Asia Pacific Business Review
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/fapb20

Innovation policies in Thailand: towards a system of innovation approach?

P. Intarakumnerd [a] & Cristina Chaminade [b]
[a] College of Innovation, Thammasat University , Bangkok, Thailand
[b] CIRCLE, Lund University , Lund, Sweden
Published online: 19 Apr 2011.

To cite this article: P. Intarakumnerd & Cristina Chaminade (2011) Innovation policies in Thailand: towards a system of innovation approach?, Asia Pacific Business Review, 17:02, 241-256, DOI: 10.1080/13602381.2011.533504

To link to this article: http://dx.doi.org/10.1080/13602381.2011.533504

Asia Pacific Business Review
Vol. 17, No. 2, April 2011, 241–256

Innovation policies in Thailand: towards a system of innovation approach?

P. Intarakumnerd*[a] and Cristina Chaminade[b]

[a]*College of Innovation, Thammasat University, Bangkok, Thailand;* [b]*CIRCLE, Lund University, Lund, Sweden*

The issue of the rationale for public intervention under the system of innovation (SI) perspective has recently received increasing attention from scholars and practitioners. However, with few exceptions, this literature has been based on the analysis of innovation policies and innovation systems in industrialized countries neglecting almost completely the specific policy dilemmas that arise from the weak and fragmented innovation systems that characterize developing countries. In the last few years, a growing number of developing countries have adopted the SI approach officially in their innovation policy. Yet, there has not been an adequate attempt to systematically analyze how (and if) this has been done in practice. This study attempts to shed some light on this issue by analyzing the innovation policy of Thailand. It suggests that while the innovation system approach might be officially adopted by a government, the practice follows old innovation paradigms and hardly addresses systemic problems.

Keywords: innovation policies; public intervention; systems of innovation; Thailand

1. Introduction

Innovation policy can be defined as 'the public actions that influence innovation processes, i.e. the development and diffusion of (product and process) innovations'. The objectives of an innovation policy are often economic ones, such as economic growth, productivity growth, increased employment and competitiveness. However, they may also be of a non-economic kind, such as cultural, social, environmental, or military. The objectives are determined through a political process, and not by researchers. They must, however, be specific and unambiguously formulated in relation to the current situation in the country and/or in comparison to other countries.

In innovation processes, private as well as public organizations are operational. Large-scale and radical technological shifts rarely take place without public intervention, while incremental innovation is normally carried out by firms. An important question for innovation policy design is in which situations public organizations should intervene and when they should not. Hence, innovation policy design is very much a question of the division of labour between, on the one hand, the actions of private firms and the operations of markets, and on the other, the actions of public organizations – with regard to factors influencing innovation processes. To discuss this division of labour is the same as discussing the *rationales*, *reasons* or *criteria* for public policy intervention.

Although the issue of the rationale for public intervention under the system of innovation (SI) perspective has recently received increased attention from scholars and practitioners (OECD 2001, Koch *et al*. 2003, Smits and Kulhmann 2004, Woolthuis *et al.*

*Corresponding author. Email: prpu6@hotmail.com

ISSN 1360-2381 print/ISSN 1743-792X online

DOI: 10.1080/13602381.2011.533504
http://www.informaworld.com

2005), there has not yet been an attempt to profoundly discuss the implications of the adoption of the SI approach for the design and implementation of innovation policies. We will try to pursue such a discussion both from a theoretical perspective and a practical one, including giving some examples of SI based policies.

Since the emergence of the SI concept in the 1990s in academic arenas (Freeman 1987, Lundvall 1992, Nelson 1993, Edquist 1997) the concept seemed to rapidly attract the interest of policy makers, especially international policy think-tanks such as the OECD (Mytelka and Smith 2002). As many studies have argued, the OECD played a significant role in the dissemination of the concept to national governments. Its many initiatives on systems of innovation and policy (OECD 1994, 1996, 1997, 1999, 2001 and 2002) had a strong impact on the way that national governments started to design and implement innovation policies. Today, countries like Finland, Sweden or Japan have explicitly adopted the SI approach in their innovation policies.

Despite the widespread use of the SI approach in policy-maker circles in developed countries, it remains a fuzzy concept and very difficult to use in practice as we have argued before (Chaminade and Edquist 2006). We still know very little about the implications of the adoption of the SI approach for public policy (what to do, when and how to do it). One way to tackle this issue is to compare the basic assumptions of the SI approach to those of the neo-classical theory (Lipsey and Carlaw 1998, Smith 2000) and discuss the knowledge, learning and innovation in neoclassical and evolutionary theories and the implications for this discussion on public intervention.

In developing countries, the situation is even worse. We know even less about whether and how these countries adopt and implement the SI approach for their science, technology and innovation polices. This is especially true for less successful countries whose innovation systems can be characterised as weak and fragmented (Intarakumnerd *et al.* 2002). This study attempts to shed some light on this issue by analyzing the innovation policy of Thailand. Thailand is an interesting case study, since the country, unlike the East-Asian Tigers, is a less-successful country in technology in terms of catching up with the forerunners, and a latecomer in trying to adopt and implement the SI approach. It is remarkable to examine to what extent and how the new SI approach has been adopted in such context.

This work is organized as follows: it starts by discussing the main rationales for public intervention under the SI approach and introduces the distinction between classic market failure (grounded in neoclassical theory) and systemic problems – often called systemic failures – (grounded in the evolutionary/systemic approach). On the basis of this, the authors discuss other potential criteria to be considered when discussing public policy intervention under a systems of innovation perspective (when and how to intervene, at what level – national, regional, and so on), such are the issues of coordination, uncertainty and selectivity. In the last section we critically discuss the relevance of the framework in understanding innovation policy in Thailand with the aim of suggesting extra set policies required as prerequisites to enhance the 'learning to learn' capabilities of less successful countries before adopting a more standard SI approach.

