

1 The mechanisms underlying the spread of disease and bank notes

The similarities between the geographical spread of infectious diseases and of bank notes are illustrated in Fig. 1.1. Humans possess home ranges, which can be operationally defined as a geographical patch in which a person resides most of the time. Humans interact and pass a disease by virtue of overlapping home ranges or travelling to a home range belonging to someone else. The temporal succession of steps involved in an idealized model for the spread of disease are the following. An infected person (red) visits a susceptible individual (blue) and transmits the disease. Subsequently the initially infectious person returns to his or her home range (forward geographical transport A in Fig. 1.1). Alternatively a susceptible person (purple) can visit an infected one and take home the disease (backward geographical transport). Money is transported along the same pathways as indicated in the figure. The symmetry of the system suggests that both pathways possess identical probability density functions for the distance traveled.

On small length scales (the size of a few patches in the model) and temporal scales (a small number of transmissions) the characteristics of disease transport on one hand and bank note transport on the other may differ. The limiting theorems of random walks (see supplementary information on Lévy flights and continuous time random walks), however, suggest that on large spatio-temporal scales the distribution of travelling distances of both disease and bank notes share universal characteristics which determine the geographical spread.

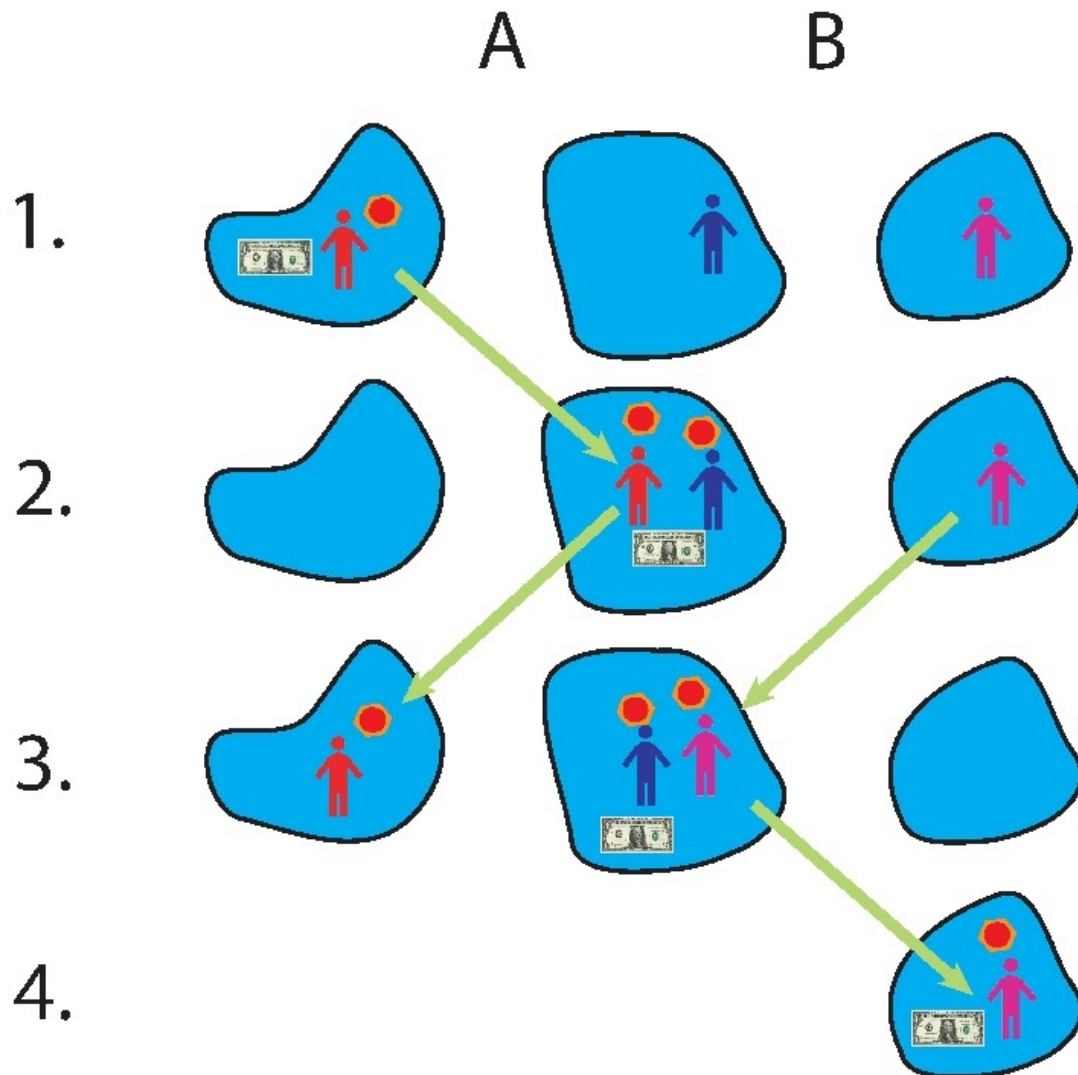


Figure 1.1: Qualitative mechanisms of the geographical spread of disease and bank notes. The numbers on the left indicate the temporal succession of steps involved. The blue areas indicate home ranges of three individuals. The spread can occur along pathways A and B. In A an infected individual leaves his or her home range and visits a susceptible person (blue) which is subsequently infected. The initially infectious person returns home. A third susceptible person (purple) visits the newly infected person (blue), is infected and returns with the disease (pathway B). As indicated, bank notes travel in a qualitatively similar fashion.