and increasing in $R$, because CL is more attractive to the South the greater is the quality of the imitated product and the lower is the
royalty rate under CL. Thus, when CL is an available option, the patent-holder and the South negotiate over prices that lie in the interval \( [p_E^{\text{min}}(\varphi + \Omega R), \min\{p_E^{\text{max}}(\gamma, R), p^m\}] \).

We begin with the case where the patent holder has all of the bargaining power. It is clear that the patent-holder will make a take-it-or-leave-it offer of \( \min\{p_E^{\text{max}}(\gamma, R), p^m\} \). The South is willing to accept the patent-holder’s optimal price (i.e. \( p_E^{\text{max}}(\gamma, R) \geq p^m \)) iff \( \gamma \leq \gamma_{CL}^S = \theta \gamma^S \) where \( \theta > 1 \). When \( \gamma > \gamma_{CL}^S \), the patent-holder has to offer \( p_E^{\text{max}} \) (which is lower than \( p^m \)) for the South to prefer entry to CL since the quality of production under CL is fairly high and the South is better off waiting to issue a compulsory license rather than paying the price \( p^m \) to induce entry. When \( \gamma > \gamma_{CL}^S \), the patent-holder’s payoff from entry at the price \( p_E^{\text{max}}(\gamma, R) \) is given by

\[
v_E(p_E^{\text{max}}(\gamma, R)) = (1 + \Omega)\pi(p_E^{\text{max}}(\gamma, R))
\]

Of course, since \( \pi(p_E^{\text{max}}(\gamma, R)) \leq \pi^m \) we have \( v_E(p_E^{\text{max}}(\gamma, R)) \leq v_E(p^m) \).

The patent-holder is willing to offer the price \( p_E^{\text{max}}(\gamma, R) \) iff it yields a higher payoff than CL, i.e.,

\[
v_E(p_E^{\text{max}}(\gamma, R)) - \varphi \geq \Omega R \Leftrightarrow \varphi \leq \varphi_m^B(\gamma, R) = v_E(p_E^{\text{max}}(\gamma, R)) - \Omega R \quad (20)
\]

Since \( p_E^{\text{max}}(\gamma, R) \) is decreasing in \( \gamma \), for all \( p_E^{\text{max}}(\gamma, R) \leq p^m \) it must be that \( v_E(p_E^{\text{max}}(\gamma, R)) \) and therefore \( \varphi_m^B(\gamma, R) \) decreases in \( \gamma \). Note also that at \( \gamma = \gamma_{CL}^S \), we have \( \varphi_m(\gamma, R) = \varphi_E(R) \). Figure 7 illustrates the equilibrium outcome given that the South implements patent protection.

[Figure 7 here]

In Figure 7, to the left of the vertical line at \( \gamma_{CL}^S \), the patent-holder sells at \( p^m \) if \( \varphi \leq \varphi_E(R) \) whereas it waits for CL otherwise. To the right of \( \gamma_{CL}^S \), CL arises everywhere above the downward sloping curve \( \varphi_m^B(\gamma, R) \) whereas the patent-holder sells at the price \( p_E^{\text{max}} \) below it. Thus, when price negotiations are incorporated, for \( \gamma > \gamma_{CL}^S \) and \( \varphi \leq \varphi_m^B(\gamma, R) \) the price under entry declines. For \( \gamma > \gamma_{CL}^S \) and \( \varphi > \min\{\varphi(E(R), \varphi_m^B(\gamma, R))\} \), price negotiations cause CL to replace entry. For all other parameters, the market outcome remains unchanged. We can now state:

**Proposition 8:** Suppose that the South offers patent protection, CL is an available option, and all the bargaining power during price negotiations lies with the patent-holder. Then, equilibrium outcomes are as follows: (i) for \( \gamma \leq \gamma_{CL}^S \) and \( \varphi \leq \varphi_E(R) \) the patent-holder sells at its optimal monopoly price \( p^m \); (ii) for \( \gamma > \gamma_{CL}^S \) and \( \varphi \leq \varphi_m^B(\gamma, R) \)
the patent-holder sells at price $p_{E}^{\text{max}}(\gamma, R)$ where $p_{E}^{\text{max}}(\gamma, R) < p^{m}$; and (iii) for $\varphi > \min\{\varphi_{m}(\gamma, R), \varphi_{E}(R)\}$ the patent-holder stays out of the South and CL occurs.