We conclude with some open questions and issues for further research.

2. Neoclassical vs. evolutionary theories: conceptual framework and rationales for public intervention

2.1. Concept of knowledge, learning and innovation in the neoclassical theory

There is no explicit definition of knowledge or learning in the neoclassical approach, although it is implicit in the analysis (Smith 2000). One of the basic assumptions of the

neoclassical theory is perfect information. It is assumed that all economic agents can maximize their profits because they have perfect information about the different options available to them. Knowledge is equal to information, i.e. it is codified, generic, and it is accessible and easily adaptable to the firm's specific conditions.

These tacit assumptions about the properties of knowledge are reflected in the discussion about the process of invention. For Nelson (Nelson 1959) and Arrow (Arrow 1962) the knowledge emanating from research has some specific properties: uncertainty, inappropriability and indivisibility (Lipsey and Carlaw 1998).

- *Uncertainty* refers to the impossibility of fully knowing the outcomes of the research process and the risk associated with it.
- *Inappropriability* means that firms cannot fully appropriate the benefits which derive from the invention. There will always be externalities emanating from the research process. As knowledge is considered to be information and is assumed to be costlessly accessible to all economic agents, this means that the incentive for research activity by firms is limited, i.e. smaller than it would be if it was possible for firms to appropriate all the benefits.
- *Indivisibility* implies that there is a minimum investment in knowledge before any new knowledge can be created.

The neoclassical analysis provided governments with a strong argument to invest heavily in fields such as energy, large-scale science and technology projects, defence research, and so on. where the public rate of return was expected to be high, the barriers to entry were significant and the externalities were also assumed to be sizeable.

For the neoclassical scholars, the innovation process is narrowed down to research (and invention). How to transform the results of the research activity into products or processes that can be used in the economy is a black box (Rosenberg 1982, 1994). For the neoclassical theorists, the process of innovation is a fixed sequence of phases, where research efforts will automatically turn into new products.

The three characteristics of scientific knowledge (uncertainty, inappropriability and indivisibility) will lead to an under-investment in R&D activities by private actors. This constitutes the main rationale for public intervention in research activities. Policy makers have to intervene because of a *market failure*: economies will systematically under-invest in R&D and not reach the optimal allocation of resources for invention[1].

A critical concept in neoclassical theory is equilibrium. For the neoclassicals, markets will always tend to achieve equilibria under the conditions of perfect information, perfect competition and profit maximization. Governments should intervene to mitigate non-desired externalities and asymmetries in information, correct inefficient market structures or eliminate the barriers to entry so that the markets can reach the desired equilibrium.

The main strength of the neoclassical market failure argument is its simplicity. However, the policy implications that emerge from the market failure theory are actually not very helpful for policy-makers from a practical and specific point of view. They are too blunt to provide much guidance. They do not indicate how large the subsidies or other interventions should be (as it is not possible to determine the optimum level of investment) or within which specific area one should intervene. Standard economic theory is of not much help when it comes to formulating and implementing specific R&D and innovation policies. It only provides general policy implications; for example, that basic research should sometimes be subsidised (Edquist *et al.* 2004). As neoclassical theorists tend to ignore the economic structure or institutional frameworks in which the innovation activity takes place, their policies apply across the whole economy (Lipsey and Carlaw 1998, OECD 1998).

The market failure approach is too abstract to be able to guide the design of specific innovation policies. An overall observation is that neoclassical theory does not address innovation processes broadly defined – but mainly research and invention.

2.2. Concept of knowledge, learning and innovation in evolutionary theory and the SI approach

The general policy implications of the systems of innovation approach are different from those of standard economic theory. This has to do with the fact that the characteristics of the two frameworks are very different. The SI approach shifts the focus away from actions at the level of individual and isolated units within the economy (firms, consumers) towards that of the collective underpinnings of innovation. It addresses the overall system that creates and distributes knowledge, rather than its individual components, and innovations are seen as outcomes of evolutionary processes within these systems.

The SI approach has its roots in evolutionary theory (Nelson and Winter 1982). Firms are a collection of different capabilities and resources (Grant 1996, Spender 1996, Eisenhardt and Martin 2000) which they use to maximize their profit. Knowledge is not only information, but also tacit knowledge; and can be both general and specific and is always costly. Knowledge can be specific to the firm or to the industry (Smith 2000). While in the neoclassical approach, information asymmetries are considered to be a market failure, under the evolutionary theory and the SI approach asymmetric information is essential to provide novelty and variety.

The evolutionary theory places the emphasis on the mechanisms of diversity creation and selection (e.g. competition) as the engine of innovation. It also stresses the path-dependency of innovation processes. The SI approach, takes the evolutionary theory as one of the points of departure, to focus on the interactive mechanisms that shape the emergence and diffusion of innovations.

The SI approach emphasises the fact that firms do not innovate in isolation but through continuous interactions with other organizations in the system (at regional, sectoral, national and supranational level) (Lundvall 1992, Edquist 1997, 2004). The innovation process is interactive within the firms and among the different organizations in the innovation system. At the firm level (Kline and Rosenberg 1986) innovation can take place in any part of the firm and in interaction with external sources of knowledge.

Understanding innovation as a complex interactive process has important implications for the design and implementation of any kind of policy to support innovation. It affects the focus of the policy, the instruments and the rationale for public policy, among other issues (Chaminade and Edquist 2006). The systematic approach to systems of innovation (SIs) does not imply that these systems are or can be consciously designed or planned. On the contrary, just as innovation processes are evolutionary, SIs evolve over time in a largely unplanned manner. Even if we knew all the determinants of innovations processes in detail (which we certainly do not, and will never do), we would not be able to control them and design or 'build' SIs on the basis of this knowledge. Centralized control over SIs is impossible and innovation policy can only influence the spontaneous development of SIs to a limited extent.

