

# **A REVIEW OF A LITERATURE ON INNOVATION, WITH A FOCUS ON POLICY AND INSTITUTIONAL IMPLICATIONS**

**Slavo Radosevic**  
**University College London**

Paper prepared for the World Bank and presented at GLOBELICS/PRIME  
Conference, Mexico City, September 24, 2008

*Draft. Not edited*

## **Abstract**

The underlying rationale for this review is that policy implications cannot be automatically derived from analyses of innovation issues i.e. 'normative' does not automatically follow from 'positive'. A view that policy application can be developed as an afterthought of positive analysis is similar to the logic of a linear innovation model whereby normative is derived in straightforward manner from the previous (positive) stage of research. This survey suggests that positive analysis is only one of inputs into understanding of policy issues. In that respect, there are limits to 'translation' of any conceptual framework into a concrete policy setting. For policy purposes it is essential to understand what has been 'lost in translation' but also what has been (unexpectedly) added. The limited usefulness of policy implications derived directly from either conceptual or empirical analysis call for explicit policy focused research.

This review present taxonomy of innovation policy literature through a) a literature review of a number of selected references (over 220), and b) grouping of these references into specific groups based on their theoretical /conceptual and empirical (practitioners) focus. We show that there is not a coherent paradigm (research agenda) in innovation policy area but there is a peaceful co-existence of several often incompatible perspectives (paradigms). We outline newly emerging areas of innovation policy analysis (complementarities in growth, systems and policies; interactions between innovation systems and globalization; return of the State into the analysis of innovation policy, and development of concept of broad (implicit) innovation policy).

## Table of Contents

I.	INTRODUCTION .....	4
1.1.	Rationale for review: a policy implication as an afterthought or legitimate area of research on its own?.....	5
II.	PROBING THE CONTEXT: BIBLIOMETRIC PICTURE AND ITS LIMITS IN UNDERSTANDING INNOVATION POLICY LITERATURE.....	6
III.	A TAXONOMY OF LITERATURE ON INNOVATION POLICY .....	12
IV.	ECONOMIC GROWTH AND POLITICAL ECONOMY OF INNOVATION POLICY .....	13
	Economic growth literature with Innovation policy implications .....	13
	Innovation Policy for Development.....	14
	Systems of innovation as growth theory: the absence of automatically derived policy implications.....	15
	Techno-Economic Paradigm and innovation policy.....	16
	Institutional restructuring and innovation policy .....	18
	State and Markets in Innovation Policy .....	20
	Sociology of innovation policy .....	22
	THEORY OF INNOVATION POLICY .....	23
	<i>New, old and against rationales</i> .....	23
	<i>Evolutionary technology policy</i> .....	26
	<i>Conceptual and methodological issues of Innovation Systems</i> .....	32
	<i>The scope of national system of innovation: broad or narrow</i> .....	32
	<i>Innovation system (broad) between theory and 'low level' theory</i> .....	34
	<i>Institutional vs. functional approach to innovation system</i> .....	35
	<i>Methodological issues of innovation policy (uncertainty, time)</i> .....	37
A.	INNOVATION SYSTEMS .....	37
1.	<i>National Innovation Systems</i> .....	38
2.	<i>NIS and Globalization</i> .....	39
3.	<i>Sectoral systems of innovation</i> .....	40
4.	<i>Regional innovation systems</i> .....	41
5.	<i>Interaction intensive environments</i> .....	41
B.	POLICY EVALUATIONS .....	43
1.	<i>Evaluation of national innovation Policies</i> .....	44
2.	<i>Broad innovation policy</i> .....	48
3.	<i>Evaluation of specific innovation policy instruments</i> .....	51
V.	POLICY IMPLICATIONS OF EVOLUTIONARY PERSPECTIVE IN ECONOMICS .....	52
A.	Evolutionary or structuralist - evolutionary perspective? .....	52

B.	Policy implications of evolutionary perspective .....	54
C.	Is there evolution of evolutionary perspective? .....	57
VI.	CONCLUSIONS, POLICY AND INSTITUTIONAL IMPLICATIONS .....	57
A.	Innovation System as a Dominant Policy Discourse .....	57
B.	Limits of (evolutionary perspective) policy implications and need for explicit analyses grounded in (broad) evolutionary perspective.....	58
C.	Co-evolving Theory and Policy and Policy Learning.....	59
VII.	Policy and institutional implications of the review.....	60
A.	Complementarities in growth, systems and innovation policies .....	60
B.	Interaction between domestic and foreign led modernization .....	62
C.	State as a missing actor in evolutionary perspective.....	63
D.	Broad innovation policy: a future growing area in innovation policy analysis	64

# I. INTRODUCTION

This papers aims to:

- To review evolution of policy implications of evolutionary perspective in economics
- To review the emerging literature on innovation policy by ‘practitioners’
- Analyse how the literature should address policy and institutional implications of positive analysis of innovation

This task has been approached through a) a literature review of a number of selected (over 220) references, b) grouping those references into specific groups based on their theoretical /conceptual and empirical (practitioners) focus, and c) analysis of questions raised in ToR.

An area of innovation studies is a rapidly expanding area. A latest review of this burgeoning area is 2006 *Oxford Handbook of Innovation* edited by Fagerberg, J, D. Mowery and R. Nelson<sup>1</sup>. There are several textbooks that tackle part of this survey as well as several review papers most of which are used in this report. However, there has not been a review paper specifically on the topic of innovation policy within broad growth/development and evolutionary economics perspective.

The title of the report (as defined by ToR) suggests that this should be a literature review on innovation. However, this paper has not even attempted to dwell on this broad issue but has confined itself to innovation policy. On the other hand, it is also impossible to isolate analysis of policy issues from analysis of technological change itself. The area of innovation policy studies is also growing but is still amenable to a review in the sense that it is possible to capture a variety of issues and derive conclusions with some confidence.

ToR established distinction between so called ‘birds’eye view’ of innovation and contrasting micro view, a ‘view from the trenches’. The underlying idea is that there is a significant difference in perspective and issues tackled between these two viewpoints and that this gap calls for analysis on ‘how the literature should address policy and institutional implications of positive analysis of innovation’. This sharp distinction between these two viewpoints is difficult to establish in this area in both cognitive (knowledge) as well as in social terms. This first aspect should become (hopefully) throughout the survey. As many ‘theoreticians’ and ‘practitioners’ in this are belong to the same group of innovation scholars and enlightened policy makers or consultants this distinction is difficult to establish, at least by reviewing area through published sources. This proximity of scholars, policy makers and consultants represent an important feature of the area which is not established as standard discipline. In fact, we would argue that this is an important source of dynamism of the area. Based on academic and policy literature it may be argued that there is a community of innovation scholars rather than two camps of ‘practitioners’ and

---

<sup>1</sup> Fagerberg, J, D. Mowery and R. Nelson (eds)(2006) *Handbook of Innovation*, Oxford University Press, Oxford

‘theoreticians’. A study by Fagerberg & Verspagen tries to answer ‘is there a global community of innovation scholars?’<sup>2</sup> and concludes that:

*‘a global innovation studies community exists as a collection of a large number of relatively small groups (characterized dense internal relationships) defined along geographical and disciplinary lines. Although the field has spread over many countries and disciplines, it is particularly developed in Europe and among scholars with a background in economics. These smaller groups, however, are embedded in larger transnational groups or clusters that are kept together by what is commonly referred to as “weak ties”. Leading scholars, professional associations and journals all play an important role in keeping these larger groups together (as well as distinguishing them from each other)’ (p.1).*

Based on Fagerberg and Verspagen survey the major meeting places of the community of innovation scholars are: International Schumpeter Society (ISS), Danish Research Unit for Industrial Dynamics (DRUID), European Association for Research in Industrial Economics (EARIE), Academy of Management (AOM), European Meeting on Applied Evolutionary Economics (EMAEE), European Association for Evolutionary Political Economy (EAPE), National Bureau of Economic Research (NBER), Regional Studies Association Conferences (RSA), International Association for Management of Technology (IAMOT), Strategic Management Society (SMS), European Group for Organizational Studies (EGOS), GLOBELICS, R&D Management Activities, Regional Science Association International (RSAI), and European Association for the Study of Science and Technology (EASST).

From author’s own experience participants on the majority of these places are academics but also enlightened policy makers. However, the most important is that many participating academics are frequently involved as ‘practitioners’ through field research and consultancy. So, distinction between ‘theoreticians’ and ‘practitioners’ in this area cannot be established in a straight forward manner by grouping authors in one of two categories. In fact, as argued by Mytelka and Smith (2002) ‘the theory-policy link has been central to the intellectual development of this field, which would have been impossible within the constraints of existing disciplinary structures and university funding systems’ (p.1467)<sup>3</sup>. So, idea that there is a gap between ‘bird’s’ and view from ‘trenches’ assumes that there is an emerging gap and that the interactive and co-evolving process that Mytelka and Smith talk about is not any more there, or at least, that an increasing theorizing has become dissociated from the problems of practitioners and vice versa - problems from ‘trenches’ are not recognised as ‘legitimate’ or ‘relevant’ for academic inquiry. This is actually very interesting proposition which will be implicitly tested throughout this survey.

### 1.1. Rationale for review: a policy implication as an afterthought or legitimate area of research on its own?

---

<sup>2</sup> Jan Fagerberg & Bart Verspagen (2006) ‘Is there a Community of Innovation Scholars?’, Paper presented at the DRUID Summer Conference 2006 on ‘Knowledge, Innovation and Competitiveness: Dynamics of Firms, Networks, Regions and Institutions’, Copenhagen, Denmark, June 18-20, 2006

<sup>3</sup> Lynn K. Mytelka and Keith Smith (2002) Policy learning and innovation theory: an interactive and co-evolving process, *Research Policy* 31 (2002) 1467–1479

The underlying rationale for this review is that policy implications cannot be automatically derived from analyses of innovation issues i.e. ‘normative’ does not automatically follow from ‘positive’. In the context of evolutionary economic theory Morris Teubal (2002)<sup>4</sup> expressed it succinctly by stating:

*‘Despite recent advances in the Evolutionary and Systems Perspectives to Economic Change (SI), confusion still exists about how to apply it to the design and implementation of Innovation & Technology Policy (ITP) in concrete settings. Since the ‘Normative’ aspects of systems of innovation are framed in terms so general to make them insufficient or inadequate as guides and tools for actual policymaking, a presumption exists that **additional theoretical and conceptual knowledge is required**’ (my underlying).*

A view that policy application can be developed as an afterthought of positive analysis is similar to the logic of a linear innovation model whereby normative is derived in straightforward manner from the previous (positive) stage of research. This survey suggests that positive analysis is only one of inputs into understanding of policy issues. In that respect, there are limits to ‘translation’ of any conceptual framework into a concrete policy setting. For policy purposes it is essential to understand what has been ‘lost in translation’ but also what has been (unexpectedly) added. The limited usefulness of policy implications derived directly from either conceptual or empirical analysis call for explicit policy focused research. Ideally, innovation policy making would greatly benefit from action type of research. However, it seems that academic strive for ‘global excellence’ works counter to this trend and very often leads to ‘local irrelevance’.

In continuation, we present a brief bibliometric picture of the area of innovation policy (section 2). Section 3 present a taxonomy of innovation policy literature generated in bottom up fashion where issues are grouped based on a combination of two criteria: level (conceptual/empirical) and diversity of issues (policy areas). Section 4 summarises the policy implications of broad evolutionary perspective in economics. This was necessary in order to integrate views of ‘narrow’ evolutionary and systems of innovation perspective into of one ‘broad’ evolutionary perspective with respect to their relevance for policy practice. Finally, conclusions (section 5) point to the major gaps and challenges in the innovation policy analysis.

## **II. PROBING THE CONTEXT: BIBLIOMETRIC PICTURE AND ITS LIMITS IN UNDERSTANDING INNOVATION POLICY LITERATURE**

This review is based on an extensive literature search and carries all advantages and drawbacks of such exercise. On a good side, use of databases has tremendously improved speed of search and review. However, this has also led to biases towards good coverage of journal papers and poor coverage of books and conference papers.

---

<sup>4</sup> Teubal, *J Evol Econ* (2002) 12: 233–257

We have reviewed all references in database *Web of Science* with key words ‘innovation’, ‘technology’, ‘knowledge’, ‘evolutionary’ taken solely or combined with word ‘policy’. We focused mainly on papers published in between 1995 and 2008 but have also searched older references. In addition, we searched JSTOR database, GLOBELICS conferences website, DRUID website, and Schumpeterian Society conferences website. We also searched Googles Scholar database, and checked for Web of Science search by checking *Ingenta*, *Informworld*, and *Science Direct* databases. Last but not least we complemented this by search of our own database developed over a long period of time for purposes of research, teaching or simply personal urge to keep abreast of research in this area. This latter aspect is essential in the area of innovation policy where much of very valuable analyses are not necessarily ‘captured’ by databases like *Web of Science*. Activities of consultants, international organisations and national governments form an essential part of picture of research relevant in this area. In addition, a large number of mimeo and other unpublished papers complete a picture. However, this survey does not pretend to be a comprehensive in any quantitative manner but primarily in terms of capturing a variety or qualitatively different contributions to our understanding of innovation policy area within primarily heterodox and evolutionary perspectives.

The basis for this review is *ad hoc* created database with above 220 references which has been used as one of the basis to develop taxonomy of major areas of research on innovation policy (table 5).

In continuation, figure 1 and tables 1-4 summarise bibliometric picture of research in ‘innovation policy’ area. As background for this paper we have explored bibliometric results for innovation policy related area by using keywords: ‘technology’, ‘knowledge’, ‘science’ and ‘evolutionary’ combined with ‘policy’. However, results do not substantially change the cross section picture generated by using only keyword(s): innovation policy.

Figure 1 shows fast growth of papers in innovation policy area which after mid-1990s started to grow at more than 100 papers by year and reaching in 2007 number of 426 papers. It is interesting that 62% of all papers published in innovation policy area have been published after year 2000. However, a similar picture is generated if keywords technology policy and knowledge policy is used.

Figure 1: Number of papers with keyword(s) ‘innovation’ and ‘policy’, 1970-2007 in *Web of Science*

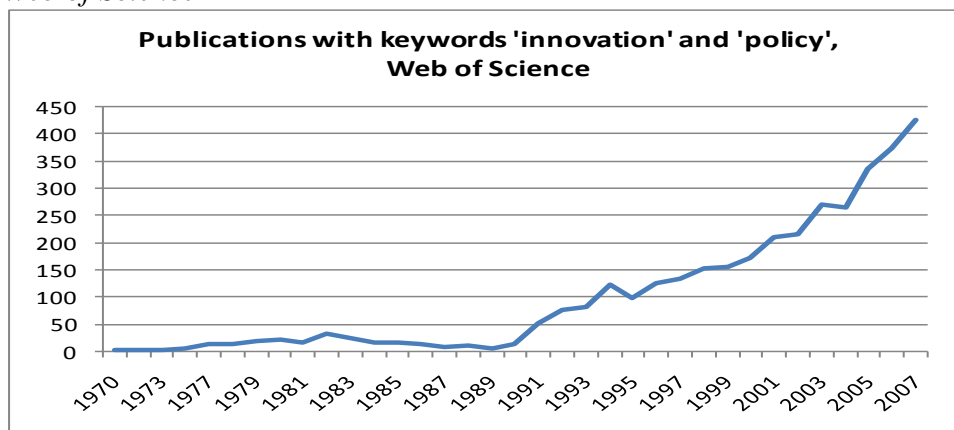


Table 1 shows top 50 journals which in period 1979-2008 published papers with keyword(s) ‘innovation policy’. Forty three percent of papers in this area are published in these journals. This may seem as high concentration but this number is quite dispersed across top 50 journals. {This dispersion is even stronger for citations to these journals which for the top journal in terms of citations (*Research Policy*) is only 2.6% as compared to share of 7% for publications.} The only two journals with substantial number of papers (over 100) are *Research Policy* and *Technovation*. For other journals this area does not seem to be central, including R&D and innovation studies oriented journals like *R&D Management*, *Industrial and Corporate Change* or *Technology in Society*. It is interesting that innovation policy is relatively strongly present in *Energy Policy* and *Telecommunication Policy*. We have highlighted those journals which we have frequently used in this survey i.e. these are journals which have published a relevant research from broad evolutionary perspective.

