Summary

This thesis presents research on the dynamics and control of porcine reproductive and respiratory syndrome (PRRS) caused by the PRRS virus (PRRSV) in the pig population of Great Britain (GB). The roles of the metapopulation of pig herds (metaherd) and individual herd characteristics are examined, and different control and intervention strategies assessed.

A novel stochastic model of a metaherd was created, incorporating the births, deaths, slaughter, culls and movement of pigs within and between herds. The metaherd was structured to have characteristics representative of the GB metaherd: the distribution of herd sizes, 'source' herds per herd, and numbers of pigs moved per movement. The metaherd was arranged into a typical pyramidal structure. A stochastic infectious process of PRRSV was included. Herd size was found to be key to within herd persistence of PRRSV, with infection failing to persist in smaller (~250 sow) herds. Fadeout did not occur in larger herds once infection established in the rearing herd.

PRRSV reduces productivity of herds and the metaherd. There was variability in productivity both between herds and within herds over time. The number of source herds did not influence the dynamics, persistence or prevalence of infection within a herd. Breeding herd production was further decreased by PRRSV when the herd also had a rearing herd (breeder finisher).
The model was extended to test the effects of control and intervention strategies. Vaccination effect increased with herd size, and reduced variability in production. Vaccination in small herds was ineffective in increasing production due to PRRSV failing to persist regardless of vaccination. Vaccination of the breeding herd produced higher gains per vaccine dose than vaccination of the rearing herd only. Vaccination of the rearing herd only resulted in higher total herd and metaherd gains, with less variability. Partial de-population combined with vaccination increased the probability of increasing herd performance unless the herd was small (<100 sows) or very large (>1000 sows).

Results highlighted the value of modelling to support the decisions of individual farmers to vaccinate and partially depopulate, showing that the optimal decision is influenced by the herd size. Results also demonstrated that the decision to introduce interventions is different for individual farmers.