Activating Actavis: A More Complete Story

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Technical Appendix: Extensions to the EHHS Model

Brand’s Incentive to Settle

EHHS develop a simple model to examine the incentive for the patent holder (Brand) to settle with an entrant (Generic).

In their model, they assume that: (i) the remaining patent lifetime is $T$ periods; (ii) the Brand places a probability $P$ on winning the patent litigation (i.e., that the patent is found valid and infringed); (iii) if the Brand wins the litigation, its profits are $M$ per period; (iv) if the Brand loses the litigation, then there will be Generic entry and profits to the Brand are $D_B$ per period ($D_B < M$); (v) the Brand’s litigation costs are $C_B$; (vi) the Brand is risk-neutral; and (vii) any patent litigation is instantaneous.

A settlement between the Brand and the Generic involves two parameters: $E$, the number of periods until Generic entry occurs, and possibly $X$, a payment from Brand to Generic.

The Brand’s payoff from settling on terms [$E, X$] is

$$EM + (T - E)D_B - X$$

and the Brand’s expected payoff from litigation is

$$PTM + (1 - P)TD_B - C_B$$

It is in the Brand’s interest to settle if (1) $\geq$ (2). Simplifying, EHHS write the Brand’s reservation entry date, $E_B$, as

$$E_B = PT + \frac{X - C_B}{M - D_B}$$

Here $PT$ is the Brand’s expected amount of time before Generic entry if the patent is litigated. Using (3), EHHS argue that anytime $X$ exceeds $C_B$ it must be the case that the Brand’s reservation entry date, $E_B$, is later than the expected entry date, $PT$.

There are other factors, however, that can affect the Brand’s settlement decision but are not captured by the EHHS model. For example, the patent holder may not be risk-neutral, but may be risk-averse. Risk aversion implies the Brand’s certainty equivalent of going to court will be below the expected value of litigation by some insurance premium. We assume that the insurance premium is proportional to the extra
profits the Brand earns under the patent.\(^1\) That is, the insurance premium equals \(R_B T(M - D_B)\), where \(R_B\) is the Brand’s risk factor.

With this modification to the EHHS model, the Brand’s payoff from settling on terms \([E, X]\) is still shown by (1) but the Brand’s risk-adjusted expected payoff from litigation is now

\[
PTM + (1 - P)TD_B - C_B - R_B T(M - D_B)
\]

Now, it is in the Brand’s interest to settle if (1) \(\geq\) (4). Simplifying, the Brand’s reservation entry date can be written as

\[
E_B = PT - R_B T + \frac{X - C_B}{M - D_B}
\]

Hence, simply by extending the EHHS model to account for risk it is possible to have a settlement with a payment, \(X\), that exceeds the direct costs of litigation, \(C_B\), and still have an entry date that is earlier than \(PT\), which is the expected entry date under litigation. In particular, the Brand can make a payment of \(X\) and accept an entry date earlier than \(PT\) if

\[
X < C_B + R_B T(M - D_B)
\]

That is, if the payment is less than the sum of the Brand’s direct litigation costs plus the Brand’s risk insurance premium.

**Generic’s Incentive to Settle**

Any settlement of the patent litigation involves not only the Brand but also the Generic. To understand why a settlement may require some payment, it is necessary to go beyond just examining the Brand’s incentive to settle and also consider the Generic’s incentive to settle, since the settlement must be satisfactory to both parties.

The Generic assigns a probability \(Q\) to winning the patent litigation (i.e., that the patent is either found invalid or not infringed). There is no assumption that \(Q = (1 - P)\). If the Generic wins the litigation, then it enters and its profits are \(D_G\) per period.

The Generic may not be risk-neutral, but may be risk-seeking. More specifically, the certainty equivalent of going to court may be above the expected value of litigation by some premium. We assume that the premium is proportional to the profits the Generic earns if it wins the litigation. That is, we assume the premium equals \(R_G T D_G\), where \(R_G\) is the Generic’s risk factor.

The Generic’s payoff from settling on terms \([E, X]\) is

\(^1\) The assumption that the insurance premium is proportional to the extra profits earned under the patent is made for expositional ease. This need not be the case, and the same result would hold qualitatively even if the insurance premium were treated as some dollar amount unrelated to the outcome of the litigation or as proportional to the variance of the risk. See Willig & Bigelow, supra note 11, at 682–83.
and the Generic’s risk-adjusted expected payoff from litigation is

\[ (7) \quad (T - E)D_G + X \]

It is in the Generic’s interest to settle if \((7) \geq (8)\). Simplifying, the Generic’s reservation entry date, \(E_G\), can be written as

\[ (8) \quad QTD_G - C_G + R_G TD_G \]

\[ (9) \quad E_G = (1 - Q)T - R_G T + \frac{X + C_G}{D_G} \]

Note that increases in the reverse payment or the costs of litigation result in a later reservation entry date. The Generic’s reservation entry date is earlier as its risk seeking increases.

