

CHAPTER 5

Conclusion

As noted by Alston and Pardey (2001), attribution problems abound in the assessment of agricultural R&D. Although it seems clear that many studies of agricultural research benefits have not paid enough attention to attribution problems, the nature and importance of the consequences for biases in estimation and interpretation of the evidence is less clear. In this study we have emphasized the role of three types of attribution challenges in the context of an ex post evaluation of the returns to public varietal improvement research investments undertaken by Embrapa, in Brazil: (1) attribution among institutions that operate independently, taking account of spillovers of technologies both within and among countries; (2) attribution among institutes that collaborate in research, both within and among countries; and (3) attribution within an institution, taking account of the allocation of overhead costs both within centers and between centers and head office.

In the case of Embrapa's varietal improvement research, all of these elements of attribution played significant roles, varying in importance from one crop to another. If we had ignored these attribution issues, as many studies have done, and had given Embrapa credit for all of the benefits from improvement in Brazil's varieties of soybeans, edible beans, and upland rice over the past 30 years, we would have grossly overestimated the benefit–cost ratio for Embrapa's work. Even after we have taken account of the international and intranational institutional spillovers of research results, which are especially important for soybeans, the rate of return to Embrapa's research remains high, particularly for soybeans.

This study has revealed the importance of taking greater care in the attribution of benefits and costs of research in a context in which the attribution problems are made more transparent through the availability of information on the genetic history of crop varieties—information on which institution released a particular variety and its parents. Nevertheless, implementation of the methods used in this study requires a great deal of information on the experimental and commercial performance and adoption rates of individual varieties, and such information is often not readily available. In many cases the results from experimental trials are not kept in an appropriate form, if they are kept at all for the longer time periods required for this kind of work, and information on adoption is often sketchy at best. Even with good information on genetic histories, performance, and adoption patterns, we are obliged to use arbitrary but nonetheless transparent procedures to apportion credit among institutions. Other types of (non-varietal) technologies may pose different, and in some senses even greater, challenges both in terms of conceptualizing how to address them and in obtaining data; especially, perhaps, privately produced technologies. However, if our results are any guide it will be important to give greater attention to attribution issues in studies of research benefits of all types.

Any evaluation of research benefits, or for that matter any benefit–cost analysis, involves a host of implicit or explicit decisions about models, data, procedures, and so on—decisions

that may have major or minor consequences for the results and their interpretation. Many of these decisions are arbitrary, and often they are left implicit. In this report we have focused on the issue of the attribution of research benefits among multiple sources. In addressing that question, as well as the measurement of the total benefits, we have attempted to make our key analytical and measurement choices transparent and explicitly clear. We have provided a detailed report of the complicated journey one must travel and the arbitrary choices one must make in producing estimates of returns to research, even when unusually detailed data and information are available. By reporting all of these details, and examining the consequences of alternative choices in those cases where there is little or no empirical basis for a particular choice, we hope to have added to the value of our estimates, in terms of a greater understanding of where they come from and what they mean. In addition, we hope this study may serve as a guide for future research evaluations, and as a set of cautions to be kept in mind when interpreting the work from other studies.

The payoffs to past investments made in Embrapa's upland rice, edible bean, and

soybean improvement research have been substantial, even after careful accounting of the contributions made by other agencies in Brazil and the spillin of new crop varieties from agencies elsewhere in the world. This ex post benefit–cost analysis provides some support for strategic decisions about the total budget for crop improvement research in Embrapa, suggesting it should be greater, and its allocation, suggesting that, everything else equal, a higher share should be allocated to the comparatively much higher payoff, soybean program. However, the benefit–cost ratios cannot be used directly to answer the related questions concerning how much additional funding in total and how best to allocate that funding among programs of research. To do this would require ex ante (forward looking) estimates of the likely benefits from such investments, as distinct from the ex post evidence developed for this study, and a measure of the sensitivity of the benefits to marginal changes in funding, as distinct from the average type of evidence implicit in the benefit–cost ratios reported here, which are more helpful in decisions on whether or not to continue with a program of research.