Table 1: Major journals in innovation policy area: number of papers based on occurrence of keywords ‘innovation’ and ‘policy’ 1979-2008

Source Title	Papers	% of 3610
1 <b>RESEARCH POLICY</b>	258	7.15%
2 <b>TECHNOVATION</b>	102	2.83%
3 <b>INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT</b>	83	2.30%
4 EUROPEAN PLANNING STUDIES	74	2.05%
5 <b>ENERGY POLICY</b>	73	2.02%
6 <b>TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE</b>	67	1.86%
7 REGIONAL STUDIES	59	1.63%
8 <b>TECHNOLOGY ANALYSIS &amp; STRATEGIC MANAGEMENT</b>	55	1.52%
9 ENVIRONMENT AND PLANNING C-GOVERNMENT AND POLICY	42	1.16%
10 ECOLOGICAL ECONOMICS	34	0.94%
11 R & D MANAGEMENT	32	0.89%
12 ENVIRONMENT AND PLANNING A	30	0.83%
13 POLICY STUDIES JOURNAL	30	0.83%
14 URBAN STUDIES	29	0.80%
15 SMALL BUSINESS ECONOMICS	27	0.75%
16 <b>WORLD DEVELOPMENT</b>	25	0.69%
17 <b>TELECOMMUNICATIONS POLICY</b>	23	0.64%
18 BUILDING RESEARCH AND INFORMATION	22	0.61%
19 EUROPEAN URBAN AND REGIONAL STUDIES	22	0.61%
20 JOURNAL OF CLEANER PRODUCTION	22	0.61%
21 OXFORD REVIEW OF ECONOMIC POLICY	22	0.61%
22 HEALTH POLICY	21	0.58%
23 PUBLIC ADMINISTRATION REVIEW	21	0.58%
24 SCIENTOMETRICS	21	0.58%
25 <b>FUTURES</b>	20	0.55%
26 HEALTH AFFAIRS	20	0.55%
27 <b>INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION</b>	20	0.55%
28 ENTREPRENEURSHIP AND REGIONAL DEVELOPMENT	18	0.50%



29	JOURNAL OF POLICY ANALYSIS AND MANAGEMENT	17	0.47%
30	EKONOMICKY CASOPIS	16	0.44%
31	ENVIRONMENTAL & RESOURCE ECONOMICS	16	0.44%
32	<b>INDUSTRIAL AND CORPORATE CHANGE</b>	16	0.44%
33	PUBLIUS-THE JOURNAL OF FEDERALISM	15	0.42%
34	<b>TECHNOLOGY IN SOCIETY</b>	15	0.42%
35	JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT	14	0.39%
36	<b>JOURNAL OF EVOLUTIONARY ECONOMICS</b>	14	0.39%
37	ECONOMIC DEVELOPMENT QUARTERLY	13	0.36%
38	ENVIRONMENTAL POLITICS	13	0.36%
39	IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT	13	0.36%
40	INTERNATIONAL JOURNAL OF TECHNOLOGY ASSESSMENT IN HEALTH CARE	13	0.36%
41	JAHRBUCHER FUR NATIONALOKONOMIE UND STATISTIK	13	0.36%
42	JOURNAL OF HEALTH POLITICS POLICY AND LAW	13	0.36%
43	MANAGEMENT SCIENCE	13	0.36%
44	RAND JOURNAL OF ECONOMICS	13	0.36%
45	AGRICULTURAL ECONOMICS	12	0.33%
46	ENERGY ECONOMICS	12	0.33%
47	LONG RANGE PLANNING	12	0.33%
48	PUBLIC ADMINISTRATION	12	0.33%
49	SOCIAL SCIENCE & MEDICINE	12	0.33%
50	AMERICAN BEHAVIORAL SCIENTIST	11	0.30%
		1570	43.49%

A picture of innovation policy as relatively dispersed area is confirmed by the list of major ten organisations whose authors have published in this area (table 2). A list of the most prolific authors in this area confirms dispersed structure of this area as the most productive contributor (P. Cooke) has 9 publications in this area while the majority of top 50 authors have 3-4 papers. This further reinforces a picture that innovation policy is most often one of the areas of involvement of researchers in these areas but it rarely constitutes the sole area of research.

Table 2: Major organisations publishing in innovation policy, 1979-2007

Institution Name	Record Count	% of 3610
HARVARD UNIVERSITY	67	1.86%
UNIVERSITY OF SUSSEX	65	1.80%
UNIVERSITY OF CALIFORNIA BERKELEY	56	1.55%
UNIVERSITY OF MANCHESTER	41	1.14%
UNIVERSITY OF CAMBRIDGE	39	1.08%
MIT	34	0.94%
STANFORD UNIVERSITY	32	0.89%
UNIVERSITY NEWCASTLE UPON TYNE	32	0.89%

This picture is further reinforced by broad disciplinary base of innovation policy. Papers in this area usually involve several disciplines so that the overall number of papers across disciplines surpasses the overall number of papers by 20% (table 3). Economics, management, planning & development and environmental studies are

four major areas of innovation policy studies but these are combined with a large number of other areas.

Table 3: Major subject areas addressing the issue of innovation policy: areas with over 100 publications with keywords ‘innovation’ and ‘policy’, 1979-2007

Subject Area	Record Count	% of total number of papers
ECONOMICS	729	20.19%
MANAGEMENT	724	20.06%
PLANNING & DEVELOPMENT	561	15.54%
ENVIRONMENTAL STUDIES	458	12.69%
BUSINESS	324	8.98%
OPERATIONS RESEARCH & MANAGEMENT SCIENCE	230	6.37%
POLITICAL SCIENCE	225	6.23%
PUBLIC ADMINISTRATION	218	6.04%
ENVIRONMENTAL SCIENCES	201	5.57%
GEOGRAPHY	173	4.79%
ENGINEERING, INDUSTRIAL	154	4.27%
ENERGY & FUELS	111	3.07%
HEALTH CARE SCIENCES & SERVICES	111	3.07%
URBAN STUDIES	110	3.05%
MULTIDISCIPLINARY SCIENCES	101	2.80%

A picture of highly dispersed area with broad disciplinary base is somewhat modified when we take into account country of origin of innovation policy papers. The degree of concentration here is the highest with the US having 35% of authored or co-authored papers and the UK behind with the share of around 20%. Area is populated by contributions from developed countries with India and China being on the 19th and 20<sup>th</sup> place with 45 and 44 papers respectively.

Table 4: Major countries/territories publishing in area of innovation policy, 1979-2007

Country/Territory	Record Count	% of 3610
1 USA	1293	35.82%
2 ENGLAND	644	17.84%
3 NETHERLANDS	215	5.96%
4 GERMANY	204	5.65%
5 CANADA	190	5.26%
6 FRANCE	117	3.24%
7 AUSTRALIA	107	2.96%
8 ITALY	99	2.74%
9 SPAIN	84	2.33%
10 SCOTLAND	83	2.30%
	2869	79.47%

This brief overview based on bibliometric data indicates:

- i) A low concentration of journals, authors and organisations which suggest, and the qualitative analysis undertaken in the next section confirms, that there is

not one coherent paradigm or research agenda in innovation policy area. In other words, innovation policy research does not have a coherent research agenda or a set of commonly agreed research questions.

- ii) In view of these findings a survey based only on academic references would not be appropriate. This is an emerging area with broad disciplinary structure and with strong links and mutual flows of ideas from universities but also from contract research organisations to consultancies, international organisations, public agencies and other public policy bodies. This has further confirmed our decision to complement search of academic references with search from several established conferences and other available sources.

In continuation we try to interpret these results within broad innovation policy literature. Why this area does not yet have a coherent research agenda? Keith Pavitt and William Walker in their now 32 years old review of innovation policy (Pavitt and Walker)<sup>5</sup> tried to answer the same question.

*‘Ideally, such policies (cf. innovation policies) should emerge from empirically substantiated theories, just as government policy towards full employment emerged from the Keynesian reformulation of the theory of investment. In the case of technological innovation, such theories should explain the dynamics of technological innovation in the industrial firm, and predict the ways in which governments can influence these innovation processes. Unfortunately, no such theories exist’.*

A 30 years after, are we anything closer to theory of the dynamics of technological innovation which seems to be indispensable for generating empirically substantiated and theoretically grounded policy implications? One cannot deny a huge improvement in our empirical understanding of innovation patterns and factors of innovation process compared to 30 years ago. In addition, evolutionary based theories of economic and technological change are much better suited to illuminate stylized facts of technological innovation. However, unlike in natural sciences our object of research also keeps changing so that our knowledge frontier should always be assessed in relation to continuously moving object of research.

For example, research on national innovation systems has established itself as accepted perspective exactly at the time when global supply chains and FDI have started to link up national innovation systems through financial, production and technological flows. Philip Auerswald and Lewis Branscomb (2008) nicely summarise this continuous policy problem as ‘fight (of) the last war’.

*‘The existence of a fundamental relationship between invention, innovation, and economic growth, as insisted upon by Schumpeter, is increasingly taken as an article of faith in nations around the world. Yet, the inventions-to-growth relationship is today more complex and less bounded at the scale of the nation than ever before. Just as the inventions-to-growth policy model—focusing on the development of capabilities to undertake basic science and a nurturing of entrepreneurial talent—is beginning to gain widespread acceptance, its shortcomings are becoming*

---

<sup>5</sup> K. Pavitt and W. Walker (1976), Government policy towards industrial innovation: a review, *Research Policy* 5 (1976) 11-97

*increasingly evident. (...) its shortcomings (are visible through, my addition) the emergence of the ‘globally networked enterprise.’*<sup>6</sup>

This moving frontier can be detected in changing innovation models which for innovation policy serve as first approximations of reality or ‘glasses’ which indicate the basic patterns of innovation. They largely reflect our increasing knowledge of innovation process (see for example the latest review of models and the innovation management area by Gann, Dogdson and Salter, 2008). Yet, analysis of these models, which form the backbone of teaching in innovation studies, shows how imperfect devices we have at our disposal. Mike Hobday questions their relevance by concluding:

*‘ (...) there is very little evidence to support the idea that actual innovation processes have evolved in the way suggested. Indeed, the interpretation of five successive generations appears to have as much to do with evolving academic perceptions of innovation processes, rather than empirically observed changes’*<sup>7</sup>.

So, before we embark on reviewing the area it is essential to have a dose of healthy scepticism regarding human ability to establish relevant ‘theory / empirics – policy’ link. An understanding of the past partly helps in understanding the future but equally ‘stylized facts’ and ‘best practices’ may be only reflections of the innovation patterns that have lost their relevance exactly at the moment when they become conventional policy wisdom.

In summary, it is not quite clear whether innovation policy will ever pass its critical stage and become an established discipline. Although Schumpeter was writing about routinisation of the innovation process we should bear in mind that innovation is essentially an entrepreneurial and evolutionary process. So, our ambition to canonize some of its determinants (including innovation policy) may be a kind of bad utopia. If innovation policy ever gets a coherent research agenda it may be the end of innovation policy as we know it today.

### **III. A TAXONOMY OF LITERATURE ON INNOVATION POLICY**

Based on an extensive literature review we created a bottom up taxonomy based on grouping of over 220 references collected in database compiled for the purpose of this survey. The result of this grouping is the table 5 below which contains major groups and sub-groups of innovation policy literature. The objective was to generate a sufficient number of references so that we can get an idea of *diversity* of issues covered by literature as well as their *theory/empirics orientation*. However, it also

---

<sup>6</sup> Philip Auerswald, Lewis M. Branscomb (2008) Research and innovation in a networked world *Technology in Society* 30 (2008) 339– 347

<sup>7</sup> Hobday, Michael (2005) 'Firm-level Innovation Models: Perspectives on Research in Developed and Developing Countries', *Technology Analysis & Strategic Management*, 17:2, 121 — 146

remains subjective as we do not have a clear formal criterion by which groups and sub-groups are generated. Such a criterion could have been based on: methodology (theoretical, empirical, appreciative theory), level of analysis (macro, micro, mezzo), or disciplinary origin. However, as any taxonomic work it would still contain a large degree of arbitrariness as many of references fall across several of these categories.

Based on detailed review of literature on innovation policy we could distinguish between four broad areas: literature on Economic Development and Political Economy of Innovation Policy; Theory of innovation policy literature; Literature on Innovation Systems, and Policy evaluations literature. In continuation, we survey key issues in each of these four major areas.

Table 5: Major areas of literature on innovation policy

Economic Development and Political Economy of Innovation Policy	Theory of innovation policy	Innovation systems	Policy evaluations
Economic Development with Innovation policy implications	New and old rationales	National Innovation Systems <i>NIS framed country analyses</i>	Evaluation of national innovation Policies <i>Evaluations of R&amp;D (organisations and partnerships, programs)</i>
Innovation Policy for Development	Evolutionary technology policy	- analytically founded - descriptive	- <i>policy implication of globalisation of NIS</i> - <i>FDI subsidiaries and innovation policy issues</i> <i>System (R&amp;D) evaluation</i>
Systems of innovation as growth theory: policy issues	Conceptual and methodological issues of Innovation Systems	<i>NIS framed inter-country comparisons</i>	Sectoral systems of innovation <i>Sectoral analyses framed within the sectoral system innovation approach</i>
Techno-Economic Paradigm and IP	Methodological issues of innovation policy (uncertainty, time)	<i>Comparative analyses of innovation policies: NIS focused</i>	Broad innovation policy - finance - competition
Institutional restructuring and innovation policy			- regulation and environment - education
State and Markets in Innovation Policy		Interaction intensive environments - Networks  - Clusters  - Intermediaries	Evaluation of specific IP instruments - tax incentives
Sociology of Innovation Policy		Regional innovation systems <i>Evaluation of Regional Innovation Policies RIS framed</i> <i>Typologies of regions (differentiation of IP)</i> <i>Regionalization of IP</i>	- patents - public procurement

Source: author

## IV. ECONOMIC GROWTH AND POLITICAL ECONOMY OF INNOVATION POLICY

A literature on Economic Development and Political Economy of Innovation Policy takes economic growth and long-term structural change in all its different conceptual perspectives as the point of departure. This group is the closest to what ToR define as ‘bird’s eye’ view of innovation policy.

### *Economic growth literature with Innovation policy implications*

A literature on economic growth and economic development is inextricably linked to issues of technology accumulation through either explicit treatment of some aspects of technology like R&D in endogenous growth theory or implicit treatment of technology through the concept of total factor productivity (TFP) in neo-classical growth approaches. This literature is usually based on growth regressions and its

policy implications are far from clear. For example, policy relevance of share of TFP remains a mystery for author of this survey. As Bosworth and Collins (2003)<sup>8</sup> in the update of literature based on growth regressions point out results from the many growth regression studies generate opposite policy conclusions. In addition, authors are surprised that these regressions demonstrate the relatively minor impact of direct role of conventional government policies. There are several reviews of these literature (for example, Temple (1999)<sup>9</sup>, Easterly and Levine (2001)<sup>10</sup> and we will not go into this area as much of what this literature can say for policy is quite vague and too aggregate or has been already discussed in cited surveys above.

