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ANALYSIS

Sustainability — in light of competitiveness

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Abstract

There is cause for concern that many current practices in the strategic use of advanced manufacturing technologies are unsustainable since they lead to increased resource consumption in the aggregate. This article examines the ways the current generation of production technologies structure the formation and growth of product markets and explains why firms, driven to stay competitive, are adopting manufacturing strategies based on reducing the time it takes to develop and manufacture new products. As experience in the use of advanced manufacturing technologies has accumulated, distinctive patterns in market organization have emerged, which, in turn, cause more firms to adopt these technologies. In effect, the markets and productions systems have co-evolved. Faster product cycles presage new product variants and faster product obsolescence linked to intensified customers' needs. This interdependency of market needs and the strategic use of manufacturing technologies has significance for drafting sustainable consumption policy.

Keywords: Sustainability; Competitiveness; Manufacturing strategy; Evolutionary economics

1. Introduction

New manufacturing technologies are radically changing the terms of market competition with significant consequence for the ways we consume as well as the ways we produce. In the name of competitiveness, numerous initiatives in the past few decades, both public and private, have aimed to accelerate the transition from mass production to the knowledge-based economy. They are largely succeeding. However, being competitive does not guarantee societal well-being. To the contrary, there is cause for concern that many current practices in the strategic use of advanced manufacturing technologies are unsustainable since they lead to increasing resource consumption in the aggregate by increasing market demand.

From industry, a consensus has emerged on what are the attributes of competitive products in today's markets, namely, cost, quality, time-to-

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market, and performance based on distinctive product features. The technical means of manufacturing products with these attributes are well in hand: computer-based, flexible production technologies have come of age. Policies aimed at increasing competitiveness promote the adoption of the latest advanced manufacturing technologies. Yet, the use of these technologies is far more involved than the intent of the pursuit of economic growth, the 'reason why' of competition. Firms' operational strategies cause changes in their markets that rebound to affect decisions on how current generation technologies should be further developed to meet changing market demands. In effect, markets and technology systems co-evolve. This suggests that policies aimed at transforming consumption patterns must also pay heed to the direction of the dominant technological trajectories in production systems. One such trajectory, faster product cycles, has serious implications for achieving sustainability for the reason that firms with fast-to-market strategies must 'grow in order to compete', resulting in the need for ever larger effective market demand.

Proposed solutions to intensive resource consumption and the more general problem of how to decouple industrial activity from negative environmental impacts have largely focused on producing 'more with less' and integrating sustainability criteria into economic decision-making. While effective in limiting the environmental impact per unit of production activity, this approach essentially overlooks the issue of how growth in consumption is allied to increasing competition. The analysis in this paper differs by examining the interdependency between market demand and the competitive uses of advanced manufacturing technologies.

In the analysis that follows, I argue that production systems structure the formation and growth of product markets. To provide a theoretical context for this reasoning, the second section of the paper reprises relevant current thinking in evolutionary economics on path dependence, technological trajectories, and technological regimes, and relates this to the construction of sustainability and competitiveness policies. The paper's core theoretical exposition, Sections 3 and 4, traces the economic significance of shortened product cycles to its technological sources. (The term 'product cycle' is used here in keeping with industry terminology. It denotes the span of time from introduction of a product to the introduction of its replacement product. Often, the initiation of a replacement product's design is used to mark the onset of the cycle. This is different from how the term 'product life cycle', sometimes abbreviated to 'product cycle', is used in the environmental literature to denote the product's material cycle from resource extraction through waste disposal.) In the third section, I undertake an analysis of computer-based production innovations using a modification of Georgescu-Roegen's fund-flow model. The fourth section explains why firms, driven to stay competitive, are adopting operational strategies based on reducing the time it takes to develop and manufacture products and how such strategies promote consumption. In the final section of the paper, the contradictions between sustainability and competitiveness, as embodied in current generation production technologies, are exposed, but also, the potential of these same technologies for seeding a sustainable technological regime based on qualitative economic development, as opposed to quantitative growth, is considered.

2. Dominant production system trajectories

The tendency for technological innovation to occur along defined trajectories is described in the evolutionary economics literature as path dependence (Nelson and Winter, 1977; Dosi, 1982; Nelson and Winter, 1982; Rosenberg, 1994). A path, or trajectory, represents the economic and technological tradeoffs made with respect to the available opportunities for technological advance. These tradeoffs characterize technologies' functionality or performance, that is, the attributes that define the technologies' effective use. In evolutionary terms, a technology's performance characteristics convey its selective advantage.

From a supply-side, or technology-push, perspective, the envelope of technological opportunities corresponds to the degree of technical