

# Chapter 82

## Innovation or Imitation: Some Economic Performance and Social Welfare Policy Perspectives

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### ABSTRACT

*This paper develops a mathematical model of innovation in technology with two main characteristics. First, it discusses the endogenously made decision on not only how much to innovate, but also, how much to imitate. Second, it demonstrates that the decision to innovate or imitate are not mutually exclusive and a firm can innovate and imitate simultaneously. A mathematical model is presented, and the authors explain the barriers to innovation development and diffusion. The model is further used to investigate the effectiveness of two technology innovation and imitation policies. It is shown that an intellectual property right (IPR) policy will better function if the price of innovation is set to a level lower than the cost of innovation. The concept “superfluous innovation” (innovations whose costs are higher than their benefits) is also proposed and developed through investigating the policy of levying subsidies on innovation.*

### INTRODUCTION

The tradeoff between innovation development and innovation diffusion has been widely studied in the technology change and industry performance literature. This tradeoff arises from the fact that

what we do to prevent free availability of existing innovative discoveries to all producers, although beneficial from an ex-post efficiency standpoint, will fail to provide the ex-ante incentives for further innovation (Arrow, 1962; Cohen & Levin, 1989; Cohen & Levinthal, 1990). Such a dilemma is called the appropriability problem.

DOI: 10.4018/978-1-4666-2136-7.ch082

In spite of its long history, the problem of how firms decide on innovation-related issues is still of much interest and importance. In its simplest form, the appropriability problem is concerned about a firm deciding on whether or not to innovate - or how much to innovate - based on the extent to which the innovation is appropriable (Arrow, 1962; Quirnbach, 1986; Ireland & Stoneman, 1986; Levin, 1988; Saracho, 1996; Sakakibara, 2002).

A newly emerging theme, mostly seen in Boldrin and Levin's (2009a, 2009b, 2009c, 2009d) recent works is divisibility according to which, the knowledge embodied in goods or people is not costlessly available. Therefore, if one firm is to imitate another, it should devote some time, money and energy into buying some copies of the goods in which the knowledge is embodied (Boldrin & Levine, 2008, 2009a). In other words, there is no free and unpriced "spillover." Therefore, the matter of interest, here, is not only the innovator deciding how much to innovate due to the degree of appropriability, but also, how the imitator decides on how much to imitate due to the degree of divisibility (which we will refer to as imitability). Boldrin and Levin (2009b, 2009c, 2009d) have studied the appropriability and divisibility decisions and their effect on market size and structure.

In this paper, we study the interdependency between innovation and imitation and show that a firm can be an innovator and an imitator at the same time. While the two-fold role of a firm has been addressed sporadically in the field literature (such as Spence, 1984), none of these studies have considered the interdependency between innovation and imitation. Not all industries can be partitioned into innovators (i.e. north) and adopters (i.e. south) as argued by Helpman (1993) and Akiyama and Furukawa (2009). This gap in the current literature might have led to some misdefinitions of the problem. For instance, it is always postulated that a firm has less incentive for investing on easily imitable innovations only because it may then be imitated by others (Arrow, 1962; Quirnbach, 1986; Ireland & Stoneman,

1986; Levin, 1988; Saracho, 1996; Sakakibara, 2002; Spence, 1984).

In this paper we construct a model to address the question of how much to imitate in the context of the two-fold role of a firm (i.e. innovator and imitator) in a strictly competitive game setting. We will investigate how firms decide on how much to innovate and imitate and how their decisions affect social welfare under different conditions of imitability. We will also investigate the effects of two widely-noted policies: first, the intellectual property right (IPR) and second, the policy of treating innovation as a public good. We argue that under different conditions of imitability, these policies may have different effects on the outcome of the complex decision structure and hence on social welfare.

The remainder of the paper is organized as follows. In the next section, we provide the main assumptions of the model and then we present the mathematical model. In the following section, we provide the results obtained from solving the mathematical model. We also explain the insights gained from the solution results and compare them to the current appropriability literature. We then investigate the subsidy and IPR policies and examine their effect on the proposed model. The last section is devoted to conclusions and future research directions.

## **ASSUMPTIONS OF THE MODEL**

For the sake of simplicity, we assume that there are two firms producing the same product at the same price in the market. We also assume equal market share but different production costs for the two firms. Since price and market share are assumed to be equal, the firm with lower production cost will make more profits. The market is also assumed competitive, thus, one firm's cost reduction will lessen the price and consequently the profit of the other firm. As we will see in the following sections, *appropriability* is captured in

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