A recent exercise of similar type but with explicit treatment of technological and institutional variables is report by Fagerberg & Martin Srholec (2007)<sup>11</sup>. Their conclusion is that *'countries that succeed in developing and sustaining strong innovation capabilities and well-functioning systems of governance do well economically while those that fail tend to fall behind'* (p.33). A policy implication is that a well developed innovation system backed by good governance is essential for catch up. An analysis by Furman and Hayes (2004)<sup>12</sup> concludes that *'no country appears to achieve high levels of investment in innovation without innovation-oriented policies'* though this is necessary *'but not sufficient to create the environment required to achieve sustained innovation at the world's technological frontier'*.

From our perspective a downside of these types of analyses is that policy implications are derived as a direct result of regression analysis ie. those variables that are significant in explaining growth are exactly those that policy should influence. These variables are too aggregate to be useful for policy purposes. In addition, they may not be the best variables for policy to focus on as they may be an outcome of other economic and socio-political factors i.e. proximate rather than true causes of growth. Instrumental variables do not solve this problem but even more complicate understanding of policy issues. What underpins these problems is the lack of equivalence between outcomes and institutional variables. As a result the institutional configurations that characterize national innovation systems of countries that have managed to catch up vary substantially (Furman and Hayes, 2004). However, these studies through their 'built- in' methodological bias actually reinforce the idea that there are common (universal) drivers of innovation and growth.

### *Innovation Policy for Development*

---

<sup>8</sup> Barry Bosworth and Susan M. Collins (2003), *The Empirics of Growth: An Update*, mimeo

<sup>9</sup> Temple Temple, Jonathan. 1999. "The New Growth Evidence." *Journal of Economic Literature* 37(1):112-156.

<sup>10</sup> Easterly and Levine (2001) It's Not Factor Accumulation, What have we learned from a decade of empirical research on growth?. *World Bank Econ Rev*; 15: 177-219

<sup>11</sup> Jan Fagerberg & Martin Srholec (2007) The role of "capabilities" in development: Why some countries manage to catch up while others stay poor, DIME Working paper 2007.08 in the series on "Dynamics of Knowledge Accumulation, Competitiveness, Regional Cohesion and Economic Policies"

<sup>12</sup> Jeffrey L. Furman and Richard Hayes (2004), Catching up or standing still? National innovative productivity among 'follower' countries, 1978-1999, *Research Policy* 33 (2004) 1329-1354

The limits of policy implications derived as an afterthought of growth regressions led to a new literature which explicitly addresses the issue of policies for development. For example, Trajtenberg (2006)<sup>13</sup> explicitly addresses the issue of innovation policies for development by using an example of Israel. He addresses the scope of policy (broad), its rationale and the main levers. Rodrik (2008)<sup>14</sup> is the most known today as a scholar which has deconstructed the conventional case against industrial policy. The basic idea is that through appropriate institutional design the traditional informational and bureaucratic constraints on the exercise of industrial policy could be molded. A much of these ideas have been already developed in analyses of Chang Ha Joon and Peter Evans but with a much more explicit political economy flavour. In our view, a good timing and ‘policy dressing’ of these ideas in Rodrik’s version has made them more acceptable in policy circles. A broad and systematic attempt to explicitly address the issue of innovation policy for development is the work of Stiglitz’s led group (see Cimoli et al, 2007)<sup>15</sup>. The aim is to build a ‘new consensus’ i.e. a new paradigm in development policy which is largely framed around the ‘market enhancing view of government’ and overlaps with views on systems of innovation as growth theory (see below). A following quote from Cimoli et al (2008) captures these two key points:

*‘Such a "consensus", we suggest, is going to be based on a pragmatic view of markets whereby the latter sometimes work in a "developmental" sense, sometimes do not, and even when do work, their effectiveness cannot be separated from the contribution of supporting institutions and policies’ (Cimoli et al, 2008, p1).*

### *Systems of innovation as growth theory: the absence of automatically derived policy implications*

In his 2002 paper Chris Freeman<sup>16</sup> approached to analysis of long-term growth through prism of national innovation systems. Although Freeman nowhere develops explicit idea that NIS could be taken as a theory of growth this nevertheless comes strongly by reading this and other of his papers. In the essence of this approach is the idea that growth emerges as fortuitous, partly spontaneous and partly strategically driven, coupling or complementarities between different societal subsystems (business, S&T, finance, trade, government, etc). In Nelson’s (2007)<sup>17</sup> view a long run economic change should be understood as involving ‘*the co-evolution of technologies in use and the institutional structures supporting and regulating these*’. Here, the idea is that NIS is a part and parcel of technology – institutions co-evolution. BA Lundvall, one of godfathers of the NIS concept confines this approach to being ‘*the application of (this concept) (...) on economic development*’ rather than being a

---

<sup>13</sup> , Manuel Trajtenberg (2006) Innovation Policy for Development: an Overview, Working Paper No. 6-2006, July, 2006, The Foerder Institute for Economic Research and The Sackler Institute of Economic Studies

<sup>14</sup> Dani Rodrik, Normalizing Industrial Policy, Working Paper No. 3 Commission on Growth and Development

<sup>15</sup> Mario Cimoli, Giovanni Dosi, Richard Nelson and Joseph Stiglitz (2007) Policies and Institutional Engineering in Developing Economies, GLOBELICS Working Paper Series, No. 2007-04

<sup>16</sup> Chris Freeman (2002), Continental, national and sub-national innovation systems—complementarity and economic growth, *Research Policy* 31 (2002) 191–211

<sup>17</sup> Richard Nelson (2007) Economic Development from the Perspective of Evolutionary Economic Theory, GLOBELICS Working Paper Series No. 2007-02

possible *approach* to economic development. In paper with Johnson and Edquist (2003)<sup>18</sup> Lundval argues that: ‘*building institutions to create order and stable living conditions is necessary to give people the opportunity and incentives to engage in learning new competences. But such institution cannot be built without engaging people in competence building and learning*’(p.15). In other words, development policy is about a double focus on basic living conditions and competence building. In addition, this implicitly makes NIS approach much more relevant to semi-developed economies which have met basic needs.

In these three examples, we have highlighted our secondary point: there are differences among proponents of evolutionary and systems of innovation approach to development (see below). However, our major point is that from none of the approaches one could derive automatic policy implications. Why is this so? In Freeman’s perspective, the issue of complementarities between different social subsystems is not amenable to easy policy generalisations. In Nelson’s perspective specificities of co-evolution of technologies and institutions also makes automatic policy implications impossible. In Lundval et al perspective policies for learning should be reconciled with other policies for institution building and basic needs. In summary, we would argue that scholars in this tradition are much more aware of complexities of growth and development and are sceptical to derive automatic policy implications from their perspective on growth. This basically reinforces our conclusion that any policies, and innovation in particular, are an area of research on its own and these policies cannot be derived as an automatic outcome or afterthought of a specific conceptual approach. These policies should be developed as an explicit policy focused research rather than as automatically derived policy implications.

### *Techno-Economic Paradigm and innovation policy*

Techno-economic paradigm is essentially a view of growth as co-evolution of technologies and institutional framework which originally has been developed by Carlota Perez in her 1983 *Futures* article. This perspective on long-term growth stem from recognition that technology and innovation processes have their structural features (regularities) and that their interaction with the institutional frameworks are important for understanding prospects and obstacles to long-term growth. This framework is quite powerful in illuminating a variety of organisational and strategic challenges linked to diffusion of ICT paradigm. Hence, policy issues are explicit in this perspective and they are developed in several of Carlota’s papers.

In Perez (2006)<sup>19</sup> she argues that the ICT revolution has reached a turning point, where institutional innovation becomes the driving force for the full deployment of the potential of the new ICT technologies and their applications. In that context paper identifies three areas of policy innovation for reshaping globalization [a] Regulation,

---

<sup>18</sup> Björn Johnson Charles Edquist Bengt-Åke Lundvall (2003) Economic Development and the National System of Innovation Approach, First Globelics Conference, Rio de Janeiro, November 3 – 6, 2003

<sup>19</sup> Perez, Carlota (2006) “Respecialisation and the deployment of the ICT paradigm: An essay on the present challenges of globalisation” in Compano et al. eds., The Future of the Information Society in Europe, Technical Report EUR22353EN, IPTS, Joint Research Centre, Directorate General, European Commission, pp. 27-56

Downloadable: [http://carlotaperez.org/papers/PEREZ\\_Respecialisation\\_and\\_ICTparadigm.pdf](http://carlotaperez.org/papers/PEREZ_Respecialisation_and_ICTparadigm.pdf)



especially of finance [b] Respecialization of developed and developing countries by regions and [c] national and global social net policies (seen not only with humanitarian goals but also as redefining demand profiles to increase global production). Perez (2001)<sup>20</sup> looks at the way the international diffusion of a technological revolution changes the context and the opportunities, both for company strategies and for development policies. Perez (2000)<sup>21</sup> contrasts the technology policies that were appropriate in an import substitution or export promotion context with the mass production paradigm and what would be appropriate policies with the current ICT paradigm. It recommends differentiating science from technology policy and within technology (distinguishing frontier, managerial and community). Each sector would require adequate and different criteria, forms of funding, institutions and mechanisms. Perez (1992)<sup>22</sup> analyses of how the changes in work organization require changes, not just in educational contents and enabling technologies, but also in the relationship between student and teacher and in the attitude to knowledge.

In strongly Perezian spirit Fulvio Castellacci (2006)<sup>23</sup> points to paradox or mismatch between the techno-economic and the socio-institutional system, in a period that marks the initial phase of a fifth long wave period (ICT paradigm). While the current trends and transformations in the techno-economic system are increasing the need for State policies to sustain the catching up process, recent changes in the socio-institutional system have significantly decreased the scope for public interventions (cf. Washington consensus). Castellacci points to the temporary nature of this mismatch. The argument is that:

*'(...) looking back at what happened in the previous four long wave periods, in fact, neo-Schumpeterian theory indicates that the socio-institutional system has always taken a longer time than the techno-economic to adjust to the emerging technological paradigm' (...) the most notable recent successful cases (cf. China, India) show that a rapid process of innovation- and imitation-based catching up is indeed possible in the fifth long wave'*

This same Perezian point is expressed by Stiglitz group (Cimoli et al, 2007)<sup>24</sup> in somewhat different way when arguing that:

*(..) both the recent changes in international – political and economic – relations and the ongoing "ICT revolution" are reshaping the opportunities and constraints facing*

---

<sup>20</sup> Perez, Carlota (2001) "Technological change and opportunities for development as a moving target", Cepal Review, No. 75, December, pp. 109-130

Downloadable: [http://www.eclac.org/publicaciones/xml/5/20135/lcg2150i\\_Perez.pdf](http://www.eclac.org/publicaciones/xml/5/20135/lcg2150i_Perez.pdf)

<sup>21</sup> Perez, Carlota (2000) "Change of paradigm in Science and Technology Policy", Cooperation South, TCDC-UNDP, No. 1-2000, pp. 43-48

Downloadable: [http://tcdc.undp.org/CoopSouth/2000\\_june/03\\_Perez.cc.pdf](http://tcdc.undp.org/CoopSouth/2000_june/03_Perez.cc.pdf)

<sup>22</sup> Perez, Carlota (1992) "New technological model and higher education: A view from the changing world of work", in Gustavo Lopez Ospina ed., Challenges and Options: Specific proposals, CRESALC/UNESCO, pp. 121-145.

Downloadable: [http://www.carlotaperez.org/papers/UNESCO\\_tech\\_and\\_univ\\_1992.pdf](http://www.carlotaperez.org/papers/UNESCO_tech_and_univ_1992.pdf)

<sup>23</sup> Fulvio Castellacci (2006) Innovation, diffusion and catching up in the fifth long wave Futures 38 (2006) 841–863

<sup>24</sup> Mario Cimoli, Giovanni Dosi, Richard Nelson, Joseph Stiglitz (2007), Policies and Institutional Engineering in Developing Economies, GLOBELICS, Working Paper Series, No. 2007-04

*policy making and “institutional engineering” but by no means have decreased their importance. On the contrary: they demand new forms of governance which one is only beginning to explore’.*

Their underlying argument is again truly Perezian in spirit when arguing that:

*‘with changes in the type of knowledge countries need to accumulate and improve upon, often come also changes in the most appropriate policy packages concerning e.g. the type of offered education; the support to national incumbent firms vs. MNCs vs. new entrants; the role of public training and research centers’.*

The argument above is that policy challenges are inextricably linked to the nature of technology (cf. *changes in the type of knowledge countries need to accumulate and improve upon*). Aghion and Howitt (2005)<sup>25</sup> go step further by arguing that ‘*growth-maximizing policies (e.g. competition and entry policies, the allocation of education funding or the design of macroeconomic policies) should vary with a country’s or sector’s distance to the technological frontier, and/or with the country’s level of financial development’.*

By taking Schumpeterian position Aghion and Howitt demonstrate that policy does matter for a country’s growth performance and that appropriate growth policies should vary with a country’s distance from technology frontier and with its institutions. This argument has been basically taken by Stiglitz group (Cimoli et al, 2007) when arguing that stringency of the new international constraints:

*‘(..) is likely to vary from sector to sector and from technology to technology **and it is likely to depend also on the distance of any country from the international technological frontier** (my underlying). For example, many African and some Latin American countries might not be directly affected by a tightening in the IPR regimes having little capabilities to imitate to begin with (...) Conversely, tighter IPR regimes may well represent a major hindrance to more advanced catching-up countries. Given that (..) how urgent is it to promote a balanced IP system and realize its development potential?’*

All the above contributions recognise that policies are dependent on underlying technological regimes. They do differ with respect to degree to which they take into account their interaction (in Nelson’s parlance co-evolution) with institutions. The issue of institutional changes and their impact on innovation policy has been taken into account by literature that looks at the effects of liberalisation policies on accumulation of technological capabilities. We turn to this literature in the next section.

### *Institutional restructuring and innovation policy*

As pointed by Stiglitz group (Cimoli et al, 2007) ‘*a free-trade shock does not automatically trigger any increase in the accumulation of knowledge and innovative*

---

<sup>25</sup> Philippe Aghion Peter Howitt (2005) *Appropriate Growth Policy: A Unifying Framework*, December 8, 2005, The 2005 Joseph Schumpeter Lecture, delivered to the 20th Annual Congress of the European Economic Association, Amsterdam, August 25, 2005

*capabilities.*’ Whether there has been accumulation of knowledge and innovation in the period of liberalisation of the 1980s/1990s, especially in countries that followed import-substitution policies in the 1960s/70s is an area of literature with important policy implications. Three examples of such literature which look at the effects of economy’s liberalisation on innovation activities of companies may highlight this issue.

