Pakes and Griliches[27], dealing with firms operating in U.S. manufacturing, also estimate a positive significant relationship between patents and R&D expenditures. There is a positive correlation between patents and R&D expenditures, but it is imperfect, as some innovations go unpatented. In Canada, McFetridge, using the Mansfield framework, found a significant positive relationship between patents and R&D expenditures and a negative relationship between patents and sales for the electrical, chemical, and machinery industries.[28]

The value of a patent declines if its exclusivity is eroded and it becomes obsolete by subsequent advance in knowledge. Pakes and Schankerman[29] used European data and found that the obsolescence rate of patents was on the order of 25 percent per year. R&D on durable goods in their sample data became virtually obsolete in 10 years on average and on nondurables in 8.5 years. The estimates of private return on R&D varied between 8 and 17 percent in their sample. If the normal (net) rate of return to physical capital is taken from Griliches[30] to be 8 percent, then Pakes and Schankerman estimates imply risk premiums for investment in research between zero and 9 percent. In view of the abnormal riskiness associated with research expenditures, these risk premiums appear modest. Thus, the carrot bait of high return on R&D turns out not to be as juicy as it may appear on the first bite.

---

[27] A. Pakes and Z. Griliches, "Patents and R&D at the Firm Level: A First Look". In *R&D, Patents and Productivity*, edited by Z. Griliches. Chicago: University of Chicago Press, 1984.

[28] Donald M. McFetridge, *Government Support of Scientific Research and Development: An Economic Analysis*. Toronto: Ontario Economic Council, 1977.

[29] Ariel Pakes and Mark Schankerman, "The Rate of Obsolescence of Patents, Research Gestation Lags, and the Private Rate of Return to Research Resources". In *R&D, Patents and Productivity*, edited by Z. Griliches. Chicago: University of Chicago Press, 1984: 73-88.

[30] Zvi Griliches, "Returns to Research and Development in the Private Sector". In *New Developments in Productivity Measurement and Analysis*, ed. J.W. Kendrick and B.N. Vaccara. Chicago: National Bureau of Economic Research, 1980.