A main focus of the SI approach is therefore the system and the complex interactions that take place among the different organizations ('players') and institutions ('rules of the game') in the system. Policy makers should intervene in those areas where the system is not operating well, that is, when there are systemic problems. But when do we talk about systemic problems or problems in the system?

One mode of approaching this question is the following (Chaminade and Edquist 2006, Edquist and Chaminade 2006): in a modern society, it is assumed that capitalist firms and the market mechanism best fulfil many economic tasks. The market mechanism evaluates and co-ordinates the behaviour and resources of private and public actors – often in a smooth and flexible manner. This concerns the production of most goods, and a large proportion of service production. It is also true for the creation of many innovations, in particular incremental ones. Most of them occur through the actions of firms and in collaboration projects between firms. This is, however, less true for radical innovations, especially in the early stages of the development of new technology fields.

There are reasons to complement the market system through public intervention for two main reasons: (a) Either there is no market mechanism operating at all and the activities are fulfilled through other mechanisms, for example, regulation; or (b) the market mechanism does not lead to the fulfilment of the objectives established by the government and have, for decades, been complemented by public intervention in most industrial countries. This is true in the areas of law, education, environment, infrastructure, social security, income distribution, research or innovations, and so on.

What, then, are the reasons for public policy intervention in a market economy? As regards, for example, technical change and other kinds of innovations, two conditions must be fulfilled for there to be reasons for public intervention in a market economy (Edquist and Chaminade 2006):

(1) First, capitalist firms and the market mechanism must fail to achieve the objectives formulated. A *problem* that is not spontaneously solved by private actors and market forces must exist. We have called this a systemic problem. It can also be called a public policy opportunity.
(2) Second, the state (national, regional, local) and its public agencies must also have or be able to build the *ability* to solve or mitigate the problem. This can be called policy competences.

It is important to note that innovation policy – or other kinds of public intervention – should be a complement to the market, not replace or duplicate it. If there is no 'additionality' the public actions are a *substitute* for the actions of private firms and the operation of markets. The two are overlapping or competing. It is of great importance that there actually is additionality associated with the public intervention. If not the public resources invested will not influence innovation processes, but lead to increased profits for the firms or to increased spending on other things than those targeted by the policy. In other words, there must be a *'systemic problem'* – which is not automatically solved by capitalist actors and market forces – for public intervention to be 'considered'. Such problems can be identified through analysis.

It is important to know that the notion of optimality is considered to be irrelevant by the SI approach. As mentioned earlier, 'market failure' in mainstream economic theory implies a comparison between conditions in the real world and an ideal or optimal economic system. However, innovation processes are path dependent over time and it is not clear which path will be taken. They have evolutionary characteristics. We do not know whether the potentially 'best' or 'optimal' path is being exploited. The system never achieves equilibrium and the notion of optimality is irrelevant in an SI context. We cannot specify an ideal or optimal SI. Hence, comparisons between an existing system and an ideal or optimal system are not possible. Thereby the notion of 'failure' looses its meaning and applicability[2]. Instead we talk about systemic problems. Some of these systemic

problems mentioned in the literature include (Norgren and Haucknes 1999, Smith 2000, Woolthuis *et al.* 2005):

- *Infrastructure provision and investment problems*: including the physical infrastructure (transport, etc), the scientific infrastructure (high-quality universities and research labs, technical institutes, etc) and the network infrastructure (IT, telecom).
- *Transition problems*: they refer to the difficulties that might arise when firms and other actors encounter technological problems or face changes in the prevailing technological paradigms that exceed their current capabilities. Firms might not be capable to foresee the emergence of new paradigms, radically new pervasive technologies or significant changes in the markets that require new technological solutions. As we will argue later, the transition from one prevailing paradigm to the next involves a high degree of uncertainty which might prevent private actors from entering a new technological field or market.
- *Lock-in problems*: derived from the socio-technological inertia, which might hamper the emergence and dissemination of more efficient technologies[3]. Firms and other organizations might be locked into existing technologies (and technology systems). The strength of technology systems might hamper the development of new technologies alien to the prevailing technological system or technology regime. Lock-in problems might lead to transition problems to the extent that the excessive focus on existing technologies might prevent the firms from being able to foresee the emergence of new technological opportunities.
- *Hard and soft institutional problems*: linked to formal rules (regulations, laws) as well as more informal and tacit ones (social and political culture for instance). The SI approach pays special attention to the role of institutions in the systems. Institutions are *sets of common habits, norms, routines, established practices, rules or laws that regulate the relations and interactions between individuals, groups and organizations* (Edquist and Johnson 1997, p. 46). The institutional framework plays a very significant role in the production of innovations as well as in the adoption and dissemination of innovations. The government can play a significant role in the development of the formal rules whilst in most cases this role is marginal when the most tacit elements are to be influenced (culture, firm routines, social networks, etc).
- *Network problems*: which include those derived from too weak linkages or too strong linkages (blindness to what happens outside the network) in the SI approach. Although it is easy to understand that the system might suffer from network problems that may require some kind of government response, in practice it is very difficult to assess the adequate degree of strength of the linkages in the system. Both strong and weak linkages are reported to have advantages and disadvantages, in terms of openness and intensity of exchange (Nooteboom 2004).
- *Capability and learning problems*: these systemic problems refer to the insufficient competences of firms (human, organizational, technological and so forth) which might limit their capacity to learn, adopt or produce new technologies over time. In other words, the system might have the right infrastructure and institutional framework, but the organizations of the system might have difficulties in accessing or creating new knowledge or in transforming knowledge into innovations.
- *Unbalanced exploration-exploitation mechanisms*: the system might be capable of generating diversity but not have the mechanisms to be able to make adequate

selections or it may have have very refined selection procedures but no capability to generate diversity.