Basant and Chandra (2002)<sup>26</sup> studied technological capabilities in liberalisation period in India. Their conclusion is that competition in the domestic markets has increased as have foreign technology flows, both embodied and dis-embodied. However, *‘indigenous R&D to assimilate foreign technology and exploit technology spillovers along with access to complementary assets (especially competitive manufacturing) to appropriate benefits appear to be missing’*. From policy perspective, they point to importance of focusing on both technology supply chains and complementary assets. Their conclusion is that *‘innovation related linkages of this kind need strengthening, policy initiatives to promote the interface of innovative agents, their cooperation on a common project and the reduction of related investment costs will be required’*. Pamukcu (2003)<sup>27</sup> studied effects of trade liberalization on innovation in Turkey. His study points to positive effects of imported embodied technology. However, a process of autonomous technology development or its coupling with import does not follow automatically from liberalization. Paulo N. Figueiredo (2006)<sup>28</sup>(2007)<sup>29</sup> summarises his empirical work on accumulation of technological capabilities in Brazil and concludes that *‘at least within this sample of firms, the rate of innovative capability building has increased following changes into a globalised and outward-looking industrial regime since the early 1990s. This challenges negative generalisations relative to implications of those policy changes of the 1990s for industrial capability building, particularly in Southern Latin America’* (Figueiredo, 2006).

It is not our objective here to evaluate whether institutional changes in economic environment in the form of liberalisation have led to accumulation of technological capabilities. It is most likely that there is not general conclusion on this issue: technological accumulation is a process affected by a variety of factors of which opening of the economy is only one factor. However, it seems that there is the lack of automatic positive effects of liberalisation on technology accumulation. Second, these examples point to the importance of systemic policies through increased importance of linkages. This is quite in line with the emerging consensus that innovation policies in developed and developing countries give great prominence to objectives related to generation of networks, linkages and FDI related technology spillovers. However, a series of studies on technology accumulation in Latin America by three ex-PhDs of

---

<sup>26</sup> Rakesh Basant and Pankaj Chandra, Building Technological Capabilities in A Liberalising Developing Economy: Firm Strategies And Public Policy, Economics of Innov. New Techn., 2002, Vol. 1 1(4-5), pp. 399-421

<sup>27</sup> Teoman Pamukcu (2003) Trade Liberalization and Innovation Decisions of Firms: Lessons from Post-1980 Turkey, *World Development* Vol. 31, No. 8, pp. 1443–1458

<sup>28</sup> Paulo N. Figueiredo (2006) *Motion or inertia, decades or years? Research on ‘dynamics’ (rate) of technological capability building in the context of late industrialisation: time to move forward? Evidence from empirical studies in Brazil*, Paper presented at the DRUID Summer Conference 2006 on Knowledge, Innovation and Competitiveness: Dynamics of Firms, Networks, Regions and Institutions, Copenhagen, Denmark, June 18-20, 2006

<sup>29</sup> Paulo N. Figueiredo (2007), What Recent Research Does and Doesn’t Tell Us about Rates of Latecomer Firms’ Capability Accumulation, *Asian Journal of Technology Innovation* 15, 2

Martin Bell suggest that ‘*it would be useful to reorient the emphasis of policy initiatives on strengthening systemic connectedness such that they foster **both** the development of linkages and flows and the capabilities of the firms*’ (my underlying)’ (Dantas et al, 2007)<sup>30</sup>. This conclusion is of high relevance in the context of literature which looks at the impact of globalisation on NIS as well as at balance between domestic technological autonomy and reliance on FDI as the major source of technology.

### *State and Markets in Innovation Policy*

The issue of openness and autonomy in technological development are at the core of political economy of development. This literature is quite extensive and it is impossible in this survey to give its fair representation. Hence, we will focus on a few issues which seem to be relevant from innovation policy perspective.

The debate in this area evolves around state vs. market and the emerging consensus seems to be so called ‘market enhancing’ view of state (Aoki et al., 1997)<sup>31</sup>. This view “*stresses the mechanisms whereby government policy is directed at improving the ability of the private sector to solve coordination problems and overcome other market imperfections*” (Aoki et al. 1997: 2). Government is regarded as an endogenous player operating in interactions with other organisations (firms, business associations etc.). This leads to a perspective which is framed within the state governance perspective rather than state vs. market perspective and which is focused on underlying institutional and political conditions. Ahrens (2002)<sup>32</sup> defines governance as ‘*the capacity of the institutional environment (in which individual actors, social groups, civic organizations and policy makers interact) to implement and enforce public policies and to improve private-sector coordination*’. From this perspective ‘*the primary role of governments then is not to directly intervene in resource allocation but to foster the emergence of those organizations and to interact with them*’. This perspective goes beyond simplified view of state promotion vs. market as demonstrated by analyses of conditions for effective design and implementation of technology policy by Chang and Cheema (2002)<sup>33</sup>. These conditions include: state autonomy; institutions that control resources flows; bureaucracy; SOEs and control over financial sector; and intermediary institutions. However, more important than a specific list of factors is the idea that it is important ‘*to understand the various economic, political, and institutional factors that influence the effectiveness of technology policy (ibid)*’.

---

<sup>30</sup> Eva Dantas, Elisa Giuliani and Anabel Marin (2007), The Persistence of ‘Capabilities’ as a Central Issue in Industrialization Strategies: How They Relate to MNC Spillovers, Industrial Clusters and Knowledge Networks, *Asian Journal of Technology Innovation* 15, 2

<sup>31</sup> Aoki, M., Murdock, K. and Okuno-Fujiwara, M. (1997). Beyond the East Asian Miracle: Introducing the Market- Enhancing View. In: *The Role of Government in East Asian Economic Development. Comparative Institutional Analysis*. Aoki, M., Kim H.-K. and Okuno-Fujiwara, M. (Eds.), Oxford: Clarendon Press, pp. 1-37.

<sup>32</sup> Joachim Ahrens (2002), Governance and the Implementation of Technology Policy In Less Developed Countries, *Economics of Innov. New Techn.*, 2002, Vol. 11 (4-5), p p. 441-476

<sup>33</sup> Ha-Joon Chang and Ali Cheema (2002), Conditions For Successful Technology Policy in Developing Countries-Learning Rents, State Structures, and Institutions, *Economics of Innov. New Techn.*, Vol. 11(4-5), p p. 369-398

In an alternative account of similar position by Ahrens (2002) the argument is that: *'the pivotal components of crafting a governance structure, that is conducive to effectively implement technology policies, include (a) the establishment of institutional mechanisms which enhance government credibility and the incentive compatibility of policy making and overall economic performance; (2) civil service reform; (3) fostering the development of a public-private interface; and (4) supporting private intermediary organizations'*.

The market enhancing view which in different forms and disguises has become a mainstream and widely accepted does not touch the issue of state autonomy in relation to foreign capital. This is quite important issue as globalisation and networked firms have led to an ongoing trend as defined by Westphal (2002)<sup>34</sup> of *'de-linking production from the accumulation of technological capabilities in latecomer economies (...), a trend which could in various ways significantly reduce opportunities for indigenous accumulation of experience in technological development through export-related technology transfers'*

As strategies focused on the domestic market seems not feasible Westphal (2002) sees in so called *MNC-mediated development* the dominant form in the future. *'The greatest success may be enjoyed by developing countries following strategies that judiciously combine elements from those followed by Singapore and Taiwan'* (ibid). In the context of Eastern Europe, the author of this survey has developed quite similar idea and analysis by focusing on distinction between foreign and domestic led modernisations (Radosevic, 2008)<sup>35</sup>.

An important issue in this context is a room for manoeuvre for autonomous policies in view of WTO regime of global political economy. A typical view is that developed by Westphal (2002) who argues that:

*'Given present trends in the formulation of rules governing international commerce, it is unlikely that the industrial policy elements of assimilation policy will figure prominently in the achievement of future success; that is, except perhaps in those countries whose geo-political importance- and, no doubt, large market size (cf. think China here) - effectively permits otherwise'*.

Amsden and Hikino (2000)<sup>36</sup> argue that *'at close examination, however, the new rules of the World Trade Organization, a symbol of neoliberalism, are flexible and allow countries to continue to promote their industries under the banner of promoting science and technology'*. We think that this partly explains the increasing popularity of innovation policy as the legitimate policy area, unlike proscribed industrial policy.

Although, state vs. market views or market enhancing view of state are very important distinctions for understanding broader context of innovation policy they

---

<sup>34</sup> Larry E. Westphal (2002), Technology Strategies for Economic Development in a Fast Changing Global Economy, *Economics of Innov. New Techn.*, Vol. 1(4-5), pp. 275-320

<sup>35</sup> Radosevic, S (2008) CEE between foreign and domestic led modernisation, Paper to be presented at the Mexico City GLOBELICS conference, draft, mimeo

<sup>36</sup> Alice H. Amsden; Takashi Hikino (2000) The Bark Is Worse Than the Bite: New WTO Law and Late Industrialization, *Annals of the American Academy of Political and Social Science*, Vol. 570, Dimensions of Globalization. (Jul., 2000), pp. 104-114.

have little to say on specifics of innovation policy. A reason for that is probably what Nelson and Langlois (1983) describe as ‘complexity’ meaning a wide diversity of technological and institutional details, of knowledge structures and incentive structures involved in innovation policy activities. Based on evaluation of US industrial policy over a long period of time they have concluded that there are three approaches that have worked in the past:

*‘support associated with government procurement or some other well-defined public sector objective; support of defined non-proprietary research, with allocation funds guided by the appropriate scientific community; and provision of an institutional structure that allows potential users to guide the allocation of applied R & D funds. A fourth kind of policy, whereby government officials themselves try to identify projects that will be winners in a commercial market competition, is always seductive, but the evidence, from our studies and others, suggests that such strategy is to be avoided’<sup>37</sup>.*

However, more than one more argument against ‘picking up winners’ policy their account actually suggest that industrial and innovation policies are far too broad to be subsumed under one type of industrial policy of picking winners. In other words, it is diversity of policy practices and their complexity that evades easy generalisations *a la* state vs. market. As contrasting stories of Korean government intervention in two related areas of IT standards suggest the success of government intervention is contingent on a variety of factors. Its success depends on technological conditions related to technology knowledge and technology cycle; market conditions concerned with market governance structure and market prospects for technology; and on conditions for government capability, which provide the technology knowledge and the technology market (see Wang and Kim, 2007)<sup>38</sup>. This does not lead us very far in terms of establishing theory – policy link but it seems that it is much more telling and instructive for policy.

### *Sociology of innovation policy*

This area of innovation policy analysis should represent a natural complement to previously outlined areas of literature. Indeed, a few papers do point to the relevance of this perspective. For example, Schwartz (2006) paper on Croatia basically explains failure of Croatia to capitalize on its science base in transition period by semi-modernism and so called ‘de-industrializing elite’. Hadjimanolis and Dickson (2001) explain an ambivalent attitude towards Cyprus national innovation policy of business community by their unrealistic expectations and inefficiency in design and implementation. Vavakova (2006) analyse factors which led French researchers from the public research sector to stage a protest movement. However, in overall our understanding of the role of different policy stakeholders and social dynamics which underpins different innovation policies is quite meagre.

---

<sup>37</sup> Richard R. Nelson and Richard N. Langlois (1983) Industrial Innovation Policy: Lessons from American History, *Science*, New Series, Vol. 219, No. 4586, (Feb. 18, 1983), pp. 814-818

<sup>38</sup> Jaesun Wang, Seoyong Kim (2007) Time to get in: The contrasting stories about government interventions in information technology standards (the case of CDMA and IMT-2000 in Korea), *Government Information Quarterly* 24 (2007) 115–134

## THEORY OF INNOVATION POLICY

A word theory would suggest that there is a coherent body of scientific valid knowledge which underpins practice of innovation policy. As we pointed out in bibliometric analysis this is far from true. So, what we mean by word theory are areas of literature which address policy from conceptual perspective i.e. from some higher theoretical framework which either implicitly or explicitly have importance for policy practice. First, we include discussion on old and new rationales for innovation policy. Second, we explore policy implications of evolutionary perspective and point to major tenets of evolutionary technology policy. Third, we point to major methodological and conceptual issues of systems of innovation perspective and their links to policy. Finally, we tackle a few methodological issues in innovation policy, primarily treatment of time and uncertainty.

### *New, old and against rationales*

By far the most cited paper with keyword ‘innovation policy’ in *Web of Science* database is David Teece’s (1986) ‘Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy’ *Research Policy* 15 (1986) 285-305. This may be not surprising as this paper implicitly touches at the core innovation policy issue - appropriability. A traditional rationale for support to knowledge is poor appropriation of benefits by private providers who would then under invest in R&D. However, there is by now an important literature which argues that the traditional rationale for market failure is flawed in its understanding of the wider process of innovation and competition. Teece’s 1986 paper clearly opened the way for thinking about policy rationales from different perspectives. His answer to who actually profits from innovation pointed to owners of complementary assets, particularly when they are specialized and/or co-specialized.

*‘Imitators can often outperform innovators if they are better positioned with respect to critical complementary assets. Hence, public policy aimed at promoting innovation must focus not only on R&D, but also on complementary assets, as well as the underlying infrastructure. If government decides to stimulate innovation, it would seem important to clear away barriers which impede the development of complementary assets which tend to be specialized or co-specialized to innovation. To fail to do so will cause an unnecessary large portion of the profits from innovation to flow to imitators and other competitors’ (Teece, 1986).*

In revisiting Teece’s (1986) contribution editors of the special issue of *Research Policy* asked themselves ‘what role should public policy play to promote and sustain innovation according to our updated understanding of the 1986 article?’ They point to the following:

*'First, countries and regions need to look carefully at the range of complementary assets and institutions they have in place to ensure, depending on context and other factors, that at least a share of domestic inventor firms are able to profit from their innovations in situ, and thus achieve increases in employment and national productivity (...) Second, some radical inventions require complementary assets, which are public or semipublic goods (...) Third, the challenge (is) of how much (of intellectual property) protection is socially necessary and desirable to motivate entrepreneurial effort on the one hand, and to foster wide diffusion on the other hand, is a difficult balance to strike' (Chesbrough et al, 2006)<sup>39</sup>.*

According to Laranja et al (2008)<sup>40</sup> rationales are *'more or less formalised models implicitly or explicitly drawing upon academic theories or concepts that could inform policy design, implementation and evaluation. (...) Implicitly or explicitly they articulate, problematise and justify the need for intervention and outline the logic through which that policy intervention is expected to lead to the intended outcomes'*. A literature that addresses the issue of innovation policy rationale had departed from market failure and had embraced several new types of failures. Arnold (2004)<sup>41</sup> expands the idea of failures to: *capability failures* (inadequacies in companies' ability to act in their own best interests), *failures in institutions* (failures in other social institutions such as universities and research institutes, patent offices and so to fulfil well their functions in the NIS), *network failures* (problems in the interaction among actors in the innovation system), and *framework failures* (framework policies which have a negative effect on innovation).

The most frequently used alternative type of failure is a *system failure*. OECD (1998) thematic issue of *STI Review* was mainly devoted to this new policy rationale. A need for an alternative failure stems from *'too much emphasis on measures to support the development of new technologies in the small high-technology segment of the economy'* and system failure represents an attempt to understand and gauge the interplay between a range of issues and mechanisms that shape technical progress (Andersson, 1998)<sup>42</sup>. While market and government failures focus on piecemeal improvements, system failures addresses need *'to optimise the contributions of innovation and technology diffusion to the economy as a whole'* (ibid). Risks of system failures are: *'overestimating the capacity of governments, losing track of priorities or getting out of balance in addressing the specific vis-a-vis the generally applicable'* (ibid).

---

<sup>39</sup> Henry Chesbrough, Julian Birkinshaw, Morris Teubal, Introduction to the research policy 20th anniversary special issue of the publication of "Profiting from Innovation" by David J. Teece, *Research Policy* 35 (2006) 1091–1099

<sup>40</sup> Manuel Laranja, Elvira Uyarra, Kieron Flanagan (2008), Policies for science, technology and innovation: Translating rationales into regional policies in a multi-level setting, *Research Policy* 37, 823–835

<sup>41</sup> Erik Arnold (2004) Evaluating research and innovation policy: a systems world needs systems evaluations *Research Evaluation*, volume 13, number 1, April 2004, pages 3–17.

