Excerpts from J.E. Meade (1952) and Steven N.S. Cheung (1973) on externalities between apple growers and bee keepers.

J.E. Meade, 1952. External economies and diseconomies in a competitive situation. *The Economic Journal*, Vol. 62, No. 245, 54-67.

Suppose that in a given region there is a certain amount of apple-growing and a certain amount of bee-keeping and that the bees feed on the apple-blossom. If the apple-farmers apply 10% more labour, land and capital to apple-farming they will increase the output of apples by 10%; but they will also provide more food for the bees. On the other hand, the bee-keepers will not increase the output of honey by 10% by increasing the amount of land, labour and capital applied to bee-keeping by 10% unless at the same time the apple-farmers also increase their output and so the food of the bees by 10%. Thus there are constant returns to scale for both industries taken together: if the amount of labour and of capital employed both in apple-farming and bee-keeping are doubled, the output of both apples and honey will be doubled. But if the amount of labour and capital are doubled in bee-keeping alone, the output of honey will be less than doubled; whereas, if the amounts of labour and capital in apple-farming are doubled, the output of apples will be doubled and, in addition, some contribution will be made to the output of honey.

We call this a case of an unpaid factor, because the situation is due simply and solely to the fact that the apple-farmer cannot charge the bee-keeper for the bees' food, which the former produces for the latter. If social-accounting institutions were such that this charge could be made, then every factor would, as in other competitive situations, earn the value of its marginal social net product. But as it is, the apple-farmer provides to the bee-keeper some of his factors free of charge. The apple-farmer is paid less than the value of his marginal social net product, and the bee-keeper receives more than the value of his marginal social net product (pp. 56-57).

… in order to pay every factor a reward equal to the value of its marginal social net product some factors must be taxed and others subsidized (p.67).

Steven N.S. Cheung, 1973. The fable of the bees: an economic investigation. *The Journal of Law & Economics*, Vol 16, No 1, 11-33.

It is easy to understand why the "apples and bees" example has enjoyed widespread popularity. It has freshness and charm: the pastoral scene, with its elfin image of bees collecting nectar from apple blossoms, has captured the imagination of economists and students alike. However, the universal credence given to the lighthearted fable is surprising; for in the United States, at least, contractual arrangements between farmers and beekeepers have long been routine. This paper investigates the pricing and contractual arrangements of the beekeeping industry in the state of Washington, the location having selected because the Pacific Northwest is one of the largest apple-growing areas in the world. Contrary to what most of us have thought, apple blossoms yield little or no honey. But it is true that bees provide valuable pollination services for apples and other plants, and that many other plants do yield lucrative honey crops. In any event, it will be shown that the observed pricing and contractual arrangements governing nectar and pollination services are consistent with efficient allocation of resources (pp. 12-13).