- *Complementarity problems*: the competences of the system might not complement each other or they might not be connected so the positive effects that might emerge from the combination of complementary capabilities are not fully deployed.

Hence our discussion of rationales for policy intervention is based on systemic problems[4] rather than on market failure. Table 1 summarizes some of the issues related to the neoclassical and systems of innovation approaches and the policy implications of these approaches.

3. Systemic innovation policies? An experience of Thailand

Thailand is a lower-middle-income country with GNP per capital of approximately 2700 US$ in the year 2005 (see 'Bank of Thailand' n.d.). The Economic performance of Thailand during the past 40 years has been rather impressive with the growth rate of GDP around 7%. Like other Asian Newly Industrialised Economies (NIEs), namely Korea, Taiwan, Singapore and Hong Kong, Thai economic structure has also changed from an agriculture-based economy to an economy in which the industrial (manufacturing in particular) sector has gained distinctive significance. There were also changes in the composition of Thai exports along the line of NIEs. The share of once-dominating resource-based and labour-intensive exports has gone down while that of science-based and differentiated exports has gone up especially in the 1990s (Intarakumnerd 2006a).

3.1. Rationale for government intervention in Thailand

Until 2001, before the government of Prime Minister Thaksin Shinawatra (January 2001 – September 2006), science and technology policy in Thailand had three main characteristics: (a) scope of S&T policies in Thailand was rather narrow and did not include the aspect of innovation; (b) there was a dichotomy between S&T policy and economic policies; and (c) policies were mainly constrained by neoclassical economics framework, that is, government intervention was only allowed in the case of market failures. During the Thaksin Government, there were major changes. This will be discussed below in details.

Scope of S&T policies

Policies before Thaksin Government, in general, covered only four conventional functions, namely, research and development, human resource development, technology transfer, and S&T infrastructure development. This narrow scope of S&T was very much based on the linear model of innovation concept. Private firms were regarded as only 'users' of S&T knowledge mainly produced by government agencies and universities (see Arnold *et al.* 2000). Therefore, to strengthen the country's S&T capability, resources and policy attention should be paid on enhancing research capability of government R&D institutes and universities, whose outputs were believed to be easily transferred to private firms. There was no articulate national innovation policy, not to mention the incorporation of the SI concept in policy content and process. Though the word 'innovation' was mentioned in several national plans, it was not whole-heartedly incorporated into the scope of S&T policies (see Lauridsen 2002). In this regard, Thailand is a laggard in terms of S&T polices, since the linear model of innovation used to be popular in developed countries in the 1960s still predominately influenced the country's S&T policy formulation even up to

Table 1. Science, technology and innovation policies: neo-classical economics vs. system of innovation approach.

	Neoclassical	Systems of innovation
Underlying assumptions	Equilibrium Perfect information	Non-equilibrium Asymmetric information
Focus	Allocation of resources for invention Individuals	Interactions in innovation processes Networks and Framework conditions
Main policy	Science policy (research)	Innovation policy
Main rationale	Market failure	Systemic problems
Government intervenes to (examples)	Provide public goods Mitigate externalities Reduce barriers to entry Eliminate inefficient market structures	Solve problems in the system or to facilitate the < creation of new systems: Induce changes in the supporting structure for innovation: support the creation and development of institutions and organizations & support networking Facilitate transition and avoid lock-in
Main strengths of innovation policies designed under each paradigm	Clarity and simplicity Long time series of science-based indicators	Context specific Involvement of all policies related to innovation Holistic conception of the innovation process
Main weaknesses of innovation policies designed under each paradigm	Linear model of innovation Framework conditions are not explicitly considered in the model (e.g. institutional framework) General policies	Difficult to implement in practice Lack of indicators for the analysis of the IS and evaluation of IS policies

the 1990s. One of the main reasons is that policy makers and opinion leaders who had major influences in S&T policy formulation were scientists (most of them being educated by prestigious universities in the West), who subscribed to the supply-push idea that gave highest priorities to research excellence (especially basic research) and S&T human resource development.

The major policy change came recently under the Thaksin government. The media and academics in Thailand and Southeast Asia labeled this government's distinctive policy as 'Thaksinomics' (Thaksin's Economics). Dual track policy was the main thrust of Thaksinomics. The government tried to enhance the international competitiveness of the nation by strengthening the 'external' side of the Thai economy, namely, export, foreign direct investment and tourism. At the same time, it attempted to increase the capabilities of domestic and grass-root economies by implementing projects such as the Village Fund (one million Baht was given to increase the local capabilities of each village), a three-year debt moratorium on farmers' debt, One Tambon[3] One Product Project (supporting each Tambon to enable them to have product champion), and the People Bank (giving loans to underprivileged people which required no collateral). However, some academics and politicians from opposition parties, branded these new grass-root supporting policies as 'populist policies' aimied at winning votes from the rural poor (see Intarakumnerd 2006a).