**Settlement Conditions**

For the Brand and the Generic to reach a settlement, it is necessary that there be a value of \(E\) that is both earlier than \(E_G\) and later than \(E_B\). Hence it must be the case that \((5) \leq (9)\). To see what these conditions imply, first consider these conditions while ignoring litigation costs, any settlement payment, and any risk adjustment (i.e., assuming that \(X, C_B, C_G, R_B, \) and \(R_G\) all equal 0). With these assumptions, the Brand’s reservation settlement date is \(E_B = PT\) and the Generic’s reservation settlement date is \(E_G = (1 - Q)T\). Hence, a settlement can only be reached if \((1 - Q) \geq P\).

Accounting for litigation costs, but still assuming no possibility of payment and ignoring risk, settlement can only occur if \((1 - Q) \geq P\) or if the parties’ expectations regarding the outcome of the litigation are sufficiently close. In the latter case, it requires that

\[ (10) \quad Q < (1 - P) + \frac{C_G}{TD_G} + \frac{C_B}{T(M - D_B)} \]

That is, the probability the generic assigns to its winning the patent lawsuit must be lower than the probability the Brand assigns to its losing the patent lawsuit, adjusted for savings of litigation costs. If either or both parties are overly optimistic, such that

\[ (11) \quad P + Q - 1 > \frac{C_G}{TD_G} + \frac{C_B}{T(M - D_B)} \]

then no settlement is possible based solely on a settlement date. Since each party’s direct litigation cost is likely to be small relative to its gain from winning the litigation, there does not need to be a large gap between the two parties’ expectations regarding the outcome of litigation for there to be no possible settlement based solely on an entry date.

Accounting for risk, settlement based strictly on an entry date is not possible if

\[ (12) \quad P + Q - 1 - R_B + R_G > \frac{C_G}{TD_G} + \frac{C_B}{T(M - D_B)} \]
Equation (12) indicates that settlement based strictly on an entry date is less likely (i) the greater each parties’ assumed probability of winning, (ii) the lower the Brand’s risk aversion, (iii) the greater the Generic’s risk seeking, and (iv) the lower the costs of litigation relative to the gain from winning the litigation.

However, a settlement may be possible with a payment. Simultaneously considering the two equations that identify the Brand’s and the Generic’s reservation settlement dates (i.e., equations (5) and (9)) shows whether there are settlement solutions. The solution may result in a payment from the Brand to the Generic that exceeds the Brand’s litigation costs but still allows for entry earlier than \(PT\), the entry date expected by the Brand under litigation.

To see this, we simplify the calculation of the settlement solution by assuming that litigation costs are zero (i.e., that \(C_B\) and \(C_G\) both are zero). Under this assumption, the settlement solution \([E_S, X_S]\) obtained by solving equations (5) and (9) simultaneously is given by\(^2\)

\[
X_S = T \left[ \frac{(M - D_B)D_G}{M - D_B - D_G} (P + Q - 1 - R_B + R_G) \right]
\]

and

\[
E_S = T \frac{(P - R_B)(M - D_B) - ((1 - Q) - R_G)D_G}{M - D_B - D_G}
\]

Note that \(X_S\) is positive and exceeds the Brand’s litigation costs. The term in the square brackets in (13) is positive because the Brand’s profits before Generic entry exceed the sum of the Brand’s and Generic’s profits following entry (i.e., \(M - D_B - D_G\) is positive). The term in the parentheses in (13) is also positive, provided no settlement based solely on an entry date is possible, because, from (12) and the given assumptions, it must be the case that

\[
P + Q - 1 - R_B + R_G > 0
\]

Also, \(X_S\) exceeds the Brand’s litigation costs, \(C_B\), because litigation costs are assumed to be zero.

The settlement entry date shown in (14) will be earlier than the entry date expected by the Brand under litigation, \(PT\), if

\[
P + Q - 1 - R_B + R_G < R_B \left( \frac{M - D_B - D_G}{D_G} \right)
\]

\(^2\) Note that the solution \([E_S, X_S]\) represents the earliest entry date and lowest payment that satisfy conditions (5) and (9). Other settlement values are possible which may also satisfy both \(X > C_B\) and \(E < PT\).