<sup>42</sup> Thomas Andersson (1998), Managing a systems approach to technology and innovation policy, *STI Review* No. 22, OECD, p9-30



Moriss Teubal (1998)<sup>43</sup> defines a system failure as *'failure to stimulate in a timely fashion the emergence of a new component of a NSI which is deemed to be of strategic value for the economy'*. This does not necessarily correspond to Andersson's perspective which implicitly defines system failure as failure to coordinate a range of issues that shape technical progress. Woolthuisa et al (2005)<sup>44</sup> distinguish different types of system failure: *infrastructural failures*, *transition failures* (the inability of firms to adapt to new technological developments), *lock-in/path dependency failures* (the inability of complete (social) systems to adapt to new technological paradigms), *hard institutional failure* (failures in the framework of regulation and the general legal system), *soft institutional failure* (failures in the social institutions such as political culture and social values), *strong network failures* (the 'blindness' that evolves if actors have close links and as a result miss out on new outside developments), *weak network failures* (the lack of linkages between actors as a result of which insufficient use is made of complementarities, interactive learning, and creating new ideas) and *capabilities' failure* (the phenomenon that firms, especially small firms, may lack the capabilities to learn rapidly and effectively and hence may be locked into existing technologies, thus being unable to jump to new technologies). Peneder (2008)<sup>45</sup> recognizes that there is *'the large array of policy tools, where system failure, caused by a lack of coordination among the manifold agents and organisations involved, is a widespread and growing concern'*. As a solution he creates the policy mind map which not only illustrates the numerous instruments available *'but also concatenates them with different causes of market failure, their respective rationales for public intervention and the according aims and targets of innovation policies'*.

Edquist (2001)<sup>46</sup> also identifies system failure as *'a matter of identifying functions that are missing or inappropriate and which lead to the 'problem' in terms of comparative performance. Let us call these deficient functions 'system failures (...)'* When we know the causes behind a certain 'problem' we have identified a 'system failure'. Edquist (2001) identifies four main categories of system failures (which are partly overlapping):

- Functions in the SI may be inappropriate or missing.
- Organisations may be inappropriate or missing,
- Institutions may be inappropriate or missing, or
- Interactions or links between these elements in the system of innovation may be inappropriate or missing

This brief review indicates that the concept of system failure is still in embryonic stage and that there is a variety of views what it should represent. An application of this idea in the context of specific sectors should be a way to give it clarity and agree on definition. An example of usefulness of this type of analysis is paper on food

---

<sup>43</sup> Morris Teubal (1998) Policies for promoting enterprise restructuring in national systems of innovation: Triggering cumulative learning and generating system effects, *OECD STI Review*, Special Issue on "New Rationale and Approaches in Technology and Innovation Policy", no. 22, OECD, Paris

<sup>44</sup> Rosalinde Klein Woolthuisa, Maureen Lankhuizen, Victor Gilsing (2005), A system failure framework for innovation policy design, *Technovation* 25 (2005) 609–619,

<sup>45</sup> Michael Peneder (2008), The problem of private under-investment in innovation: A policy mind map, *Technovation* 28 (2008) 518–530,

<sup>46</sup> Charles Edquist, (2001) The Systems of Innovation Approach and Innovation Policy: An account of the state of the art, Paper presented at DRUID conference, 2001

safety by Hennessy et al (2003)<sup>47</sup> which suggest a taxonomy of four general ways in which a systemic failure might occur: failure in *the connectedness of the system*; failure due to *mistrust on the part of downstream parties* concerning signals on product attributes, production processes, and the performance of regulatory mechanisms; failure due to *asymmetric information* which leads to low incentives for preserving food quality; and, *inflexibilities* in adapting to different states of nature which may leave the system vulnerable to failures. Their conclusion is that *‘innovations in information technology and institutional design may ameliorate many problems, while appropriate trade, industrial organization, science, and public infrastructure policies may also fortify the system’* (ibid).

However, the importance of rationales should not be overestimated. As pointed out by Laranja et al (2008) *‘theoretical approaches may be positively ambiguous in this regard, for instance a variety of very different interventions may be justified by ‘systems’ approaches (Abramovsky et al., 2004)’*. Their argument is that *‘theories are seldom directly taken up by policy-makers and unproblematically translated into specific policy rationales. Where ideas do influence policy they may well be the result of policy makers’ own processes of learning and experimentation (Mytelka and Smith, 2002) and we must acknowledge that’*.

This realism leads to an alternative view which is sceptical regarding general rationale or justification for active government support of R & D. Nelson (2007)<sup>48</sup> argues that: *‘public funding of basic research, conducted largely at public labs and universities, is a reasonable policy not so much because of “market failure”, but because well allocated basic research spending yields high expected social returns, and publicly funded research conducted at public institutions would appear to be the best way of getting certain kinds of research done and the results made available for general use. Similarly, it makes much better sense to argue for well designed industrial policies in terms of high expected payoffs (if in fact that can be argued) than to go through a litany of “market failures that might justify such policies’*.

In conclusion, it seems that we are currently in flux regarding the accepted policy rationales. However, this by itself may be not that bad as thinking about good policies does not necessarily require justification of why good policies are good.

### *Evolutionary technology policy*

Among different theories of innovation and technical change evolutionary perspective illuminate relatively well the dynamic aspects of technological change. Being much better in conceptually capturing dynamics of economic change there is a great expectation that its application for policy purposes should also lead to new and more effective innovation policies. In this section we refer to ‘narrow’ or ‘proper’ evolutionary policy perspective. By this we mean perspective which derives its policy views from evolutionary theory as outlined by Nelson and Winter 1982 book. We

---

<sup>47</sup> David A. Hennessy, Jutta Roosen, Helen H. Jensen (2003) Systemic failure in the provision of safe food, *Food Policy* 28 (2003) 77–96

<sup>48</sup> Richard Nelson (2007) Economic Development from the Perspective of Evolutionary Economic Theory, *GLOBELICS Working Paper Series*, No. 2007-02

distinguish it from broad evolutionary perspective which includes a variety of systems of innovation and structuralist perspectives.

The evolutionary analysis of economic policy highlights that policy-making is largely an experimental process of trial and error (Pelikan and Wegner, 2003)<sup>49</sup>. This edited volume points to unpredictability of innovations which calls for a bottom-up strategy in institutional policy, especially regulations. Instead of market failure innovatory failure should be more in the focus. Path-dependencies, leading to lock-in situations, may result in inferior institutional outcomes even in the face of competition between countries.

The most prominent economists working in what Metcalfe would call evolutionary theory of technology (innovation) policy are JS Metcalfe, U Witt and M Teubal. The key features of evolutionary theory of technology policy are probably best articulated in Metcalfe (1994<sup>50</sup>, 1995<sup>51</sup> and 2007<sup>52</sup>). Its key features (Metcalfe, 1994, 1995) are: focus of policy on variety and selection; adaptive policy making; policy is focused on diffusion as well as on generation of knowledge; the importance of the wider institutional context, and policy is about the facilitation of the self-organization of innovation system. Implicitly or explicitly this suggests that rationale for evolutionary policy is a system failure.

#### *Variety and selection*

Economic variety drives economic selection and economic selection drives variety. As Metcalfe (1994) points out: *'The aim of technology policy is (...) twofold: to stimulate the generation of variety through innovation and to ensure that feedback from the selection process does not operate to the detriment of variety creating mechanisms'*

#### *Adaptive policy making*

Evolutionary policy making is not about optimisation *'with respect to some objective function (e.g. social surplus) but rather to stimulate the introduction and spread of improvements in technology'*. Unlike neo-classical optimizer evolutionary policy makers *adapts* (Metcalfe, 1994) *'and his/her central concern is the innovation process, the operation of the set of institutions within which technological capabilities are accumulated'* (ibid). He/she *'does not have a superior understanding of market behaviour or technological opportunities, and so technology policies may fail just as readily as the technology strategies of private firms'*. Hence, *'policy makers learn and adapt in the light of experience'* and thus naturally make mistakes. Schwerin and

---

<sup>49</sup> Pavel Pelikan, Gerhard Wegner (eds) (2003): *The Evolutionary Analysis of Economic Policy*, Edward Elgar Publishing, Cheltenham

<sup>50</sup> J. S. Metcalfe, Evolutionary economics and technology policy, *The Economic Journal*, Vol. 104, No. 425, (Jul., 1994), pp. 931-944

<sup>51</sup> J. S. Metcalfe Technology systems and technology policy in an evolutionary framework *Cambridge Journal of Economics* 1995, 19, 25-46

<sup>52</sup> J Stanley Metcalfe Policy for Innovation , in *Elgar Companion to Neo-Schumpeterian Economics*, Edited by Horst Hanusch and Andreas Pyka, EE, Cheltenham, 2007 943-967

Werker (2003)<sup>53</sup> build on Metcalfe insights to further develop the idea of policy making as a ‘learning’ activity.

Ulrich Witt (2003)<sup>54</sup> further highlights the experimental and adaptive nature of policy making in evolutionary perspective by pointing out that *‘the positive and normative knowledge that informs the actions of the agents involved can change through experience and induced inventive learning. Accordingly, at each of the different levels of the theory of economic policy making the time horizon in tracking causes and effects and in assessing means-ends relationships needs to be extended to account for the repercussions of the changes induced in the agents’ knowledge constraints’*. (Un)fortunately, for policy practitioners *‘an evolutionary perspective does not itself imply any normative conclusions. But the insight that factual and normative knowledge may change is likely to have an effect both on the possibilities of making normative judgements and on their content’* (Witt, 2003).

*Policy is focused on diffusion as well as on generation of knowledge*

Within evolutionary perspective, *‘it is not helpful to treat innovation and the diffusion of innovation as separate categories, in fact they are inseparable, with feedback from diffusion being one of the critical elements shaping how a technology is developed’*. Technology policy is *‘much more than a matter of supporting R&D expenditures, it covers the whole spectrum from invention to diffusion and from basic research to the mastery of specific technological competencies’*.

Alternatively as Metcalfe (1994) put it:

*‘What is clear, is that the separate analysis of innovation and diffusion is no longer tenable, the two are inseparable and mutually reinforcing and this is one of the key sources of density dependence in the evolutionary competitive process. The significance of this for the conduct of technology policy is to see opportunities to innovate as the joint products of market and technology evolution. Necessarily this involves not only the behaviour of firms but the behaviour of all the institutions producing knowledge, skills and artifacts within the relevant technology system’*.

*A Wider Institutional Context*

Technology policy is not simply *‘about the technological activities of firms; it must necessarily encompass the wider context’*.

*‘Policy must address much more than R&D in private firms, and policy makers must address complex questions of institutions and their connectivity’ i.e. innovation systems are essential part of evolutionary framework’*.

*Multifaceted nature of technology*

---

<sup>53</sup> Joachim Schwerin, Claudia Werker (2003), Learning innovation policy based on historical experience, *Structural Change and Economic Dynamics* 14, 385/404

<sup>54</sup> UlrichWitt (2003), Economic policy making in evolutionary perspective, *J Evol Econ* (2003) 13: 77–94

In an evolutionary perspective technology is embodied as knowledge, skills and artifacts and in each case there are different variety-generating mechanisms, different selection processes and different institutional structures. Table below structures different policy dimensions. As pointed out by Metcalfe (1995) *‘the significance of all this for policy is that any programme of technical development draws on different kinds of knowledge created in different institutions and accumulated by different mechanisms’ (...)* For policy purposes, the degree of connection between these different dimensions of technology is at the core of technology policy’

A focus of evolutionary technology policy  
(based on Metcalfe, CJE, 1995)

	Variety generation	Selection process	Institutional structures
Knowledge			
Skills			
Artefacts			

As table above suggest, the final picture is rather complex as technology policy can focus on technology in its different forms, on institutions and market processes that generate variety (novelty, R&D) and impact on selection (diffusion) of different forms of technology. In reality, all these dimensions are either closely connected or difficult to separate which makes technology policy a complex area.

*Policy is about facilitation of self-organisation of innovation systems*

In evolutionary perspective, *‘the processes of innovation depend on the emergence of Innovation System connecting many actors engaged in the innovation process, and these systems are essentially self organising and self transforming (...)(Hence), innovation policy should be about facilitating the self-organization of IS across the entire economy, not only in ‘new’ sectors’* (Metcalfe, 2007).

The primary role of the state is to facilitate the emergence of Innovation System. *‘In so doing ‘government’ takes responsibility to for the ecology of organisations and institutions that facilitate business experimentation but recognizes that without the necessary interconnections the ecology is not a system’* (p.960, Metcalfe 2007). The stated aim of innovation policy is not promoting individual innovation events but *‘setting the framework conditions in which Innovation System can better self – organize across the range of activities in an economy’*.

Implicitly (and as stated explicitly by Metcalfe, 2007) rationale for technology policy is system failure. *‘A system failure policy seeks to address missing components, missing connections and misplaced boundaries’*

Morris Teubal is the scholar that has progressed the furthest in applying evolutionary perspective to policy making area. He has recognised that although *‘it is important to emphasize the implications of variety, learning, institutions, and alternative selection mechanisms for policy, this is an incomplete basis for what could be termed an*

*integrated 'evolutionary technology policy.'* (Teubal, 1997). As the 'Normative' aspects of systems of innovation based policies are *'framed in terms so general to make them insufficient or inadequate as guides and tools for actual policymaking'*, there is *'a strong need for additional theoretical and conceptual knowledge'* (Teubal, 2002).

His major contributions are in developing the concept of 'horizontal' technology policy, as opposed to traditional vertical ('picking up winners) and functional policies which are geared towards *'improving markets, in particular factor markets, without favouring particular activities'*. 'Horizontal' policies lay in between these two policies and can promote selectivity across sectors. They address activities for which markets are missing or are particularly difficult to create. In paper with Lall (Lall and Teubal, 1998)<sup>55</sup>, this approach described as 'market stimulating policies' consists of *'different forms of intervention (...) eligible to develop missing markets'*. This approach is opposed to World Bank 'market friendly policies'.

Horizontal technology policies in Teubal version are not specific to a particular sector or technological area i.e they are neutral in the support of R&D/innovation and thus are 'supportive of variety and of a more efficient market selection mechanism'. Teubal (2002)<sup>56</sup> develops ten technology policy "Salient Normative Policy Principles or Themes" classified into four groups:

1. Innovation and Technology Policy Objectives (Learning and SI transformation);
2. The Nature of Policy Making (Adaptive Policy Maker, An Explicit Strategic Dimension; Policy as Judgement; and the Context Specificity of Policy);
3. Learning, Demand & Dynamics (the importance of: New SI Components, explicit consideration of Demand; Learning during Implementation; Policy Learning, etc);
4. Characteristics of the Policy Set (e.g. mix between Targeted and Horizontal programs, etc).

We refer reader to Teubal (2002) paper for elaboration of specific principles/themes. Here it suffices to say that they give conceptual vocabulary for analysing innovation policy within the 'horizontal' policy perspective.

In Teubal (1997)<sup>57</sup> the horizontal policy perspective is applied within a technology policy cycle with distinct infant, growth, and mature phases. The aim of infant phase is *'proactive "generation" of a critical mass of projects for efficient learning and diffusion of innovation routines' (...)* *The mature phase of the policy focuses on policy restructuring including drastic reductions in the support of routine projects and enhanced support of more complex types of innovation'*. Teubal points to the importance of a neutrality in incentives in the infant phase and of building policy capabilities for efficient policy design and implementation.