Importantly, the concept of an SI approach has been, to a certain degree, 'formally' adopted during this government. Building the innovative capabilities of the nation was highly regarded as a very important factor in increasing and sustaining Thailand's international competitiveness. An 'innovative nation with wisdom and learning base' was one of seven Thailand's Dreams projected by the government (see Phasukavanich 2003). The 10-year Science and Technology Strategic Plan (2004–2013) places the concept of a national innovation system and industrial cluster at its heart. The scope of the plan is much broader than the aforementioned four functional areas. Measures to stimulate innovations and to strengthen national innovation systems are explicitly highlighted. Examples of these measures are; developing more industrial-oriented centres of excellence and knowledge intermediaries such as science parks, enhancing technical services supporting private firms such as testing, calibration, quality assurance and metrological systems, expanding the scope of R&D tax incentives to cover design and engineering activities, improving the intellectual property system and its management, and the reforming national science and technology management system (National Science and Technology Policy Committee 2004). As a result, S&T policies were expanded to become Science, Technology and Innovation (STI) policies.

A dichotomy between S&T policies and economics polices

Unlike in Japan, Korea, and Taiwan, S&T elements were not part of broader economic policies namely, industrial policy, investment policy and trade policy, and, to the lesser extent, education policies (see Intarakumnerd *et al.* 2002).

The industrial policy of Thailand did not pay enough attention to the development of indigenous technological capability as an integral factor in the process of industrialisation (Sripaipan *et al.* 1999, p. 37). Investment policy, especially the promotion of foreign direct investment (FDI), was aimed primarily at generating inward capital flow and employment. Unlike in Singapore, where FDI was specifically used to upgrade local technological capability (see Wong 1999), there was no explicit and pro-active link between promoting FDI and upgrading local technological capability in Thailand. Trade policy, with the most important instrument in Thailand being tariff, was not used strategically to promote

technological learning as for example in NIEs (see Amsden 1989, Chang 1994, Lall 1996). Instead, trade policy was very much influenced by macro economic policy, for instance, to reduce domestic demand for imports at the time of balance of payment deficit. The Ministry of Finance, the dominant agency which controlled the policy, had little knowledge or experience of industry and industrial restructuring (Lauridsen 2000, 16–20).

During the Thaksin government, the gap between science, technology and innovation policies and economics policies was reduced. Unlike its predecessors which paid the most attention to macro-economic stability, this government focused more on enhancing meso- and micro-level foundations for international competitiveness. The high priority of the 'competitiveness' issue on the government's agenda was illustrated by the establishment of a National Competitiveness Committee chaired by the Prime Minister. Investment policy, for example, has substantially changed. The main thrust of new investment policy was on the issues underlying the long-term competitiveness of the country, namely, the development of indigenous technological capability and human resources. A special investment package promoting 'Skill, Technology and Innovation' was initiated. Firms can enjoy one or two years extra tax incentives if they perform the following activities in the first three years: spending on R&D or designing using at least 1–2% of sales revenue; employing scientists or engineers with the minimum of a bachelors degree and constituting at least 5% of their workforce; spending at least 1% of total payroll on the training of employees; and spending at least 1% of total payroll on training the personnel of their local suppliers.

A mechanism to link science, technology and innovation policies with other policies, especially economic policies has been pursued, although has not yet being successful. A supra-ministerial policy body, the National Science and Technology Policy Committee (NSTC) was formed a few months before the Thaksin era. The Deputy Prime Minister is the chairperson of NSTC, and members are permanent secretaries of concerned ministries and experts in the fields of natural sciences, economics, and other social sciences and humanities. Also, during Thaksin government, there was an attempt to establish an inter-ministerial coordination mechanism by having Chief Science Officers in every concerned ministry to co-ordinate STI activities and interact with the NSTC (National Science and Technology Policy Committee 2004). This is an endeavour to broaden the scope of STI policies and integrate them with economics and other policies such as education and health.

The influence of the neoclassical economics paradigm

While science and technology policies in the past have been dominated by scientists who mainly subscribe to the linear model of innovation, neo-classical economists both in bureaucracy and universities were the ones who directly and indirectly formulated Thailand's economic policies. Therefore the market mechanism is highly regarded and the reason for government intervention is largely limited to market failures. This translates to policies formulation and implementation. For example, industrial policy in Thailand was constrained to the World Bank's 'functional' intervention such as promoting infrastructure building, general education, and export push in general. There were virtually no selective policy measures, such as special credit allocation and special tariff protection, targeting particular industries or clusters. The exception was the local content requirement in the automobile industry, which was successful in raising the local contents of passenger vehicles to 54% in 1986 (see Doner 1992). Interestingly, with the exception of the automotive industry, there were no reciprocal performance-based criteria (such as export and local value added and technological upgrading targets) set for providing state incentives for example in Korea or Japan (see Johnson 1982, Amsden 1989, Evans 1989,

1998, Chang 1994, Lall 1996). Investment promotion privileges, for example, were given away once approved. The intention of attracting foreign direct investment and promoting export overshadowed the need to develop local initiatives and indigenous technological capabilities. As a result, linkages between multinational corporations and local firms were also weak. Unlike Taiwan, governmental protection and promotion, without strengthening the absorptive capabilities of Thai suppliers, left a profound impact on the weak technology and suppliers' network of industries (Vongpivat 2003).

During the Thaksin regime, several influential people such as ministers and prime minister's advisors came from different backgrounds. They were not orthodox economists. Some of them had experience in business management education and practice and therefore applied management concepts to economic policy formulation. More weight was given to enhancing firm's innovative capabilities and systemic linkages among firms and between firms and other actors in innovation systems.

3.2. Selectivity and uncertainty

As mentioned above, before the Thaksin government, policy intervention in Thailand was limited to functional intervention. During the Thaksin regime, it was the first time that the Thai government implemented serious 'selective' policies addressing specific sectors and clusters. Based on the country's specialization and future potential, the government declared five strategic sectors which Thailand should pursue: automotive, food, tourism, fashion, and software. Clear visions have been given to these five sectors, which are: Kitchen of the World (food cluster); Detroit of Asia (automotive cluster); Asia Tropical Fashion, World Graphic Design and Animation Centre (software cluster); and the Asia Tourism Capital.