A comparison of Propositions 6 and 8 (and Figures 5 and 7) provides three important insights. When the quality of imitation and the costs of entry are both quite low ($\gamma \leq \gamma_{L}^{S}$ and $\varphi \leq \varphi_{E}(R)$), price negotiations do not affect the equilibrium outcome and therefore the welfare of either party. But if the quality of imitation is not too low and the cost of entry is of intermediate magnitude, the patent-holder is forced to lower its price from $p^{m}$ to $p_{E}^{\text{max}}(\gamma, R)$. This price reduction under entry benefits the South at the expense of the patent-holder while also increasing total welfare. Third, price negotiations expand the parameter range over which CL occurs: in particular, for $\varphi \in [\varphi_{m}(\gamma, R), \varphi_{E}(R)]$, in the absence of price negotiations the patent-holder sells at its optimal monopoly price $p^{m}$ whereas the South would rather have CL but is unable to implement it since the patent-holder preempts it.

It is noteworthy that for $\varphi \in [\varphi_{m}(\gamma, R), \varphi_{E}(R)]$ even though the bargaining power lies entirely in the hands of the patent-holder, price negotiations benefit the South by making it possible for it to refuse a price offer that drives its welfare below that under CL. The effect of this change in the market outcome on joint welfare is ambiguous: CL yields a lower price relative to entry but also lowers quality while delaying the introduction of the product to the South.

We are now in a position to consider how the availability of CL affects incentives for patent protection when the bargaining power during price negotiations lies entirely in the hands of the patent-holder. Price negotiations lower the price at which the product is available under entry while also ensuring that the patent-holder cannot preempt CL since the terms of its entry become subject to the approval of the South. Exactly for the same reasons, the attractiveness of entry relative to CL decreases in the eyes of the patent-holder since its payoff under CL (i.e. $\Omega R$) is unaffected by price negotiations. As a result, the patent-holder is more willing to stay out of the South and wait for CL. Note, however, that price negotiations do not affect Southern welfare under CL and therefore CL continues to be dominated by imitation from the perspective of the South. Furthermore, Southern welfare under entry at price $p_{E}^{\text{max}}(\gamma, R)$ equals that under CL. As a result, the South’s equilibrium patent policy is not affected by price negotiations (i.e. is the same as that given in Proposition 3) when the patent-holder has all the bargaining power.

We now briefly discuss the case where the South has all of the bargaining power. Here, for $\varphi \leq \varphi_{E}(R)$ the South can induce entry by making a take-it-or-leave-it offer of $p_{E}^{\text{min}}(\varphi + \Omega R)$ to the patent-holder. Since the existence of the CL raises the price that the South must pay to the patent holder, the higher the royalty rate under CL the less
desirable is patent protection from the South’s perspective. The payoff to the South under patent protection is greater than that without if

$$\varphi + \Omega R \leq \varphi^B(\gamma)$$

This inequality binds at the critical value of the fixed cost below which the South implements patent protection to induce entry:

$$\varphi^B(\gamma, R) = \varphi^B(\gamma) - \frac{\Omega R}{1 + \Omega}$$

(21)

Observe that $$\varphi^B(\gamma, R) < \varphi^B(\gamma)$$ for all $$R > 0$$.

Thus, as illustrated in Figure 8, the availability of CL reduces South’s incentive for patent protection when it has all the bargaining power during price negotiations. Over regions C21 and C31, the South offers patent protection only when it does not have the option of CL. Thus, the basic message of Proposition 3 (i.e. the option to use CL weakens the South’s incentive for patent protection) continues to hold when the South can make a take-it-or-leave-it price offer to the patent-holder.

[Figure 8 here]

Finally, note that for $$\varphi < \varphi_I$$, the South’s decision not offer patent protection is unaffected by the possibility of CL because it has no effect on the bargaining problem.

6 Conclusion

TRIPS flexibilities such as compulsory licensing are intended to provide member countries of the WTO with a safety valve when domestic considerations make it imperative to opt out of TRIPS obligations. While CL predates TRIPS, developing countries had little use for it when they were free to deny patent protection to foreign firms. During the pre-TRIPS era, imitation and reverse-engineering allowed developing countries with adequate technological capability to obtain cheap access to pharmaceuticals that were patented in the rest of the world. Even those developing countries that lacked the ability to produce pharmaceuticals domestically were able to import them from countries such as India and China. But with the ratification of TRIPS, developing countries have come under increasing pressure to offer and enforce patent protection at a level that is on par with the Western world. As a result, during the post-TRIPS era CL has the potential to become an important policy tool using which developing countries can provide local
consumers access to patented pharmaceuticals at reasonable prices provided its use is not met with serious resistance from developed countries.

