ELSEVIER

Journal of Economic Behavior & Organization
Vol. 49 (2002) 97–112

JOURNAL OF
Economic Behavior
& Organization

www.elsevier.com/locate/econbase

Product and process innovations in the life cycle of an industry☆

Darren Filson*

Department of Economics, School of Politics and Econimics, Claremont Graduate University, 160 E. Tenth Street, Claremont, CA 91711, USA

Received 1 August 2000; received in revised form 2 December 2000; accepted 14 December 2000

Abstract

Filson [Rev. Econ. Dyn. 4 (2001)] uses industry-level data on firm numbers, price, quantity and quality along with an equilibrium model of industry evolution to estimate the nature and effects of quality and cost improvements in the personal computer industry and four other new industries. This paper studies the personal computer industry in more detail and shows that the model explains some peculiar patterns that cannot be explained by previous life-cycle models. The model's estimates are evaluated using historical studies of the evolution of the personal computer industry and patterns that require further model development are described.

JEL classification: L10: market structure, firm strategy and market performance; L63: industry studies, microelectronics; O31: innovation and invention

Keywords: Technology; Technological change; Industry dynamics; Personal computer market; Microelectronics

1. Introduction

As new industries evolve price falls, quantity rises and the number of firms rises and then falls (Gort and Klepper, 1982; Klepper and Graddy, 1990; Agarwal and Gort, 1996). Product quality improves over time. Fig. 1 shows that these patterns have occurred in the personal computer (PC) industry (the data is discussed in the next subsection).

Although economists generally agree that innovations cause the observed trends (Hopenhayn, 1994; Jovanovic and MacDonald, 1994; Klepper, 1996), we still lack knowledge about the types of innovation that occur at different stages of the life cycle and their effects on firm size, prices, and profit. This problem is exacerbated by the lack

☆ This work is based on my Ph.D. dissertation at the University of Rochester.

* Tel.: +1-909-621-8782; fax: +1-909-621-8460.
E-mail address: darren.filson@cgu.edu (D. Filson).

0167-2681/02/$ – see front matter
PII: S0167-2681(02)00060-4

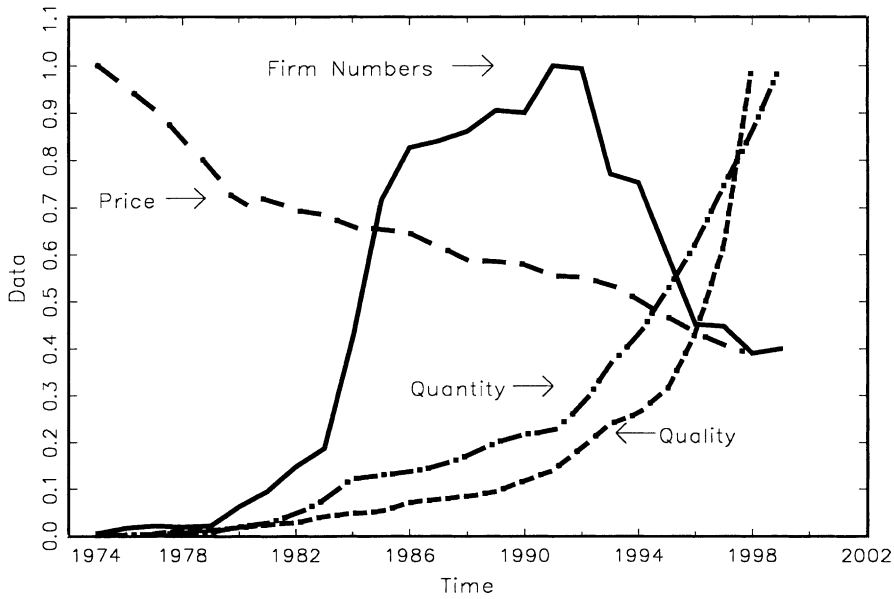

Fig. 1. Firm number, price, market quantity and quality.

of useful measures of innovation. Patents are hard to value and not all innovations are patented or documented in trade journals. In particular, cost innovations are often kept secret (Levin et al., 1987). Private companies do not report R&Dexpenditures and public companies are typically multiproduct firms (IBM, for example), making it difficult to determine R&Dexpenditures for any particular product.[1]

Filson (2001) attempts to overcome the measurement problem by using industry-level data on firm numbers, price, quantity and quality along with an equilibrium model of industry evolution to estimate trends in quality, variable costs and fixed costs. The model is estimated using five industries: the early automobile industry, the PC industry, the rigid disk drive industry, the computer monitor industry and the computer printer industry. The estimates for the early automobile industry match conventional wisdom about technological change over the life cycle (Utterback and Abernathy, 1975; Klepper, 1996): the rate of quality improvement is highest early on, the rate of cost improvement is higher later on and firms obtain lower variable costs and higher fixed costs over time. However, the estimates for the modern microelectronics industries depart from this pattern in several ways: the rate of quality improvement does not diminish over time, the rate of cost improvement is not always highest later in the life cycle and while variable and fixed cost tradeoffs tend to occur they do not always involve decreasing variable costs and increasing fixed costs.

[1] Gort and Klepper (1982) and Abernathy et al. (1983) attempt to measure innovation over the industry life cycle. Griliches (1990) and Cohen (1995) discuss the difficulty of measuring innovation. Archibugi et al. (1994) show that the measurement method affects conclusions about the nature of innovation.