The cluster concept was used as a main industrial policy of the Thaksin Government for national, regional and local levels. At the national level, it was used to strengthen advanced industries both in service and manufacturing sectors such as the automotive, textile and garment, software and tourism sectors in order to make them to be coherent and innovative 'industrial clusters'. The National Economic and Social Development Board (NESDB) has been implicitly responsible for the overall cluster policy of the country. Moreover, Thailand's Board of Investment (BOI) initiated new investment packages in 2004 for specific strategic clusters such as the hard disk drive and semiconductor clusters. Eligible firms in these sectors were not only final product makers but also suppliers in the value chain. This indicates a transformation of the focus of investment policy measures from giving incentive for individual projects, which might not be related to each other, to using incentives to strengthen the cluster as a whole. At the regional level, Thailand was divided into 19 geographical areas. Each area had to plan and implement its own cluster strategy focusing on a few strategic products or services. It was supervised by the so-called 'CEO Governors', who were given authority by the central government to act like provincial Chief Executive Officers (CEOs). For the local level, the cluster concept was applied to increase the capacity of grass-root economics in the name of 'community-based clusters', especially to help the 'One-Tambon-One Product' succeed.

According to the NESDB, dealing with the problems of selectivity and uncertainty, clusters should be selected and developed via a bottom-up approach. The selection and development of a certain cluster should be carried out by its key actors, not by the top-down discretion of the central government. NESDB, therefore, has made significant attempts to diffuse the concept to various government and private-sector agencies which were key actors in specific clusters by organizing cluster seminars and workshops in the main regions of Thailand. It also commissioned a study to create a 'cluster map' of

Thailand, i.e. identifying significant agglomerations of firms that function or have the potential to function as clusters in various geographical locations throughout the country. Several government agencies such as the Department of Industrial Promotion and sectoral-specific institutes under the Ministry of Industry (Thai Automotive Institute, Thailand Textile Institute, National Food Institute, Electrical and Electronics Institute and so forth), the National Science and Technology Development Agency under the Ministry of Science and Technology, the Office of SMEs Promotion along with others have tried to develop their own cluster projects in their respective areas (Intellectual Property Institute 2006).

3.3. Problems of policy implementation and path dependency

In reality, the implementation of the changes initiated in the Thaksin era have been far from successful. Alhough a new thinking paradigm was introduced in favour of the SI approach at the top level of the policy making process, the middle and bottom levels were, to a large extent, locked in the old paradigm. Many senior policy makers in STI policies are still the same group of scientists or their successors who strongly believe in the linear model of innovation. They might have been introduced to the new concept and begun to use new terms such as 'innovation systems', 'clusters', 'innovation networks', 'linkages' and so forth, however, when they are involved in the STI policy making, they still place emphasis on research and development within public research institutes and universities and exploit 'existing' research capabilities and outputs to solve the problem of private firms, which are still mainly regarded as 'users' of knowledge and technologies. Policy measures to enhance the technological and innovative capabilities of firms and to solve systemic failures such as creating intermediaries, linkages, and institutional context (for instance, conducive intellectual property regime, trust, entrepreneurship) were given much less priority and resources. At the same time, for many government officials in economic ministries, the neo-classical economic paradigm still primarily directs the rationale for government intervention. Initiatives to solve systemic failures, such as providing needed grants to help private firms increase their technological capabilities, were opposed on the ground of market distortion and inducing corruption.

4. Conclusion and policy implications

From the mid 2000s, a growing number of developing countries have adopted the SI approach officially to formulate their innovation policies. This is the case even for the group of so-called 'less-successful developing countries', whose innovation systems are weak and fragmented leading to failure in technological catching up with forerunner countries. Thailand is one of them. By adopting this approach, Thailand has been successful in broadening the scope of its science and technology policy to cover 'innovation' and begun to introduce selective intervention policies for particular sectors/clusters. Nonetheless it has faced several hurdles in transforming policies into practice, such as: deep-rooted weakness and fragmentation of its innovation system (e.g. poor linkages among government agencies and between them and other actors); a lack of a clear and shared vision of policies; a lack of supporting institutions such as Shumpeterian entrepreneurship and trust; and, most importantly, path dependency and inertia in the policy formulation process due to the problem of being locked into old paradigms. The result is a policy that hardly addresses the identified systemic problems. The SI approach is like the icing on the cake with the main ingredients of the cake being neoclassical economics and the linear model of innovation.

This study, therefore, suggests that while SI might have been 'officially' adopted by less-successful developing countries, the practice still follows old innovation paradigms and barely addresses systemic problems. Policy implications are obvious. Less successful developing countries are facing two problems at the same time. Their innovation systems are weaker and more fragmented than those of forerunner countries. There are greater systemic problems to be solved and much more effort is needed. At the same time, introducing the SI approach in these countries is also more problematic. The problems of uncertainty, selectivity, policy path dependency and inertia are much more severe than those of the forerunners.

Here, we propose a two-sided policy recommendation. On the one hand, there is an urgency to educate policy makers and mainstream academics about the limits of the old paradigms (for example, the linear model of innovation and neo-classical economics approach in the Thai case). This could be time consuming because mindsets are very much preoccupied with deep-rooted old concepts. Training courses, lectures and seminars in the SI approach should be organized, not only for high-level policy makers but also middle- and lower-level policy practitioners, as well as people who are key actors in the systems such as people from the private sector and academics. These educational activities should be carried out at national, sectoral and regional levels. One the other hand, after a 'certain degree' of capacity in formulating and implementing policy measures along the line of SI approach have been achieved, attempts should be made to solve the vivid systemic problems of certain national, sectoral and regional innovation systems. Selected small projects might be a good start. If they are successful, it will create demonstration effects and confidence among policy makers and concerned parties.

