Research Policy 42 (2013) 1053–1071

Contents lists available at SciVerse ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

Government, policy-making and the development of innovation system: The cases of Taiwanese pharmaceutical biotechnology policies (2000–2008)

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ARTICLE INFO

Article history:
Received 15 July 2011
Received in revised form 1 January 2013
Accepted 7 January 2013
Available online 21 February 2013

Keywords:
RTDI policy
Innovation system
Policy-making
Taiwan
Biotechnology
Pharmaceuticals

ABSTRACT

This article focuses on the research of RTDI policies (research, technology, development and innovation), and the theme of this article is to link the three indicators together: RTDI policy-making process—the contents of RTDI policies—the appropriateness of RTDI policies on the configuration of the national, the sectoral and the technological innovation systems. We define the configuration of the three innovation systems as national, sectoral and technological innovation system (NSTIS). We assume the policy-making process of RTDI policies would shape the contents of RTDI policies. Once the contents of RTDI policies are implemented, the RTDI policies would influence, whether appropriate or inappropriate, on the NSTIS. We use the Taiwanese pharmaceutical biotechnology policies as empirical cases. On the basis of the empirical cases of Taiwan, we find that the consistency and appropriateness of RTDI policies are shaped by four variables: polity, horizontal coordination, vertical coordination and the involvement of external stakeholders. The policy-making process indeed shapes the RTDI policies which further shape the development of NSTIS.

1. Introduction

Why some RTDI policies (research, technology, development and innovation) appropriately support the national technological and industrial development but others fail? It is one of the frequently asked questions of the date but lacking unified answers. The scholars of innovation systems have analyzed the economic and technological effects of RTDI policies on the different levels of innovation systems. While Freeman (1987) explains how governments promote technology and industrial policies to shape the overall national innovation systems (NIS), Malerba (2002) recommends that national institutions should match the specific characteristics of sectoral innovation systems (SIS), and Jacobsson and Bergek (1998) express the impact of national institutions on the technological innovation systems (TIS). The recent research of Chung (2012) has further explored the influence of RTDI policies on the dynamics of the configuration of the national, the sectoral and the technological innovation systems and defines the configuration of the three innovation systems as the *national, sectoral and technological innovation system* (NSTIS). Since different NSTIS within the same nation reveals different dynamics, RTDI policies should be customized according to the different dynamics of each NSTIS.[1] However, as the existing literature of innovation systems still treats RTDI policy-making process as a 'black-box', until now the impact of RTDI policy process on the configuration of the three innovation systems remains unclear. Besides, political scientists have shown the divergent aspects of RTDI policy process. While some political scientists emphasize the policy coordination of RTDI policies (Braun, 2008), some others focus on the participation of policy stakeholders which shapes RTDI policies (Inzelt, 2008; Tournon, 1993). Nevertheless, as different political scientists only speculate the particular aspects of RTDI policy process, among the

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http://dx.doi.org/10.1016/j.respol.2013.01.007

[1] The approach of NSTIS draws the boundary of an innovation system by a nation, a sector and a technology (as shown in Fig. 3) (Chung, 2012). While national innovation system draws the boundary of an innovation system by the territory of the nation (Nelson, 1993; Lundvall, 1992; Freeman, 1987), sectoral innovation system recognizes an innovation system by a set of products which are developed in a global context (Malerba, 2004); and technological innovation system defines a system by a knowledge field developed globally (Carlsson et al., 2002; Bergek et al., 2008). NSTIS is established upon the concept that a national system is delineated on a spatial basis, while a sectoral system usually crosses a geographical boundary and a technological innovation system typically crosses geographical and sectoral boundaries (Markard and Truffer, 2008). As described by Chung (2012), the actors within the NSTIS use the knowledge of a particular technological field to produce a set of particular products. The actors within the system carry out market and non-market interactions in order to generate, diffuse and utilize the knowledge of a particular technological field to create, produce and sell a particular set of products. The interactions and networks between the actors are shaped by national institutions. The national government plays the central role in the establishment of the national institutions.

existing literature we can find very limited theoretical insights which display a whole picture of the policy process of RTDI policies.

This article searches for a synthetic perspective for the analysis of RTDI policies based on the existing foundations of innovation systems and political science studies enlightening RTDI policy research. On one hand, we tend to understand the policy-making process which shapes the contents of RTDI policies, in terms of policy objectives and policy instruments. On the other hand, we tend to understand the influence of RTDI policies, whether appropriate or inappropriate, on the development of the configuration of the three innovation systems. We follow the definition of Chung (2012) and define the configuration of the three innovation systems as the NSTIS. Indeed the theme of the article is to link three indicators together: the RTDI policy-making process—the contents of RTDI policies—the development of NSTIS. We highlight the theme again in Fig. 1. Since we pay more attention to the linkage between RTDI policy-making process and the contents of RTDI policies, we use thicker arrow for the linkage between the two.

