

# Board Work for Lecture 18: Hold Up

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## 1 Hold Up

We solve via backwards induction. Suppose NLC has started LOTR (paid fixed cost  $c$ ) and EW has proposed a wage  $w$ . NLC accepts and pays  $w$  if profit from accepting exceeds the outside option:

$$\pi(\text{accept}) \geq \pi(\text{reject}) \leftrightarrow b - w - c \geq -c \leftrightarrow b \geq w$$

Knowing this, EW “holds up” NLC: he proposes a wage which extracts all box office revenue:  $w = b$ . Any higher wage means NLC rejects. Any lower wage is leaving money on the table.

Then, NLC decides whether to start LOTR. They evaluate the profit of doing so against the outside option:

$$\pi(\text{start}) \geq \pi(\text{not}) \leftrightarrow b - w - c \geq 0$$

Remember that  $w = b$ , therefore it is never profitable to film LOTR (the following inequality does not hold)

$$b - w - c \geq 0 \leftrightarrow -c \geq 0$$

Thus LOTR never is made, even when box office revenues  $b$  are extremely large.

## 2 Hold Up: Back-to-Back Filming

We model back-to-back filming as EW proposing a wage beforehand. By accepting the wage offer, NLC agrees to start LOTR. So the fixed cost occurs after the wage is set. We solve via backwards induction. NLC accepts a wage offer if the profit of doing so exceeds the outside option:

$$\pi(\text{start}) \geq \pi(\text{not}) \leftrightarrow b - w - c \geq 0$$

Knowing this, EW proposes the highest wage NLC will accept, which is box office revenue less the fixed cost of production:

$$w = b - c$$

This is true as long as  $b - c \geq \bar{u}$ . If  $b - c < \bar{u}$  there is no wage that EW can propose that is acceptable to both parties, so EW will propose any high wage  $w > b - c$ , NLC will reject, and both get their outside options.

When is LOTR made? First, box office revenues less the fixed cost must be positive:  $b - c \geq 0$ . Once this is true, NLC agrees to the wage EW proposes. Second,  $b - c$  must be at least EW's outside option:  $\bar{u}$ . Otherwise, there does not exist a wage that both NLC and EW will accept. Putting this together, LOTR is made whenever  $b - c - \bar{u} \geq 0$ . This is exactly when it is efficient to make LOTR: when real benefits are greater than real costs, and total surplus is maximized.