These two policy recommendations should not be totally stepwise, developing countries have urgent problems to be addressed and they cannot wait until the capacity to handle the SI approach is fully developed. Instead, implementation of the two recommendations should go hand in hand, as they would mutually strengthen each other. To carry out these two recommendations, an organization similar to Sweden's VINNOVA specifically created to develop *effective* innovation systems, is needed (VINNOVA 2002, 2003). This organization might be a semi-governmental organization with high flexibility and autonomy but it is well-equipped with high-calibre people capable enough to make this organization a promoter of SI approach.

Notes

1. Indeed research conducted for the OECD countries (Mohnen 1966, c.f. Norgren and Hauckes 1999) has shown that the social rate of return of investments in R&D and Human Capital largely exceeds the private rate of return, therefore providing strong arguments for public intervention in the supply of R&D and the provision of human capital.
2. It is important to note that the absence of an optimum implies that there is no clear 'gap' that policy makers need to target as in the neoclassical theory. That is, policies cannot be objectively defined against a clear (and measurable) target.
3. One clear example of lock-in is the fossil energy. The productive system is so dependent on the fosile energy that it is preventing the expansion of new forms of energy (such as solar, eolic, etc).
4. The notion of market failures is associated to the existence of an optimum. Since the evolutionary theory and the systemic approach does not support the idea of an optimum but rather a miryad of systems performing in different ways, we prefer to talk about systemic problems instead of market failures.

Notes on contributors

Patarapong Intarakumnerd is now at the College of Innovation, Thammasat University, Thailand. He is a Regional Editor and a member of international editorial boards of *International Journal of*

Technology and *Globalisation*, *Science*, *Technology and Society Journal*, and *Asian Journal of Technology Innovation*. His research interests include the roles of intellectual property right in technological catching up of industrializing countries, and national innovation systems and industrial clusters in Asian newly-industrializing countries. He has been invited as an Advisor/Consultant of research projects commissioned by the World Bank, German Development Institute, UNCTAD, OECD, International Development Research Center of Canada and JICA.

Cristina Chaminade is a Full Professor in Innovation Studies at the Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund University (Sweden). She is affiliated to LEAP4D (Learning Economy Analysis for Development) at the Research Policy Institute, Sweden and visiting professor at HHL Leipzig School of Business (Germany). She holds a PhD in Economics from Autonomous University of Madrid (UAM). Her research focuses mainly on understanding innovation and knowledge creation in the globalized learning economy. She is coordinating several projects on globalization of innovation in China, India, South Africa and Central America. She has been author of numerous articles, book chapters and books in the fields of innovation systems and innovation system policy, particularly in developing countries like the *Handbook of Innovation Systems and Developing Countries*. She is also main Editor of the *Journal Innovation and Development*.

References

Amsden, A., 1989. *Asia's next giant: South Korea and late industrialisation*. New York: Oxford University Press.

Arnold, E., Bell, M., Bessant, J., and Brimble, P., 2000. *Enhancing policy and institutional support for industrial technology development in Thailand: the overall policy framework and the development of the industrial innovation system*. Washington, DC: World Bank.

Arrow, K., 1962. Economic welfare and the allocation of resources for invention. *In*: R. Nelson, ed. *The rate and direction of inventive activity*. Princeton, NJ: Princeton University Press, 609–629.

Bank of Thailand, 2007. [online]. *Thailand's economic indicators*. Available from: http://www.bot.or.th/bothomepage/databank/ EconData/Thai_Key/Thai_KeyE.asp [Accessed 28 March 2007].

Chaminade, C. and Edquist, C., 2006. From theory to practice. The use of the systems of innovation approach in innovation policy. *In*: J. Hage and M. De Meeus, eds. *Innovation, learning and institutions*. Oxford: Oxford University Press, 141–162.

Chang, H., 1994. *The political economic of industrial policy*. London: Macmillan.

Doner, R., 1992. Politics and the growth of local capital in Southeast Asia: auto industries in the Philippines and Thailand. *In*: R. McVey, ed. *Southeast Asian Capitalists, Southeast Asia Program (SEAP)*. New York: Cornell University Press, 223–256.

Edquist, Charles, 2004. Systems of innovation: perspectives and challenges. *In*: J. Fagerberg, ed. *The Oxford Handbook of Innovation*. Oxford: Oxford University Press, 181–208.

Edquist, C. and Chaminade, C., 2006. Industrial policy from a systems of innovation perspective. *European investment bank (EIB) papers*, 11 (1), 108–133.

Edquist, Charles, Malerba, Franco, Metcalfe, J. Stanley, Montobbio, F., and Steinmueller, W., eds, 2004. *Sectoral systems: implications for European innovation policy. Sectoral systems of innovation - concepts, issues and analysis of six major sectors in Europe. F. Malerba*. Cambridge: Cambridge University Press.

Eisenhardt, Kathleen and Martin, Jeffrey, 2000. Dynamic capabilities; what are they? *Strategic management journal*, 21 (9), 1105–1121.

Edquist, C. and Johnson, B., 1997. Institutions and organisations in systems of innovation. *In*: C. Edquist, ed. *Systems of innovation: technologies, institutions and organisations*. London: Pinter, 41–63.

Edquist, C., 1997. *Systems of innovation: technologies, institutions and organizations*. London: Pinter.

Evans, P., 1989. The future of the developmental state. *The Korean journal of policy studies*, 4 (2), 129–146.

Evans, P., 1998. Transferable lessons? Re-examining the institutional prerequisites of East Asian economic policies. *Development studies*, 34 (6), 66–86.

Freeman, C., 1987. *Technology policy and economic performance: lessons from Japan*. London: Pinter.

