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An early contribution of Martin Faustmann to natural resource economics

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Abstract

Martin Faustmann has been credited with discovery of the 'Faustmann formula', but in this paper we show that similar principles of capital valuation were expounded somewhat earlier. A recently discovered article, published in August 1849 under nom de plume F., is a landmark in the capital valuation of forests and other renewable natural resources, as it appears to contain the first comprehensive and explicit description of the valuation principles in accord with modern capital and investment theory. In contrast to Faustmann's subsequent classical paper, this article also shows how the optimal cutting age of standing timber can be determined analytically and demonstrates how the valuation method adopted can be used to solve several other key questions concerning efficient forest management and land use.

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Introduction

The development of economic thought related to optimal use of forest resources has attracted increasing interest in the forest economics literature in the last few

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years (Löfgren, 1983, 1995; Löfgren and Mattsson, 1995; Scorgie, 1996; Scorgie and Kennedy, 1996; Helles and Linddal, 1997). An important motivation has been the discovery that already in the early 1800s agriculturalists and foresters had made fundamental contributions to capital theory and optimal use of renewable natural resources. An additional factor has been that many controversial issues related to contemporary forest management, such as the use or non-use of economics and mathematics in forest economics (Löfgren, 1990) and the friction between land rent theory and the forest rent approach (Möhring, 2001), have a strong historical background.

Previous studies on the development of forest economics have emphasized the contributions of Martin Faustmann, William Marshall and Max Robert Pressler. In his classical article, Faustmann (1849b) showed that the value of a forest can be expressed as a sum of discounted net cash flow over an infinite time horizon. The impact of this 'Faustmann formula' on the economics of renewable natural resources has been monumental for the last 150-plus years. The formula has numerous theoretical and empirical applications in the area of optimal forest management and efficient land use and hence also, e.g. in timber supply, land allocation, forest conservation, and carbon sequestration policies. Its status has been compared to Hotelling's rule in nonrenewable resource economics as a basis for normative and positive economic models of forest management (e.g. Hanley et al., 1997, p. 338).

Faustmann's contribution is underlined by the fact that several decades later some prominent economists made several attempts to clarify the theory of capital and value (e.g. Jevons, 1871; Menger, 1871; von Böhm-Bawerk, 1888; Wicksell, 1893). However, it was not until Irving Fisher's *The Nature of Capital and Income* (1906) that the capital valuation approach elaborated by Faustmann began to gain ground in general economics. In Fisher's words:

> The fundamental principle that applies here is that the value of capital at any instant is derived from the value of the future income which the capital is expected to yield. (p. 188)

Fisher made clear that he was not the originator of the idea. He pointed out that a similar capital valuation method was already being used in forestry:

> Other classical examples [of capital valuation] are wine, the value of which is present worth of what it will be when 'mellow' and ready for consumption; and young forests, which are worth the discounted value of the lumber they will ultimately form. *In Germany and some other countries*, *such appraisement of forests is now worked out with considerable precision*. (Fisher, 1906, p. 205, emphasis added)

Faustmann wrote his paper as a response to a teacher of forest mathematics, von Gehren (1849), who had proposed a method for determining the value of bare forest land. Although Gehren applied the correct valuation principle to bare land (discounted cash flow to infinity), he erred in using the geometric mean interest instead of compound interest and was inconsistent in taking immature forest stands at their immediate sale value (stumpage price times timber content). Faustmann