

Investment in Biosecurity with Spillover Effects: a real options approach

Abstract

The increase in prevalence of infectious diseases affecting plants and the importance and magnitude of monetary damages from infection suggests a strong incentive for control measures which reduce the likelihood of transmission. However, control is costly and generates positive spillover effects: it reduces the likelihood of infection not only for one particular area or firm but potentially also for neighbouring areas or firms. If the firms are distinct or more generally decision makers consider only internal costs and benefits, this gives rise to a second-mover advantage problem: Control by firm A benefits firm B by reducing B's expected loss from infection. However this reduces firm B's incentives to implement their own costly control. The delay in B's infection control in turn reduces the initial firm (A)'s incentives to control as first mover.

We initially consider how these spillover effects alter investment incentives in the absence of competitive interactions, i.e. when it is optimal for a single decision-maker to implement biosecurity controls on each of a number of distinct sites. We investigate the trade-off between sequential and simultaneous control in a simple case of two sites where biosecurity measures not only have different costs but also produce different levels of risk reduction (measured by changes in the exponential hazard rate of infection) and, as in Kort, Murto and Pawlina (2010), find the flexibility advantage of sequential control means there needs to be a cost advantage to simultaneous control to make simultaneous control worthwhile. In this case the decision-maker internalises the spillover benefits of biosecurity measures from one site to the other.

We next consider the case where decision making over biosecurity is on a site-by-site basis (for example, where sites are owned by competing enterprises), so positive spillovers are ignored. This delays initial control and reduces value for both firms/sites (relative to the combined decision-making case). In future work we plan to investigate incentives for negotiated simultaneous control and the impact of transfers between the two parties.