

# Stimulating new industries from emerging technologies: challenges for the public sector

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## Abstract

Stimulating new industries from emerging technologies is central to successful high-tech based economic growth, employment, competition and sustainability in modern market economies. The Taiwanese experiences in developing new technology-based industries (e.g. integrated circuits, personal computers, notebooks, scanners, and TFT LCDs) illustrate some of the ways policy makers can shape the development of emerging technologies into new industries. These ways of actions are manifold, but at least policy attentions to three key mechanisms are critical. These mechanisms encourage partnership in the commercialization process, foster entrepreneurship and venture initiatives in the innovation system, and sustain commercialization and the creation of new firms. The study of Industrial Technology Research Institute in Taiwan on biochips and nanotechnology further shows how the policy makers can build a statutory body to effectively address the functions of three mechanisms as a whole.

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*Keywords:* Emerging technology; New industry; ITRI; Public sector

## 1. Introduction: from emerging technologies to new industries

Companies use a variety of technologies in their products, production, and services. Some of the technologies are core in the sense that they are uniquely necessary to the product, production, or services of the industry. Emerging technologies are the core technologies, which have not yet demonstrated potential for changing the basis of competition. A set of complex processes and sophisticated approaches are involved in transitioning the emerging technologies to key technologies. These technologies are then embedded in the enabled products and processes to have major contributions on value added streams and allow competitive positions of a set of newly established firms and industrial sectors. As such, the emerging technologies such as spin transistors, gene therapy, interactivity and electronic commerce, intelligent sensors, digital imaging,

micro-machines and super conductivity are scientific research-based innovations that have the potential to create a new industry or to transform an existing one (Adner and Levinthal, 2002; Day et al., 2000). In a world increasingly characterized by high uncertainty, change, and innovation, stimulating new industries from emerging technologies is central to successful economic growth, employment, competition and sustainability.

The transition from emerging technologies to new industries is a complex process by which new firms enter into industrial markets, either grow and survive or exit from the industry (Audretsch, 1995). At the center of this process is commercialization with underlying knowledge conditions shaping the patterns of industrial evolution. The commercialization process, which links the technological discovery/acquisition to a worthwhile and dynamic market opportunity, plays a pivotal role in transitioning emerging technologies to new industries. It fits well within the broader public policy area of connecting research and innovation. In general, it involves orchestrating the overall organization in building the value of a new technology and mobilizing actors/stakeholders in the innovation chain. The process of commercializing emerging technologies, among

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others, is particularly complex, highly risky, costly, and prone to failures.

To find greater uses for the emerging technologies, economies around the world are enacting measures to encourage commercialization as part of innovation. Finding a way to stimulate new technology-based industries has been a major challenge for both industrialized economies and catch-up economies, especially on how to devise public policies that would have significant impact in launching or speeding up the development of new technology-based industries. The role of government in technology commercialization, however, is not monolithic. From supporting basic research to building infrastructures and establishing regulations, government policy makers can define industries and affect the fortunes of individual firms. The Taiwanese experiences in developing new technology-based industries (e.g. integrated circuits, personal computers, notebooks, scanners, and TFT LCDs) illustrate some of the ways policy makers can shape the development of emerging technologies into new industries. These ways of actions are manifold, but at least policy attentions to three mechanisms are considerably critical to stimulating new technology-based industries. These mechanisms, discussed below, encourage partnership in the commercialization process, foster entrepreneurship and venture initiatives in the innovation system, and sustain the commercialization and the creation of new firms.

## 2. Encouraging partnership in the commercialization process

The first important way of stimulating new technology-based industries is through encouraging partnership in the commercialization process which links the technological discovery/acquisition to worthwhile and dynamic market opportunities. Incentives are given on rationales of the market failures or national mission. Most notably in the R&D partnership, incentives are provided in the area of reducing transaction costs (e.g. avoiding high cost of knowledge asset transaction and internalization) and achieving organizational benefits (e.g. shared development cost, pool risks, and access resources) (Hagedoorn et al., 2000). This diversity has been reflected in policies toward cooperative R&D, including the nature and extent of government role in promoting and regulating R&D partnerships. There are, however, potential downside effects associated with collaboration, particularly the negative potential to block competition and to create various kinds of monopolies. Hence, policy makers need to constantly modify regulations on incentives in order to take into account the newly emerging technologies that have the potential to create new competitive industries.

It is well known that an effective competition policy in a dynamic market encourages innovation. However, technology-based competition erodes appropriability and

increases risk. To deal with the trade-off, a public–private partnership mechanism has to be effectively structured (Branscomb and Keller, 1998). It involves partial public funding of privately performed R&D and is considered to be beneficial to SMEs and entrepreneurial activities. A prominent example of this partnership program is the US Advanced Technology Program (ATP) (Link and Scott, 2001). The goal of ATP is to assist US businesses in creating and applying the generic technology and results necessary to commercialize significant new scientific discoveries and technologies rapidly. In Taiwan, the formation of the Advanced Semiconductor Technology Research Organization (ASTRO) illustrates how a government-sponsored research institute has brought together the six semiconductor manufacturers to research a common platform for advanced process technology (Chang and Tsai, 2000).

## 3. Fostering entrepreneurship and venture initiatives in the innovation system

The second mechanism we identify strongly in speeding up the transition process is to foster entrepreneurship and venture initiatives in the innovation system. Traditionally, entrepreneurship has often been thought of as an isolated event. In the context of new formation of industries, a broader definition of entrepreneurship is justified. Entrepreneurial behaviors include both economic innovation and organization creation, engaging both innovative and imitative activities; occurring in both new and existing organizations. The more available market opportunities in an industry, the greater the potential for entrepreneurial activities and new venture formations. Entry barriers, capital requirements, concentration, and excess capacity were all related negatively to the formation of new ventures. Different types of entrepreneurial behaviors impact one another in different parts of a community defined by the industrial value chain (Van de Ven, 1993; Mezas and Kuperman, 2000). That is, during the emerging of a new industry, entrepreneurial behaviors in one population of the community may create opportunities elsewhere in the community. Therefore, the success of entrepreneurial behaviors in one population may be supported by behaviors in other population. The implications for the policy makers and practitioners are: (1) how activities in a broad community of organizations can set the stage for entrepreneurship and have a high impact on its ultimate success; and (2) what the variety of behaviors necessary to create, reinforce, and maintain fundamental and widespread changes.

Technology entrepreneurs in the new economy face another challenge—globalization. Globalization of economy has encouraged companies and entrepreneurs to leverage their resources and skills by expanding into international operations, alliances and joint ventures.

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