JOURNAL ARTICLE

R&D Spending, Knowledge Capital, and Agricultural Productivity Growth: A Bayesian Approach

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Abstract

In this article, we employ Bayesian hierarchical modeling to better capture and communicate the uncertainties surrounding the transformation of U.S. public agricultural research and development (R&D) expenditures to knowledge capital stocks as well as its contribution to the historic growth of U.S. agricultural total factor productivity. Compared to studies based on classical statistics, analytical methods grounded in Bayesian inference explicitly incorporate existing information and permit revision of our knowledge regarding the distribution of the unknown model parameters as additional information becomes available. Bayesian hierarchical modeling is particularly useful in statistically estimating the underlying parameters of the R&D lag weight structure, as well as the R&D knowledge stocks given observed data on agricultural productivity and R&D expenditures. Our results show a significant level of uncertainty on the R&D lag weight structure, indicating that published assumptions about the R&D lag structure can now be tested and validated against available data. Estimating the R&D lag weights and knowledge stocks also make a large difference in the uncertainties surrounding economic returns from R&D investments. Indeed, our results show that the best-fit linear model yields slightly higher mean returns to R&D spending relative to the log model results and have significantly less uncertainty. This suggests that marginal returns to U.S. public agricultural research spending might have remained relatively constant despite a century of growth in expenditure. Furthermore, we find that such investments could take a longer time to bear fruit than previously realized.

JEL: C11 - Bayesian Analysis: General, C52 - Model Evaluation, Validation, and Selection, Q16 - R&D; Agricultural Technology; Biofuels; Agricultural Extension Services, Q18 - Agricultural Policy; Food Policy

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