We construct a stylized model in which a developing country (South) chooses its patent protection policy taking into account the effect of its policy on the incentive of a patent-holder to sell in its market. As per TRIPS rules, we assume that the South has the option to issue a compulsory license to a local firm only if the patent-holder chooses not to work its patent locally. Our analysis provides several interesting insights. First, we find that the South has an incentive to offer patent protection if and only if it is necessary for inducing the patent-holder to serve its market and the quality of the imitated local product is sufficiently low. Second, from the Southern perspective, TRIPS consistent CL is a poor substitute for imitation: not only does it involve a waiting period (during which the patent-holder is given an opportunity to work its patent), it also requires royalties to be paid to the patent-holder. Third, from the perspective of joint welfare, the desirability of CL hinges very much on whether or not the South has the freedom to deny patent protection. When the South has such policy freedom, CL is essentially counter-productive: not only does it not arise in equilibrium, but the option to use it results in a Pareto inferior outcome. On the other hand, when the South has no choice but to offer patent protection (as is basically true today for all members of the WTO), CL plays a much more useful role: not only does it arise in equilibrium, it can even generate a Pareto improving outcome. This result argues in favor of Article 31 of TRIPS under which CL is sanctioned by the WTO.

We also extend the basic model to the case where the patent holder and the South bargain over the price. We show that patent protection becomes more likely when the South can negotiate a price below the optimal monopoly price. This effect arises in two ways. First, if the patent-holder would not enter in the absence of patent protection, the ability to obtain the higher quality product at a lower price makes entry more attractive to the South than relying on the low quality imitated product. Second, when the South makes a take-it-or-leave-it offer to the patent-holder, it has an incentive to offer patent protection even if the patent-holder is willing to enter without it. This is due to the fact that the price needed to induce entry is higher under imitation because competition from imitators reduces the patent-holder’s sales in the South. This adverse effect of imitation on the price required to induce entry dominates the benefit of making the low quality product available to local consumers. Finally, we also show that the ability to issue a compulsory license undermines the South’s incentive to offer patent protection when price is negotiated, just as it does in the absence of price negotiations.
7 Appendix

Here we show that for $\theta < \gamma_I$ the South chooses to offer patent protection.

Let $\theta < \gamma_I$. The South offers patent protection iff

$$s_E(p^\text{min}_E(\theta)) \geq s_I(p^\text{min}_I(\theta, \gamma))$$

which is the same as

$$\int_{\frac{\theta}{p^\text{min}_E(\theta)/q}}^{1} [q\theta - p^\text{min}_E(\theta)]d\theta \geq \int_{0}^{\frac{\theta}{p^\text{min}_I(\theta, \gamma)}} [q\theta - p^\text{min}_I(\theta, \gamma)]d\theta$$

where $\frac{\theta}{p^\text{min}_I(\theta, \gamma)}$ is rewritten as

$$\frac{\gamma}{(1 - \gamma)^2} + q \left(1 - \frac{\theta}{p^\text{min}_I(\theta, \gamma)}\right)[q - 2p_I + q \theta^\text{min}_I(\theta, \gamma)]$$

Substituting for $\frac{\theta}{p^\text{min}_I(\theta, \gamma)}$, $p^\text{min}_E(\theta)$, and $p^\text{min}_I(\theta, \gamma)$ and simplifying allows us to rewrite this inequality as

$$\left(q - \frac{2\theta}{1 + \Omega}\right)^2 \geq q \left(q - \frac{4\theta}{1 + \Omega}\right)$$

which always holds.

References


Figure 1: Equilibrium w/o CL

Region $A$: $(I, E)$
Region $B$: $(P, E)$
Region $C$: $(I, N)$
Region $D$: $(I, N)$
Region A: (I, E)*
Region B: (P, E)*
Region C1: (I, N) but (P, E)*
Region C2: (I, N)*
Region D: (I, N)*

Figure 2: Efficiency of equilibrium
Figure 3: How the possibility of CL changes equilibrium
Figure 4: How TRIPS affects equilibrium and welfare

Region $A_1$: CL replaces $(I, E)^*$
Region $A_2$: $(P, E)$ replaces $(I, E)^*$
Regions $B_1+C_3+D$: CL replaces $(I, N)^*$
Region $B_2$: still $(P, E)^*$
Region $C_{11}+C_2$: $(P, E)$ replaces $(I, N)$

$\Delta W$ due to TRIPS: (+) only over $C_{11}$
Figure 5: How CL affects both parties (South listed second)
Figure 6: Equilibrium with price bargaining and w/o CL.
Figure 7: Effects of price negotiations (South listed second)
Figure 8: Equilibrium with price bargaining and CL