

# Schumpeter and the Micro-foundations of Endogenous Growth\*

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**ABSTRACT.** This chapter traces the idea that technological change is endogenous to microeconomic roots considerably earlier than those emphasized in the “new” macroeconomic theories of economic growth. Building upon contributions by Richard Nelson, Jacob Schmookler, F.M. Scherer, and Yoram Barzel, it presents a lean model of how incentives for technological innovation arise endogenously from the interplay of changes in knowledge and demand. Paradoxes attributable to monopoly, parallel but independent technical initiatives, uncertainty, and the divergence between social and private benefits are resolved. A simulation analysis explores the implications of skew stochastic payoff distributions for the optimal number of R&D approaches.

**Key words:** Endogenous technical change, innovation, Schumpeterian system, technology-push, demand-pull

**JEL Classification:** L10, O31

Beginning in the late 1980s, a “new” essentially macroeconomic theory of economic growth began to materialize. As characterized in a memoir by one of its founders (Romer, 1994), the new theory distinguished itself from neo-classical theories “by emphasizing that economic growth is an endogenous outcome of the economic system,” and not simply the result of superior technology descending like manna from heaven, to be exploited at will by one and all.

One premise of the new endogenous growth theory is that newly discovered knowledge spills over to facilitate technological innovations by the profit-seeking firms that invest in them and which, by securing patent protection on details of the innovations even if not on the facilitating

knowledge, earn what are hoped to be supra-normal profits from them. A curiosity of the new theory is that, despite placing so much emphasis on the facilitating role of knowledge as a basis for subsequent innovations, it largely ignores the vast stock of knowledge contributed over previous decades on technological innovation and its essentially endogenous character. It in effect purports to reinvent the endogenous innovation wheel. This, as an old curmudgeon who participated in laying the earlier theoretical foundations, I recognize, may come from ignorance of previous scholars’ contributions. But it ought to be taken into account by historians of thought attempting to survey the advance of economic theory during the 20th century. In this paper, I attempt at least in a limited way to set matters straight and to identify some of the persisting puzzles.

## 1. Schumpeter’s pioneering role

Proponents of “new” endogenous economic growth theories do acknowledge, typically in a cursory way, one predecessor: Schumpeter (1912).<sup>1</sup> From the time of his *Habilitationsschrift* (1912), Schumpeter argued correctly that innovation, and in particular technological innovation, is one of the main driving forces underlying economic growth. In the English translation of his classic Schumpeter (1934, p. 60), acknowledges his intellectual debt to Karl Marx and criticizes John Stuart Mill’s view that technological improvement “is something which just happens and the effects of which we have to investigate, while we have nothing say about its occurrence *per se*”. Thus, technological change does not occur exogenously, or as one of the “given” conditions in an economy. Rather, innovation is a profit-seeking activity carried out by business

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\* This article was written for, and is reprinted with permission from, Horst Hanusch and Andreas Pykas, eds., *The Elgar Companion on Neo-Schumpeterian Economics* (Cheltenham: Edward Elgar, 2005).

firms, and in particular, entrepreneurial business firms. In modern language, it is endogenous. In his later popularization Schumpeter (1942, p. 110) makes the point even more bluntly:

Was not the observed [economic growth] performance due to that stream of inventions that revolutionized the technique of production rather than to the businessman's hunt for profits? The answer is in the negative. The carrying into effect of these technological novelties was of the essence of that hunt. And even the inventing itself ... was a function of the capitalist process which is responsible for the mental habits that will produce invention. It is therefore quite wrong – and also quite un-Marxian – to say, as so many economists do, that capitalist enterprise was one, and technological progress a second, factor in the observed development of output; they were essentially one and the same thing or, as we may also put it, the former was the propelling force of the latter.

In other chapters of his 1942 book, Schumpeter advanced an additional set of hypotheses sharply at odds with the position he took in 1912. The 1912 book argued that innovations arose most frequently through new firms entering from outside the main stream of economic activity. However, he asserted in 1942 that the most likely innovators in a world of complex and costly modern technology were well-established firms, and indeed, those that not only anticipated obtaining new monopoly power as a result of patents or other elements of “monopolistic strategy” (p. 102) following their innovations, but those that enjoyed some degree of monopoly power before, and as a basis for, making investments in innovation. This claim spawned a vast literature on which I shall be able here to draw only a few limited insights.

Schumpeter provides in his various books little of what today would pass for a rigorously specified economic theory. A small part of that gap will be addressed here. More importantly, his theoretical “vision” does not make clear how, in their profit-seeking innovative efforts, entrepreneurs choose which potential avenues of technological change they will pursue and which they will ignore. In other words, his theory lacks a clear statement of how the “invisible hand” guides innovation efforts. One might analogize firms' innovative efforts to the search for still-

undiscovered oil deposits. The opportunities are put there by nature; firms merely need to find them and perfect the means of exploiting them. But such a model would sooner or later run into diminishing marginal returns, which are clearly inconsistent with the Schumpeterian vision. Thus, it remained for later scholars to elaborate the entrepreneurial search mechanism and explain why technological change might be self-regenerating.

## 2. Early builders on the Schumpeterian vision

One theoretical track initiated by Hicks (1932) asked how changes in wages induce technological changes in the factor bias of production functions. Most of the substantial literature on this point excepting perhaps Fellner (1961) emerged after the contributions that will be reviewed here, so it will be given short shrift.<sup>2</sup>

The first known contribution that provided a fully articulated view of how market forces influence innovative efforts was a 1959 article by Nelson (1959). Two major themes are stated in the first two paragraphs and elaborated both conceptually, with careful recognition of precursor authors, and extensive case study evidence, in the remainder of the article. To paraphrase the first two paragraphs:

[I]nvention is strongly motivated by perceived profit opportunities. Demand and cost factors play major roles with the state of scientific knowledge significantly affecting the cost and hence the profitability of invention... [S]econd, ... invention ... is an activity often carried on under conditions of great uncertainty.

George Stigler once said that “It's all in Adam Smith”. Smith in fact had important things to say about the precursors of modern industrial research and development laboratories. However, for the roots of endogenous innovation theory, one can justifiably say that “it's all in Nelson”.

The “demand factors” examined in Nelson's contribution went beyond prior authors' vague notions of “need” as inducements to technological innovation. The role of demand was suggested in tentative form by Schmookler (1954) and then elaborated by Schmookler (1966) into a conceptualization supported by an ambitious