---

<sup>55</sup> Sanjaya Lall and Morris Teubal (1998) "Market-Stimulating" Technology Policies in Developing Countries: A Framework with Examples from East Asia, *World Development* Vol. 26, No. 8, pp. 1369-1385

<sup>56</sup> Morris Teubal (2002), What is the systems perspective to Innovation and Technology Policy (ITP) and how can we apply it to developing and newly industrialized economies? *J Evol Econ* (2002) 12: 233-257

<sup>57</sup> Morris Teubal (1997) A catalytic and evolutionary approach to horizontal technology policies (HTPs), *Research Policy* 25 (1997) 1161-1188

The latest conceptual issue of evolutionary technology policy developed by Avnimelech & Teubal (2008)<sup>58</sup> is the idea of ‘evolutionary targeting’. This is defined as ‘*a dynamic, systems-evolutionary policy perspective which focuses on triggering, re-enforcing and sustaining market-led evolutionary processes of emergence of Multiagent Structures (industries, clusters, markets, etc)*’. (Its) ‘*major aspect is leveraging existing successes in firms to promote emergence of such structures. This requires discrete policy interventions directed at varying areas of system/market failure, which make their appearance at different phases of the overall process*’. The argument is that this framework ‘*differs radically from the ‘Picking Winners’ policies of the past and from the successful targeting of infant industries in Korea and post war Japan, (and) seems to fit the increasingly turbulent and high return/high risk global environment prevailing today*’.

Richard Lipsey’s work in area of technology policy closely relates to Metcalfe, Witt and Teubal’s contributions. Lipsey’s (2002)<sup>59</sup> perspective – ‘structuralist-evolutionary’ - is micro based and stresses the uncertainty that is associated with technological advance. As Lipsey (2002) points out ‘*these theories are evolutionary in that they deal with the evolution of the economy when technology is changing endogenously and they are structural in the sense that they specifically analyse many of the economic structures that neoclassical theory keeps in black boxes*’. As it is impossible to achieve optimal allocation of resources innovation policy ‘*must rely on a mixture of theory, empirical analysis and policy judgment.*’ In summary, the large amount of policy advice that follows from structuralist-evolutionary theories is context-specific. Lipsey argues that ‘*focussed, context-specific policies and programs are commonly found in almost all countries*’. They are policies operating ‘*in addition to, not substitutes for, the market-orienting measures*’. In several respects, Lipsey’s framing of policy is very much in line with ‘market enhancing view’ of state and overlaps with ‘market stimulation’ framing policies by Lall and Teubal (1998).

So, what is the novelty and usefulness of ‘proper’ evolutionary technology policy? Our conclusion is quite ambiguous in the sense that conceptual developments within this perspective remove from policy makers ‘shackles’ of neo-classical market failure framework which cannot tackle dynamic issues of innovation policy with all its dimensions like uncertainty and system of innovation. On the other hand, by going not much further than beyond general principles and policy taxonomies its poverty in terms of policy specificity becomes obvious. So, similar to Freytag & Renaud<sup>60</sup> in their review of the evolutionary policy making book we conclude that evolutionary technology policy demonstrates a trade off between specificity and relevance of policy implications. It does not lead to substantial normative conclusions with respect to detailed policy rules but it makes clear the complexity of economic and innovation processes and the need for specific policy responses. Finally, if metaphors are important in policy-making than evolutionary metaphor is much more appropriate than neo-classical for innovation policy.

---

<sup>58</sup> Gil Avnimelech & Morris Teubal (2008) Evolutionary targeting, *J Evol Econ* 18:151–166

<sup>59</sup> Richard G. Lipsey, Some implications of endogenous technological change for technology policies in developing countries, *Economics of Innovat. New Techn.*, 2002, Vol. 1 1(4-5), pp. 321-351

<sup>60</sup> Andreas Freytag & Simon Renaud (2007), *J Evol Econ* 17:647–648

### *Conceptual and methodological issues of Innovation Systems*

A wider institutional context of innovation processes has been recognised by evolutionary perspective as an important ingredient of innovation policy. An increasing complexity and interactivity of innovation process as reflected in different innovation models and in an increasing systemic nature of technological change represents an important ‘technological’ driver for the emergence of innovation systems. In conceptual terms, the idea of innovation systems is based on the view of economy as ‘an ensemble of connected elements not an aggregate entity’ (Metcalfe, 2002)<sup>61</sup>.

Why conceptual and methodological issues of innovation systems are relevant from policy perspective? Policies inevitably reflect underlying conceptual thinking, frameworks and ideas. Policy concepts rest on theoretical ideas and their empirical soundness is (at least partly) reflected in the relevance of policy. Specifically, methodological and conceptual issues related to systems of innovation are reflected in scope and shape of innovation policy. In continuation, we highlight several conceptual/methodological issues related to systems of innovation research which have impact on innovation policy. These are:

- The scope of national system of innovation: broad or narrow
- Innovation system (broad) between theory and ‘low level theory’
- Institutional vs. functional approach to innovation system

Other methodological issues which we will not tackle here are: how to determine the population, i.e. delineate the system and identify the actors and/or components, and how to measure the performance of the system. For discussion of these issues see Carlsson et al, 2002)<sup>62</sup>

#### *The scope of national system of innovation: broad or narrow*

The term NIS is used in two meanings: broad and narrow NIS (Lundvall, 1992)<sup>63</sup>. ‘Narrow’ refers to formal R&D systems and organisations which are systematically active in knowledge generation and diffusion. These “narrow” institutions are embedded in a much wider socio-economic system (‘broad’ NIS) ‘in which political and cultural influences as well as economic policies help to determine the scale, direction and relative success of all innovative activities’ (Freeman, 2002).<sup>64</sup>

---

<sup>61</sup> J. S. Metcalfe, (2002) Knowledge of growth and the growth of knowledge, *J Evol Econ* 12: 3–15

<sup>62</sup> Bo Carlsson, Staffan Jacobsson, Magnus Holmén, Annika Rickne (2002) Innovation systems: analytical and methodological issues, *Research Policy* 31, 233–245

<sup>63</sup> Lundvall, B.-Å. (Ed.), 1992. *National Systems of Innovation: Towards A Theory of Innovation and Interactive Learning*. Pinter, London.

<sup>64</sup> Chris Freeman (2002), Continental, national and sub-national innovation systems—complementarity and economic growth, *Research Policy* 31 (2002) 191–211



Johnson et al (2003)<sup>65</sup> consider that ‘authors from the US with a background in studying science and technology policy, tend to focus on ‘the innovation system in the narrow sense’. For them NIS represents ‘a broadening of earlier analyses of national science systems’ and they focus on ‘the systemic relationships between R&D-efforts in firms, S&T-organizations, including universities, and public policy’ in high tech-sectors. Johnson et al (2003) contrast this view with the ‘Freeman and the ‘Aalborg-version’ of the national innovation system-approach’ which aims at understanding ‘the innovation system in the broad sense’.

*‘Innovation is seen as a continuous cumulative process involving not only radical and incremental innovation but also the diffusion, absorption and use of innovation. Second, a wider set of sources of innovation is taken into account. Innovation is seen as reflecting, besides science and R&D, interactive learning taking place in connection with ongoing activities in procurement, production and sales’* (Johnson et al, 2003).

These two perceptions of NIS underlie different conceptions of innovation policies. The scope of Innovation Policies differs whether broad or narrow NIS is taken as a unit of analysis and of policy focus. For example, World Bank in its Knowledge Assessment methodology (KAM) takes view of NIS in a narrow sense. The idea of the ‘third generation innovation policy’ rests implicitly on understanding of the NIS in its broad sense (see below).

For Lundvall (undated)<sup>66</sup> these differences are far from trivial as understanding of NIS in narrow sense leads to ‘policies aiming almost exclusively at stimulating R&D efforts in high-technology sectors’. This in turn led *‘to so-called ‘innovation paradoxes’ which leave significant elements of innovation-based economic performance unexplained’*. Accordingly, *‘without a broad definition of the national innovation system encompassing individual, organizational and inter-organizational learning, it is impossible to establish the link from innovation to economic growth’*.

Moreover, Lundvall regards *‘the neglect of ‘learning as competence-building’ as the principal weakness of standard economics and the narrow definitions of innovation systems as reflecting a negative spill-over from this misdirected abstraction’*.

In their paper to the Rio Globelics Conference, Reinert and Reinert (2003) warned about the abuse of the IS perspective in academic and policy circles. They mentioned that *“by integrating some Schumpeterian variable to mainstream economics we may not arrive at the root causes of development. We risk applying a thin Schumpeterian icing on what is essentially a profoundly neoclassical way of thinking”* (p.

63)(Cassiolato and Lastres, 2007)<sup>67</sup>

---

<sup>65</sup> Björn Johnson Charles Edquist Bengt-Åke Lundvall Economic Development and the National System of Innovation Approach First Globelics Conference, Rio de Janeiro, November 3 – 6, 2003

<sup>66</sup> Bengt-Åke Lundvall (undated) Post Script: Innovation System Research Where it came from and where it might go

<sup>67</sup> José E. Cassiolato Helena M. M. Lastres (2007) Discussing innovation and development: Converging points between the Latin American school and the Innovation Systems perspective GLOBELICS Working Paper Series No. 08-02

*Innovation system (broad) between theory and 'low level' theory*

Among analysts of systems of innovation there is no agreement regarding what should be included in and what should be excluded from a '(national) system of innovation' (Sharif, 2006)<sup>68</sup>. This leads to a variety of approaches in terms of what is included as NIS, from studies which are confined only on public R&D system to those which include a variety of non-technological factors into analysis. This variety of perspectives, frameworks and differences in the scope of analysis are seen by some scholars as an advantage. Broad nature and flexibility of the concept are seen by some 'as a great advantage since it makes it useful for practical purposes.' (Lundvall et al 2002: 221) Another one is: "...heuristic concepts and focusing devices such as national systems of innovation may play a major role since they offer a broad and flexible framework for organizing and interpreting case studies and comparative analyses." (Lundvall 2003: 9)'(as cited in Sharif, 2006). In addition to Lundvall, a similar position is held by RR Nelson based on several public and private communications.

Another view is that '*the NSI approach is 'under theorized' and needs to be made more precise in its terminology and in its definition. The problems mentioned are then regarded as weaknesses and it is argued that conceptual clarity should be increased. Ambiguities should be sorted out and the approach should be made more 'theory-like'. Its degree of rigor and specificity should be increased, e.g. with regard to statements about relations between variables*' (Shariff, 2006). Shariff (2006) cites OECD as having this position. Among innovation scholars Edquist holds this view. For a critique of theoretical inconsistencies in definitions of system of innovation see Radosevic (1998).<sup>69</sup>

By being a 'low level theory' the use of NIS as a concept will inevitably lead to abuses, distortions and misinterpretations. In that respect, Lundvall's objections that biased use of NIS lead to narrow policies and 'innovation paradoxes' while at the same time citing its 'flexibility' and 'broad nature' as 'useful for practical purposes' are somewhat contradictory. Paradoxically, Lundvall himself has made first steps to overcome 'looseness' of innovation system concept by outlining for the first time a common analytical approach or method to study NIS. See Lundvall (undated)

Scholars of regional innovation systems have been also struggling with the theoretical vs practical relevance issue. For example, Cooke et al (1997)<sup>70</sup> tried to make this concept more operational than theoretical as regional level of analysis requires much more hands on approach than is the case at national level. The biggest difficulty is to explore 'the extent to which innovation processes at regional level could be defined as systemic'. A focus of innovation policies at regional level is learning which can be improved 'through certain institutional changes and properly oriented active policies'.

---

<sup>68</sup> Naubahar Sharif (2006) Emergence and development of the National Innovation Systems concept *Research Policy* 35, 745–766

<sup>69</sup> Radosevic, Slavo (1998) "Defining Systems of Innovation: A Methodological Discussion", *Technology in Society* 20, pp. 75-86.

<sup>70</sup> Philip Cooke, Mikel Gomez Uranga, Goio Etxebarria (1997) Regional innovation systems: Institutional and organisational dimensions, *Research Policy* 26 (1997) 475-491

*Institutional vs. functional approach to innovation system*<sup>71</sup>

NIS are defined in institutional terms. For example, Freeman (1987:7) defines it as 'the network of institutions in the public and private sectors whose activities and interactions initiate, import and diffuse new technologies'.<sup>72</sup> This, and other definitions of national, but also sectoral and technological systems of innovation, define system in institutional terms, i.e. as a network of agents, a population of firms, a set of institutional actors, the system of interacting public and private firms, universities and government agencies, etc. (see Radosevic, 1998, for an overview and critique). The methodological problem of defining NIS only in institutional terms is that there is no simple relationship between the institutional forms of national systems and economic functions. Radosevic (1998) concludes that systems of innovation should be defined not only in institutional terms, but also in technological terms or, more generally, in functional terms.<sup>73</sup> Otherwise, there is a danger that definitions will become circular, i.e. any institutional variety could be declared relevant from an economic or technological perspective, which would be misleading

The issue then becomes one of identifying which institutions are relevant for explaining systems of innovation or what is the relevant diversity between two systems. Radosevic (2007) argue that only institutional variety that performs different economic function (functional variety) can be considered relevant from an economic perspective. Or, in terms of technology, only variety that performs different technological function (technological variety or variety in terms of technological regime) can be considered relevant from an economic-institutional perspective.

Why is it useful to focus on functions in innovation systems? Johnson (2001) sees several benefits. First, the concept of function provides a tool for setting system borders.

*The innovation system would then include all components that influence one or more of the identified functions for the object of study (e.g. a product or technology). This means that borders are not set a priori to nation, region or technology and that different levels of analysis may be combined. (Johnson, 2001: 16)*

Second, the concept of function can be used as a tool to describe the present state of a system. Third, by mapping functional patterns, i.e. how functions have been served

---

<sup>71</sup> This section mainly draws on Radosevic, S. (2007), 'National Systems of Innovation and Entrepreneurship: In Search of a Missing Link' UCL Centre for the Study of Economic and Social Change in Europe: Working Papers, No. 73 February 2007, <http://www.ssees.ac.uk/economic.htm>

<sup>72</sup> Freeman (1987) and Lundvall (1992: 2) distinguish between the *narrow* NIS (organisations and institutions involved in searching and exploring - such as R&D departments, technological institutes and universities) and the *broad* NIS (all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring - the production system, the marketing system and the system of finance. (For examples of narrow and broad NSI see Freeman, 2002: 194-195.) For our purposes, we distinguish here between 'narrow' NIS as composed primarily of organisations directly involved in innovation processes, and 'broad' NIS consisting of institutions, norms and rules (formal and informal) which (directly or indirectly) affect the innovation process.

<sup>73</sup> Boundaries of institutional diversity of systems of innovation are provided by technological regimes. The relevant institutional differences between systems of innovation occur those where interaction between institutional set-ups and technological regimes produces a distinctively different techno-institutional configuration.

we can study system dynamics. Fourth, it allows us to assess the performance of innovation systems by analysing its ‘functionality’ i.e. how well the functions have been served. Fifth, by focusing on functions ‘actors may be uncoupled from what happens in an innovation system. This may be useful in comparative studies since it reduces the risk of comparing system structure instead of systems functionality; two systems may function equally well even though their structure is totally different’ (Johnson, 2001: 17).