We choose the empirical example according to the theme of the article, and the Taiwanese pharmaceutical biotechnology policies are chosen because of two reasons. First, pharmaceutical biotechnology itself shows the interesting dynamics of the configuration of the three innovation systems. The origin of modern biotechnology was tightly inter-linked with the evolution of pharmaceutical sector (McKelvey, 1996; McKelvey et al., 2004). In different countries, pharmaceutical biotechnology not only possesses distinctive dynamics but is deeply shaped by the different national institutions (Giesecke, 2000; Senker et al., 2000). Pharmaceutical biotechnology therefore provides a suitable empirical example for the analysis of the appropriateness of RTDI policies on the configuration of the three innovation systems.[2] Second, the country of Taiwan offers a fascinating example to discuss the development of pharmaceutical biotechnology, the policy-making process and the appropriateness of RTDI policies. Pharmaceutical biotechnology in Taiwan reveals specific dynamics. The local small and medium enterprises (SMEs) were the main forces of pharmaceutical innovation. The knowledge base of the majority of companies was chemical engineering, and only a small number of companies started to adopt modern biotechnology in the late 1990s to carry out the products of bio-pharmaceuticals and new herbaceous medicines. During 2000–2008, the Taiwanese government promoted lots of policies to support the development of pharmaceutical biotechnology (Waluszewski et al., 2009), yet there has not been significant success (Dodgson et al., 2008). In fact all the policies were made in the conditions that the Taiwanese government was a presidential divided government,[3] the elected politicians and administrators within the government faced serious problem for coordination (Wong, 2005), and policy stakeholders were not fully involved in the policy-making process. The Taiwanese pharmaceutical biotechnology policies were indeed dynamically formulated in the particular polity with characteristic interactions of actors on the multiple levels.[4] Through analyzing the unique policy-making process of the Taiwanese pharmaceutical biotechnology polices, we will deeper understand how such policy-making process shaped the contents of pharmaceutical biotechnology policies in Taiwan which further shape the appropriateness on the innovation system of Taiwanese pharmaceutical biotechnology.

The article is structured based on the theme. In Section 2, we establish the analytical framework which not only uncover the black-box of RTDI policy-making process but also analyze the influence of the policy process on the contents and appropriateness of RTDI policies. Section 3 describes the methodology used to operationalize the analytical framework for the empirical case studies. Among the various pharmaceutical biotechnology policies promoted by the Taiwanese government from 2000 to 2008, we only choose the National Science and Technology Program for Biotechnology and Pharmaceuticals (typically shortened to be the National Program) and the Law of Pharmaceutical Affairs (typically shortened to be the Law) as the two cases. Section 4 analyzes the consistency and appropriateness of the two policies. Section 5 discusses the policy-making process of the two policies through the lens of our analytical framework. Section 6 reflects the analytical framework with the empirical cases. Section 7 concludes the article.

2. The analytical framework of RTDI policy-making process

The analytical framework which is shown in Fig. 2 is integrated established upon the literature of innovation systems and the political science literature on political structures and policy-making process which has an implication for RTDI policies. On the basis of the literature of innovation systems, we assume RTDI policies are made in the context of NSTIS. Moreover, following the political science literature[5] we recognize a government as the integral part of the political system, which is the sub-system of a NSTIS.

[2] Modern biotechnology as defined by Laage-Hellman et al. (2004) is the biotechnology which is developed in the post-genetic engineering era. Modern biotechnology is comprised of a broad range of knowledge fields, including DNA (the coding), proteins and molecules, cell and tissue culture and engineering, process biotechnology, and sub-cellular organisms. The development of modern biotechnology intersects with multiple sectors (Brink et al., 2004; Senker, 2004; Gilsing and Nooteboomb, 2006), such as pharmaceuticals (Stuart et al., 2007) and agriculture (Chataway et al., 2004). Besides, modern biotechnology also intersects with the national innovation systems of plural countries (Reiss et al., 2004; Guennif and Ramani, 2012). Within the same country, not only different sectors offer contrasting opportunities for the development of modern biotechnology but the governance of modern biotechnology is different from sector to sector. For example, in Taiwan modern biotechnology intersects with at least two sectors, pharmaceuticals and agriculture. While pharmaceutical sector only adopted modern biotechnology in the 1990s and involved both pharmaceutical local SMEs and MNCs in the network of governance, the agricultural sector adopted modern biotechnology in the 1980s and dominantly governed by a large agricultural public company and research institutions (Chung, 2012). In this article, we focus on the policy-making and the governance of pharmaceutical biotechnology policies.

[3] Between 2000 and 2008, Democratic Progressive Party (DPP) was the ruling party and Kuomintang (KMT) was the opposition party. The political competitions between the two parties were considered to be the reason which made the government as a whole very indecisive for supporting biotechnology. See Li (2005), Wong and Huang (2005) and Xiu (2005).

[4] The policy-making process of the Taiwanese pharmaceutical biotechnology policies from our perspective is not fully explored. Even though some existing literature, such as Wong (2005), has done the initial research of the policy process of the Taiwanese pharmaceutical biotechnology policies, the majority of the existing literature which enlightens the studies of RTDI policy process, such as the literature of RTDI policy coordination (Braun, 2008; Biegelbauer, 2003) and the literature of the participation of external stakeholders (Inzelt, 2008; Mogee, 1988; Barker and Peters, 1993), mainly focuses on the empirical experiences of the United States or European countries. While we search for a synthetic perspective for the analysis of RTDI policies and establish our analytical framework upon the existing literature (as shown in Section 2), we adopt the empirical case studies not only to further explore our analytical framework but to intensively reflect on the literature which composes of the analytical framework. Since the cases of Taiwan gain relatively few discussions of the existing literature and show contrasting dynamics from the empirical experiences of the United States and European countries, we recognize these cases to be suitable to broaden the empirical studies of RTDI policies as well as to enrich the analysis of the literature of the day (as shown in Section 6). Nevertheless, we only consider the study of the Taiwanese cases to be the initial analysis of RTDI policy process and the appropriateness of RTDI policies. We actually anticipate more international comparative studies to extensively speculate the dynamic process which shapes the contents and appropriateness of RTDI policies on the different NSTIS of particular countries.

[5] As described by Easton (1965), government is the internal part of the political system which is embedded in the environment surrounding it. Almond et al. (1996) further combines the theory of political system with institutionalism and perceive the government as the core of political system which is composed of institutions and actors. Political institution as synthetically defined by Almond et al. (1996) and Lane and Ersson (2000, pp. 4–7) is represented by political organizations, political