Intarakumnerd, P., 2002. National innovation system in less successful developing countries: the case of Thailand. *Research policy*, 31 (8–9), 1445–1457.

Intarakumnerd, P., Chairatana, P., and Tangjitpiboon, T., 2002. National innovation system in less successful developing countries: the case of Thailand. *Research policy*, 31 (8–9), 1445–1457.
Intarakumnerd, P., 2006a. Thailand's national innovation system in transition. *In*: B. Lundvall, P. Intarakumnerd and J. Vang, eds. *Asia's Innovation Systems in Transition*. Cheltenham, UK and Northampton, USA: Edward Elgar, 100–122.
Johnson, C., 1982. *MITI and the Japanese miracle: the growth of industrial policy, 1925–1975*. California: Stanford University Press.
Kline, Stephen and Rosenberg, Nathan, 1986. An overview of innovation. *In*: L.A. Rosenberg, ed. *The positive sum strategy*. Washington, DC: National Academy of Sciences, 289.
Koch, Per, Norgren, Lenmart, and Oksanen, Juha, 2003. Goodnip: *Good practices in Nordic Innovation Policies*. Oslo: STEP - Centre for Innovation Research.
Lall, S., 1996. *Learning from the Asian Tigers: studies in technology and industrial policy*. London: Macmillan Press.
Lauridsen, L., 2000. *Industrial policies, political institutions and industrial development in Thailand 1959–1991*. International Development Studies Working Paper No. 21, Roskilde University, Roskilde, Denmark.
Lauridsen, L., 2002. Coping with the triple challenge of globalization, liberalization and crisis: the role of industrial technology policies and technology institutions in Thailand. *European journal of development research*, 14 (1), 101–125.
Lipsey, R. and Carlaw, K., 1998. *A structuralist assessment of technology policies – taking schumpeter seriously on policy*, Industry Canada Research Publications Program, 123.
Lundvall, B-A., ed. 1992. *National systems of innovation. Towards a theory of innovation and interactive learning*. London: Pinter.
Lundvall, B-A., Intarakumnerd, P., and Vang, J., 2006. *Asia's innovation systems in transition*. Cheltenham, UK: Edward Elgar.
Mytelka, L.K. and Smith, K., 2002. Policy learning and innovation theory: an interactive and co-evolving process. *Research policy*, 31, 1467–1479.
National Science and Technology Policy Committee, 2004. Science and Technology Strategic Plan 2004–2013, National Science and Technology Development Agency (NSTDA), Bangkok.
Nelson, R., 1959. The simple economics of basic scientific research. *In*: N. Rosenberg, ed. *The economics of technological change*. Harmondsworth: Penguin Books.
Nelson, R., ed. 1993. *National innovation systems. A comparative analysis*. New York: Oxford University Press.
Nelson, Richard and Winter, Sydney, 1982. *An evolutionary theory of economic change*. Cambridge, MA: Harvard University Press.
Nooteboom, B., 2004. *Interfirm collaboration, learning and networks: an integrative approach*. London: Routledge.
Norgren, L. and Hauknes, J., 1999. Economic rationales of Government involvement in innovation and the supply of innovation related services, RISE – RTOs in the service economy. Work package report, wp3, University of Brighton, UK.
OECD, 1994. *Technology flows in National systems of innovation*. Paris: OECD.
OECD, 1996. *National innovation systems: Report on pilot case studies*. Paris: OECD.
OECD, 1997. *National innovation systems*. Paris: OECD.
OECD, 1998. Special Issue on "New Rationale and Approaches in Technology and Innovation Policy". STI review n. 22.
OECD, 1999. *Boosting innovation: The cluster approach.* Proceedings. Paris: OECD.
OECD, 2001. *Innovative clusters. Drivers of national innovation systems*. Paris: OECD.
OECD, 2002. *Dynamising national innovation systems*. Paris: OECD.
Office of Higher Education Commission, 2006. Report on Higher Education Development Project, Ministry of Education, Bangkok (in Thai).
Phasukavanich, C., 2003. The pace of Thailand through the Year 2020. Power point presentation, Bangkok, Thailand, 20 May. Mimeo.
Rosenberg, Nathan, 1982. *Inside the black box*. Cambridge: Cambridge University Press.
Rosenberg, Nathan, 1994. *Exploring the black box: technology, economics and history*. Cambridge: Cambridge University Press.
Smith, K., 2000. Innovation as a systemic phenomenon: rethinking the role of policy. *Enterprise and innovation management studies*, 1 (1), 73–102.

Smits, R. and Kuhlmann, S., 2004. The rise of systemic instruments in innovation policy. *International journal foresight and innovation policy*, 1 (1/2), 4–32.

Sripaipan, C., Vanichseni, S., and Mukdapitak, Y., 1999. *Technological innovation policy of Thailand* (Thai version). Bangkok: National Science and Technology Development Agency.

VINNOVA, 2002. Effective innovation systems and problem-oriented research for sustainable growth. Vinnova Strategic Plan 2003–2007. Stockholm, VINNOVA. Available from: http://www.vinnova.se [Accessed April 2006].

Vongpivat, P., 2003. A national innovation system model: an industrial development in Thailand. Unpublished PhD Thesis. The Fletcher School of Law and Diplomacy, Tufts University, Cambridge, USA.

Wong, P., 1999. National innovation systems for rapid technological catch-up: an analytical framework and a comparative analysts of Korea, Taiwan, and Singapore. Paper presented at the *DRUID's summer conference*, Rebild, Denmark.

Woolthuis, R.K., Lankhuizen, M., and Gilsing, V., 2005. A system failure framework for innovation policy design. *Technovation*, 25, 609–619.