Hekkert et al. (2006)<sup>74</sup>, proposed a model to structure empirical work on functions in innovation systems which is not focused on institutions. However, the most applied version of functional view of innovation system is manual on functional analysis of innovation system by Swedish group (see Bergek et al, 2008)<sup>75</sup>. The usefulness of functional view is that ‘policy makers often experience difficulties in extracting practical guidelines’ from innovation studies. Bergek et al (2008) operationalize a functional approach to analyzing innovation system dynamics into a practical scheme of analysis for policy makers. Their scheme can be used by policy makers not only to identify the key policy issues but also to set policy goals.

It is worth mentioning here Bell’s analysis of neglected function of innovation systems in developing countries - design and engineering activities. Bell (2008)<sup>76</sup> argues that bodies responsible for science, technology and innovation policy in developing countries inherited from the advanced countries a preoccupation with R&D as the core focus for policy.

*‘This remained the case when concepts of ‘innovation system’ were wrapped around existing policy approaches and interests over the last decade or so. For Bell, this is ‘deeply distorting as ‘design and engineering’, play a much more central role in innovation across wide areas of the economy. Correspondingly, they also constitute a more important focal point for policy concerned with accumulating technological or, more broadly, innovation capabilities. But not only is such a policy emphasis blindsided by the preoccupation with R&D, it has been undermined over recent years by global changes in the way design and engineering activities are organised, and it is actively thwarted by common approaches to development assistance’.*

Why these methodological / conceptual issues of innovation systems are relevant for innovation policy? A loose, all encompassing, vague but useful heuristics as SI currently operate more as a metaphor than analytical approach for policy making. Unless the concept becomes more analytically founded it will exhaust its life as a metaphor. This by itself may be not such a problem provided that there are well developed alternatives on the horizon. However, this survey does not seem to suggest that there are.

---

<sup>74</sup> Hekkert, M.P. / Suurs, R.A.A. / Negro, S. / Kuhlmann, S. / Smits, R. (2006): Functions of Innovation Systems: A new approach for analysing technological change. In: *Technological Forecasting & Social Change*

<sup>75</sup> Anna Bergek, Staffan Jacobsson, Bo Carlsson, Sven Lindmark, Annika Rickne (2008), Analyzing the functional dynamics of technological innovation systems: A scheme of analysis, *Research Policy* 37 (2008) 407–429

<sup>76</sup> Martin Bell, Design and engineering activities - the neglected heart of innovation systems in developing countries: some questions about capability building. SPRU Friday seminar series, abstract, mimeo

### *Methodological issues of innovation policy (uncertainty, time)*

There are several dimensions of policy which are specific to innovation policy. The two most obvious ones are: uncertainty and time. As pointed out by evolutionary perspective uncertainty turns policy making into learning and adaptive activity. However, innovation policy by being ‘adaptive’ may turn into one more source of uncertainty. This issue has been addressed by Marcus (1981)<sup>77</sup> who tries to define the problem. For him, the relevant issue is whether policy uncertainty ‘*impedes business with respect to all government policy or only some government policy; whether uncertainty impedes all firms and industries or only some firms and industries; and, particularly, whether it is simply a rationalization for decisions not to innovate or whether there is, in fact, a simple cause-and-effect relationship between policy uncertainty and technological change*’. In view of proliferation of innovation policy it is surprising that this issue has not been explored empirically.

A closely related to uncertainty is the issue of time scale of innovation policy which is linked to how long it ‘typically’ takes for firms to move through a sequence of stages in the process of technology and innovation capability building, especially in situations where innovation policy aims to target these capabilities. As pointed by Bell (2006)<sup>78</sup> (and elaborated by Figueiredo, 2006) ‘*we remain an enormous distance away from being able to offer any insight into how and why such time periods vary under different sets of circumstances*’.

On the other hand, shortening of technology cycles poses another set of challenges in terms of inability of policy to anticipate speed of changes (see Rycroft, 2006)<sup>79</sup>. This is important not only for leaders but also for followers; it increase the importance of broader perspectives and intelligence-gathering becomes essential to policy making.

## A. INNOVATION SYSTEMS

Innovation policy thinking today is largely framed within the systems of innovation perspective. As we already pointed out this has to do with the increasing realization that innovation and technical change is a systemic activity. The system of innovation approach opens the possibility to analyse S&T and innovation in integration with broader economic policy. For developing countries this helps to broaden perspective on development which has been usually confined on either investment in the past or on institutional convergence issues (for example, World Bank ‘Doing Business’ analyses) as the current mainstream. As this survey indicates, whether this opportunity has been fully used is still an open question.

---

<sup>77</sup> Alfred A. Marcus (1981) Policy Uncertainty and Technological Innovation, *The Academy of Management Review*, Vol. 6, No. 3, (Jul., 1981), pp. 443-448

<sup>78</sup> Bell, M. (2006), How long does it take? How fast is it moving (if at all)? Time and technological learning in industrialising countries. *International Journal of Technology Management*, Special Issue,

<sup>79</sup> Robert W. Rycroft (2006), Time and technological innovation: Implications for public policy, *Technology in Society* 28 (2006) 281–301

In this ‘box’ we review applied literature on different systems of innovation. We group literature based on the level of analyses: national, sectoral, regional systems of innovation and on ‘interaction intensive environments’ (clusters, networks, etc)

## 1. *National Innovation Systems*

Innovation policy has been until recently mostly treated as an extension of R&D policy. The diffusion of NIS perspective was supposed to change this but judging based on this literature review this is not yet the case. By expanding the perspective on innovation to include interactive linkages in the innovation system has not entirely changed the framework for innovation policy. We can discern three types of literature:

- Innovation policy analyses within the explicit NIS framework
- Innovation policy analyses with occasional or superficial reference to NIS framework
- Innovation policy analyses within basically S&T system framework

*Innovation policy analyses within the explicit NIS framework* are actually quite rare. We refer not only to major comparative studies on NIS like books by Lundval, Nelson and Edquist but also to individual country studies. They are usually published as books and rarely as journal papers. They require good understanding of the NIS framework and concepts and their application in the context of individual country is not trivial task. They are actually quite laborious and demanding in terms of range of issues and can rarely be handled by individual scholars. When they are of high quality they usually contain a link to conceptual toolbox of evolutionary technology policy. For example, ShuLin papers on Chinese NIS<sup>80</sup> contain frequent references to notion like ‘interactive learning’, ‘policy experimentation’, ‘adaptive policy’ (cf. Metcalfe) and like.

The strength of these analyses is that innovation policy is considered as one of factors in shaping of the NIS. This broader perspective on policy certainly brings a dose of realism and provides political economy background required for understanding the profile of policies.

*Innovation policy analyses with occasional or superficial reference to NIS framework* reflect a widespread phenomenon: NIS has become a common discourse so that even when analysis can be undertaken comfortably without NIS framework author still feel obliged to refer to NIS as a background of their analysis. This lip service to NIS idea does not really improves our understanding of the issue at hand and contributes to conceptual confusion. Very often analyses of public R&D policies are actually interpreted as analyses of NIS. For example, authors would usually reduce the issue on public organisations in support of R&D and would rarely refer to enterprises.

---

<sup>80</sup> Shulin Gu and Bengt-Åke Lundvall (2006) China’s Innovation System and the Move Towards Harmonious Growth and Endogenous Innovation, Published in IMPP (Innovation, Management, Policy and Practice) 2006 vol 8, 1-2

*Innovation policy analyses within basically S&T system framework* reflect more easiness to handle such a complex issue as innovation within this framework rather than belief of authors that this is the most appropriate framework.

We are reluctant here to cite examples of specific approaches to NIS as grouping of specific authors into a specific group is always open to criticism.

Our conclusions regarding analyses of NIS largely apply to inter-country comparisons of NIS. The NIS framed inter-country comparisons are very rare and we find much more often comparative analyses of innovation policies which are only NIS focused. The NIS focused analyses take background understanding of NIS as given and implicit. A world centre of these comparisons is the EU with its huge demands to monitor and benchmark innovation policies of its 27 member states + other countries. EU ProINNO Trendchart exercise with the EIS Scoreboard and country reports are a good example of difficulties to convert conceptual ideas from innovation system and evolutionary technology policy into policy analyses. These exercises open Pandora of methodological problems which reach its height in attempts to make sensible and useful comparisons of innovation capacity and innovation systems of different countries. For example, when forced to compare a large number of countries benchmarking inevitably turns into a narrow technical procedure focusing on comparing quantitative data. However, identical indicators for countries with big differences from technology frontier make the whole exercise relevant for some and irrelevant for others in dependence where we want to put focus. A gap between need to have reliable indicators for the quality and intensity of relationships, interactions and networks or for the characteristics of learning organisations and indicators that are actually available is too large. As pointed by Lundvall and Tomlinson (2001)<sup>81</sup> there is a need for ‘new conceptual work before meaningful indicators can be constructed’. This further reinforces conclusion that the NIS concept is in a dire need of stronger analytical basis.

## 2. *NIS and Globalization*

Globalisation and NIS is an area of research which has increasingly caught attention of innovation scholars. A survey by Carlsson (2006) captures the majority of literature and points to continuous importance of national institutions to support innovative activity, even though that activity is itself becoming increasingly internationalized.<sup>82</sup> However, this conclusion seems to be far from sufficient for contemporary innovation policy. For example, analysis of IT policies in Europe shows that on one hand, *‘the concepts and strategies guiding public policies have become more and more complex, resulting in comprehensive programs for national and European “innovation policies”*. *On the other hand, as a result of the economic globalization; as well as of changes in the internal structure of the state, the state capacities to implement these*

---

<sup>81</sup> Bengt-Åke Lundvall and Mark Tomlinson (2001) International benchmarking as a policy learning tool, Chapter for the Lisbon Summit follow up book

<sup>82</sup> Bo Carlsson Internationalization of innovation systems: A survey of the literature, *Research Policy* 35 (2006) 56–67

*ambitious strategies successfully have been eroding. As a consequence, technology policy both on the national and on the supranational level has been confronted with an intensifying strategic dilemma'* (Grande, 2001)<sup>83</sup>

While this problem may be specific to EU the relationship to FDI and capacity of countries to maximise technological benefits is increasingly relevant. Policies that encourage domestic firms' innovation are often perceived as conflicting with policies that aim to acquire foreign technologies. In other words, policies for NIS are perceived as opposite to policies to attract FDI. Unfortunately, there is very little that conceptual analysts could contribute to policy making in this area. So, we consider it as an important challenge for innovation policy (see below). What we have are mainly conceptualisations which address only the issue of policy implication of globalisation of NIS but not interaction between NIS and globalisation.

In our view, the most interesting work from innovation perspective has been done by a circle of PhD students of Martin Bell - Eva Dantas, Elisa Giuliani and Anabel Marin (Dantas et al, 2007)<sup>84</sup>. Their focus is on links between FDI subsidiaries and NIS and their work goes beyond usually FDI spillovers perspective. In the core of this perspective lies a policy question: how to strengthen links between the FDI and the capabilities of the local firms.

### 3. Sectoral systems of innovation

A work on sectoral innovation system has remained somewhat in a shadow of literature on NIS. Yet, our survey of literature suggests that this line of research is developing and this perspective is able to generate relevant policy implications. This is even more surprising given the silence of conceptual work on sectoral innovation systems regarding policy implications. For example, a review of a few papers by Franco Malerba, one of major contributors in this area, does not demonstrate clear view of innovation policy that would follow from sectoral analyses. For example, in his summary of research on SIS Malerba (1999)<sup>85</sup> is silent on policy issues. He argues that '*on this ground it will be possible to develop public policy indications based on a deeper understanding of the structure, working and dynamics of sectors (...). Sectoral systems may prove a useful tool in ..... and finally for the development of new public policy indications'*. So, research on SIS has actually much less to say to policy than the research on NIS.

Within database *ad hoc* constructed for this paper we reviewed 40 papers on sectorally focused innovation policy and found that 15 of these are framed within the SIS perspective. We have reviewed these 15 papers and found that only one paper (Godoea and Nygaard, 2006)<sup>86</sup> applies a conceptual idea when analysing policy: a

---

<sup>83</sup> Edgar Grande The erosion of state capacity and the European innovation policy dilemma, *Research Policy* 30 (2001) 905–921

<sup>84</sup> Eva Dantas, Elisa Giuliani and Anabel Marin (2007), The Persistence of 'Capabilities' as a Central Issue in Industrialization Strategies: How They Relate to MNC Spillovers, Industrial Clusters and Knowledge Networks, *Asian Journal of Technology Innovation* 15, 2

<sup>85</sup> Franco Malerba (1999), Sectoral Systems of Innovation and Production, DRUID Conference on: National Innovation Systems, Industrial Dynamics and Innovation Policy, Rebild, June 9-12, 1999.

<sup>86</sup> Helge Godoea, Stian Nygaard (2006) System failure, innovation policy and patents: Fuel cells and related hydrogen technology in Norway 1990–2002 *Energy Policy* 34 (2006) 1697–1708



system failure. In all other cases, policy issues do originate in grounded manner from analysis of SIS. Moreover, these analyses have demonstrated the relevance of the SIS as a conceptual approach and relevance of policy analysis within this framework. This type of analysis seems quite amenable to newly emerging sectors, in particular in alternative energy areas. This may be due to ability to clearly identify actors including ‘missing actors’. An interesting finding from this survey is that many sectoral issues are explained by the features of country’s NIS. For example, see Szapiro1 and Cassiolato (2003)<sup>87</sup>, Hung (2006)<sup>88</sup>(Hung and Yang, 2003)<sup>89</sup>(Shulin, 2007)<sup>90</sup>. This points to need to undertake analyses which would combine sectoral and national level analyses or be complementary. This also applies to sectors where national and global boundaries are quite mixed up. See for example Sagar, J.P. Holdren (2002)<sup>91</sup>

#### 4. *Regional innovation systems*

A literature on regional innovation system is still largely EU in origin as this is the region which has invested heavily in innovation at regional level but within the perspective of RIS. There is a surprisingly limited literature on regions from RIS perspective in developing countries.

#### 5. *Interaction intensive environments*

‘Interaction intensive environment’ is a suitable term to describe a variety of mezzo level networks whose feature is a close interaction among actors of networks (REF). These could be clusters, networks, university – industry links (triple helix), value chains, etc. Literature on these ‘environments’ in particular on policy created institutional forms like S&T parks, technoparks etc is already significant. For example, journal *Technovation* has already a long stream of references which are focused only on S&T parks. It seems that these papers reflect to a large extent demand to evaluate relevance of different clustering initiatives rather than genuine process of bottom up driven clustering.

A much more than NIS framed innovation policies clusters and different forms of networks reflect the thesis that ‘*networking is a universal requirement of innovative activity*’(DeBresson,1999)<sup>92</sup>. Recognition of natural propensity of innovation to cluster has led to development policies that ‘*think beyond individual innovative*

---

<sup>87</sup> Marina Szapiro1 and José Cassiolato, (2003) Telecommunications System of Innovation in Brazil: Development and Recent Challenges, Prepared for the The First Globelics Conference Innovation Systems and Development Strategies for the Third Millennium, Rio de Janeiro, November 2-6, 2003

<sup>88</sup> Shiu-Wan Hung (2006), Competitive strategies for Taiwan’s thin film transistor-liquid crystal display (TFT-LCD) industry, *Technology in Society* 28, 349–361

<sup>89</sup> Shiu-Wan Hung and Chyan Yang (2003) The IC fabless industry in Taiwan: current status and future challenges, *Technology in Society* 25 (2003) 385–402

<sup>90</sup> Shulin Gu (2007) The emergence and development of vegetable sector in China: An analysis from the sectoral innovation systems perspective, GLOBELICS Catching Up project, mimeo

<sup>91</sup> A.D. Sagar, J.P. Holdren (2002) Assessing the global energy innovation system: some key issues *Energy Policy* 30 (2002) 465–469

<sup>92</sup> Christian DeBresson (1999), An Entrepreneur Cannot Innovate Alone; Networks of Entreprises Are Required. The meso systems foundation of innovation and of the dynamics of technological change, Paper to be discussed at the DRUID conference on systems of innovation in Aalborg, Denmark, June 9-11, 1999

*capabilities in terms of technological systems and innovative clusters*' (DeBresson, 1989)<sup>93</sup>.

However, the issue that remains open is whether poles of dynamic interaction make a system. Lundvall (undated) would argue that they are only subsystems which capture some types of linkages, especially science and innovation linkages in the case of academic incubators.

It is not our aim here to evaluate this literature but simply to point out that ideas of 'interactivity' and 'collective learning' have been fully embraced by innovation policy and have become its mainstream. However, there is a huge gap between principles of policies for clusters and value chains and specific policy practice. Policy principles require promoting 'external economies' and inter-firm relationships like trust, business association, external linkages which are difficult to translate into a specific manual. Specific policy activities require ingenuity, location-(context) specificity, sector specificity, intensive coordination, and adaptability. In fact, regional cluster policies represent a microcosm of problem between innovation policy theory and practice. It is an area of research where action type of research should be the major mode of work.

Innovation as reflected in interactive agents and flows of knowledge is essentially a social activity. This is un-surmountable problem for policy which is supporting surrogates of interactivity in the form of organisations like S&T parks or technoparks. The idea of 'learning networks' as policy induced form of inter-firm learning may be an alternative. If successful they should induce 'action learning' and experience sharing, essentially social activities. A number of policy programmes have tried to establish learning networks—for example, 'best practice clubs'—but they seem to last as long as there is a project support (Bessant and Francis, 1999)<sup>94</sup>.

A strong focus on linkages neglects that links are as strong as actors or its nodes are strong. This emphasizes the role of intermediaries and the quality of interface between users and producers (Smits, 2002)<sup>95</sup>. We should bear in mind that their role has increased not only due to increasingly systemic nature of innovation but also due to institutional changes in direction of privatisation and commercialisation which then led to increasing market and systemic failures. The privatization of agricultural research and extension establishments worldwide which has led to the development of a market for services designed to support agricultural innovation is a case in point (see Klerkx and Leeuwis, 2008)<sup>96</sup>. In order to mitigate market and systemic failures on demand and supply side '*a field of intermediary organizations has emerged to assist agricultural entrepreneurs to articulate demand, forge linkages with those that can provide innovation support services, and manage innovation processes*'. The conclusion of analysis of Dutch intermediaries is that '*the state should play a role as a 'market facilitator', by funding such innovation intermediaries, primarily in*

---

<sup>93</sup> Chris DeBresson, Breeding Innovation Clusters: A Source of Dynamic Development, *World Development*, Vol. 17, No. 1. pp. 1-16. 1989.

<sup>94</sup> John Bessant, David Francis (1999) Using learning networks to help improve manufacturing competitiveness *Technovation* 19: 373–381

<sup>95</sup> Ruud Smits (2002), Innovation studies in the 21st century: Questions from a user's perspective, *Technological Forecasting & Social Change* 69, 861–883

<sup>96</sup> Laurens Klerkx and Cees Leeuwis (2008) Matching demand and supply in the agricultural knowledge infrastructure: Experiences with innovation intermediaries, *Food Policy* 33 (2008) 260–276

*articulation of demand (...) 'because of their pre-competitive scope and impartial position they can fulfil an important liaison function in the agricultural innovation system and restore the innovation systems interaction and coordination that have been disturbed by privatization processes'. However, 'in practice, proper justification of public spending on innovation intermediaries appears difficult, because of the invisibility and immeasurability of the services they provide in the end result of the innovation process'.*

This points to limits of enhancing the linkages in absence of organisations that are natural network organisers. These could be intermediate organisations but also often large firms (for Latina America see Vonortas, 2002)<sup>97</sup>. So, enhancing linkages solely as a result of government policy is limited unless there are 'network organisers'. So, the nature of such organisations is essential to understand the scope and strength of potential linkages. For example, there are high expectations of the role universities and public research institutions could have in the process of innovation through various schemes to promote university – industry links. Largely inspired by the US Bayh-Dole Act some countries are introducing legislation to enhance patenting by universities. (Ironically, this is happening at the time when analyses have shown scepticism regarding the effects of the US Bayh-Dole Act). These expectations neglect complexities of universities as organisations and assume that it is possible for them to compensate for the lack of innovative firms.

In conclusion, it seems that literature on 'interaction intensive environments' and regions has neglected has been overly focused on linkages and has neglected the nodes or key agents which form networks. As concluded some time ago by Teubal et al, (1991)<sup>98</sup> policy support to networks is unlikely to be dynamic unless it is built around 'focal organisations' or network organisers. Who could be these organisations will largely depend on a specific context. This calls for a research and policy agenda which is more multifaceted and involves support to local potential local 'champions of networking' rather than only focus on linkages.

## B. POLICY EVALUATIONS

Policy evaluation is a 'bread and butter' activity of 'practitioners'. It is a quite recent activity as until 1980s evaluation of technology / innovation policy was rare in the most developed countries and almost non-existent in developing countries. Evaluation is an activity which in countries with developed evaluation culture precedes, accompanies and follows a completion of programs and policies. Only a minor part of this activity ends up in academic publications, some of it is increasingly accessible via Internet while some of it remains in restricted circulation. We are confined in this survey on tip of the iceberg i.e. on academic literature. Fortunately, some know-how that is being generated in this activity by consultants gets converted into academic or policy analysis literature.

---

<sup>97</sup> Nicholas S. Vonortas (2002), Building competitive firms: technology policy initiatives in Latin America, *Technology in Society* 24 (2002) 433–459

<sup>98</sup> Teubal M, Yinnon T, Zuscovitch E. (1991) Networks and market creation. *Research Policy* 1991;20:381–92.

A literature that we surveyed under this heading lends itself to three fold classification. The majority of it is *evaluation of national innovation policies*. There is a limited literature on *evaluation of specific innovation policy instruments* and very sparse literature which we describe as '*broad innovation policy literature*'. By this we mean that literature which does not address innovation explicitly but which has effects (very often even stronger) on innovation than explicit innovation policy.

### 1. *Evaluation of national innovation Policies*

Innovation policies should be about all aspect of national innovation capacity i.e. not only about generation of new knowledge but also about its absorption, diffusion and demand. If our survey of collected references with key word 'innovation policy' in *Web of Science* and several related sites is any representative sample than this is still far from being understood in innovation literature. A literature on evaluation of national innovation policies can be divided into three sub-groups: a literature focused on evaluation of R&D organisations, partnerships and programs; a sparse literature that evaluate diffusion policies; and, a newly emerging literature on system's (R&D) evaluation.

References which would reflect that innovation policies have moved far beyond R&D policy are not yet there or at least not to any significant extent. This may reflect a usual lag of academic literature which needs to catch up with the changing policy practice but it also could reflect the practice of innovation policy. Also, we should consider whether policies to increase the capability of firms' to absorb and generate innovations are easy to monitor, evaluate and whether these types of analyses could generate results of broader importance for academic press.

At this point it is useful to highlight key trends in innovation policy of developed countries. We draw on thematic issue of *Research Policy* (2001)<sup>99</sup> which explores the issue of innovations in innovation policy of US and EU. The editors of this issue have highlighted three emerging trends:

First, '*the institutional locus of innovation policy is broadening in both Europe and the US. Once the realm of national governments, innovation policies are now increasingly promoted by non-governmental organizations, public-private partnerships, sub-national agencies, and — particularly in Europe — supra-national programs*'

Second, '*the targets of innovation policies are shifting. Emerging research fields that promise rapid economic benefits are now the ones that most readily attract support, overshadowing traditional fields of scientific inquiry with less obvious payoffs. Similarly, defense-related research faces downsizing and is required to pursue new objectives following the end of the Cold War, while environmental and medical research is tasked with meeting growing global climatic and public health challenges*'.

---

<sup>99</sup> Editorial, Innovations in European and US innovation policy *Research Policy* 30 (2001) 869–872

Third, ‘*new models for innovation policy are being pursued — models that are typically iterative, catalytic and networked and which accelerate the growth and pace of innovation among multiple participants, including small as well as large companies. These new innovation policy models seek modifications not only to programs, but also framework conditions and institutions and are subject to greater accountability and evaluation*’.

It seems that we do not yet observe in innovation policy literature these trends or at least not to any significant scale. However, there are a few references to indicate some of these issues. For example, the issue of coordination in innovation policy at national level has been addressed in the case of Germany (see Wilson and Vangelis Souitaris, 2002)<sup>100</sup>. The issue of coordination of innovation policy at the EU level and analysis of trend of an increasing transnationalization of innovation policy in Europe is discussed by Kuhlmann and Edler (2003)<sup>101</sup>. The author of this review is aware and has been himself involved in several exercises within the EU which tackle the issue of horizontal and vertical coordination in innovation policy but these results are not yet visible in academic literature. A rare analysis of policy to support development of innovation networks on the example of Germany is Eickelpasch and Fritsch (2005)<sup>102</sup>.

In overall, by being overly focused on R&D it seems that innovation policies have not yet picked up the importance of firm level learning and much more mundane issues related to technology absorption. In other words, there is a much stronger bias of innovation policy towards what Lundvall et al (undated)<sup>103</sup> call ‘Science, Technology, and Innovation’ (STI-mode) that give the main emphasis to promoting R&D and creating access to explicit codified knowledge than to ‘Doing, Using, and Interacting’ (DUImode) mainly based on learning by doing, using and interacting. Based on our limited survey it seems that this applies much more to developing than to developed countries. Innovation theory and policy would suggest that it should be the other way around.

Finally, there is an increasing number of references that analyse innovation policy of fast growing Asian economies like China, India, Singapore, Korea, Malaysia and Taiwan. They do not have a specific underlying conceptual basis but are informative and heavily focused on government policy. For example see: Koha and Wong (2005)<sup>104</sup> and Jian (2008)<sup>105</sup>. In cases when analyses are based or have underlying conceptual framework like NIS or evolutionary technology policy concept the level

---

<sup>100</sup> David Wilson and Vangelis Souitaris (2002) Do Germany’s federal and land governments (still) coordinate their innovation policies? *Research Policy* 31 (2002) 1123–1140

<sup>101</sup> Stefan Kuhlmann and Jakob Edler (2003) Scenarios of technology and innovation policies in Europe: Investigating future governance, *Technological Forecasting & Social Change* 70: 619–637

<sup>102</sup> Alexander Eickelpasch and Michael Fritsch (2005) Contests for cooperation—A new approach in German innovation policy, *Research Policy* 34 (2005) 1269–1282

<sup>103</sup> Morten Berg Jensen, Björn Johnson, Edward Lorenz, Bengt Åke Lundvall (undated) Forms of Knowledge, Modes of Innovation and Innovation Systems, mimeo

<sup>104</sup> Winston T.H. Koha and Poh Kam Wong (2005), Competing at the frontier: The changing role of technology policy in Singapore’s economic strategy *Technological Forecasting & Social Change* 72 (2005) 255–285

<sup>105</sup> Song Jian (2008), Awakening: Evolution of China’s science and technology policies *Technology in Society* 30 (2008) 235– 241

the robustness analysis improves. See for example Breznitz (2007)<sup>106</sup> and Vekstein (1999)<sup>107</sup>. This suggests that interaction between conceptual basis and practice of innovation policies improves the level of analysis.

### **Evaluations of R&D (R&D system, partnerships, and programs)**

A literature on evaluations of R&D systems in developing countries probably forms the bulk of literature on innovation policy. Only some of it is available as academic literature while most of it is presented at conferences and accompanying volumes. Its quality varies and analysis of R&D system is often presented as the component of the NIS. For example, see Adeyinka (2005)<sup>108</sup>. In our *ad hoc* compiled database based on *Web of Science* there are not examples of this type of analysis for developing countries. This literature does not interact much with the conceptual toolbox of innovation theory but represents more application of some concepts, in particular of linkages of R&D with the economy.

A related to the issue of R&D system is the literature on R&D partnerships as well as literature on public R&D as complement/substitute to private which occupy niches within the industrial economics. Again our search of *Web of Science* and related websites has identified only one reference on partnerships in R&D and technological development for developing countries (Hall et al, 2001)<sup>109</sup>. This may suggest that for many developing countries all the talk about interactivity and linkages i.e a systemic view of innovation policy remains more at the level of policy objectives ‘than in the design or practice of effective policies’ (Viotti, 2007)<sup>110</sup>.

### **Evaluation of diffusion policies**

Within evolutionary perspective innovation and the diffusion of innovation are inseparable, as diffusion shapes pattern of technology development. The appreciation of diffusion within innovation theory has influenced innovation policy. However, assessments of its presence as a component of innovation policy widely differ, probably in dependence of the scope of diffusion policy. In assessment of technology diffusion in late 1980s and early 1990s Stoneman and Diederer (1994) concluded that ‘*given that there is a serious theoretical case for diffusion policy, it is surprising to find that in fact there are very few policy initiatives in developed countries aimed at tuning the speed of innovation diffusion (patent laws apart)*’. However, they have also noted that ‘*a gradual reorientation of policy direction toward diffusion*’.

---

<sup>106</sup> Dan Breznitz (1999) Industrial R&D as a national policy: Horizontal technology policies and industry-state co-evolution in the growth of the Israeli software industry, *Research Policy* 36 (2007) 1465–1482

<sup>107</sup> Daniel Vekstein (1999), Defense conversion, technology policy and R & D networks in the innovation system of Israel, *Technovation* 19 (1999) 615–629

<sup>108</sup> Adeyinka, Foluso. Modupe (2005), The Roles and Functions of Research and Development (R & D) Institutions in Nigeria, Paper presented at the GLOBELICS 2005 South Africa Conference

<sup>109</sup> Hall A. et al (2001), Why research partnership theory really matter: Innovation theory, institutional arrangements and implications for developing new technology for the poor, *World Development*, Vol. 29, No. 5: 783-797

<sup>110</sup> Eduardo B. Viotti (2007), Roles and Challenges of Science, Technology and Innovation Policies in Latin America, Presentation at Atlanta Conference on Science, Technology, and Innovation Policy 2007, Georgia Institute of Technology, Atlanta, Georgia, USA, October 19-20, 2007

This assessment stands in sharp contrast to Park (1990) who argues that *'dating back to the conventional transfer practices of the early 1970s, advanced countries have implemented a wide variety of diffusion policy measures and programs'*.

This difference is probably due to differences in what is meant by diffusion policy. Stoneman and Diederer (1994)<sup>111</sup> have in mind specific diffusion programs while Park (1999)<sup>112</sup> had in mind broader set of programs which also include those focused on absorptive capacity of SMEs and regions. What is certain is that in the last 10-20 years we have seen a proliferation of policy initiatives that are focused on enhancing absorptive capacity of SMEs and where distinction between diffusion and absorption is actually difficult to establish. This may reflect an increasing trend (noted by Park, 1999) in diffusion policy towards inclusion of 'soft technologies such as know-how, technical skills, and information software'. Diffusion of soft technologies is difficult to discern from absorption of knowledge.

Park (1999) concludes that *'almost all countries now employ technology diffusion as an important part of macro-technology policy and consider it an essential element of national systems of innovation'*. The policy has widened to include balanced regional development and technology infrastructure building. A search of academic literature shows not empirically oriented policy papers focused on evaluation of diffusion policies. This may be not the case of SMEs, and especially regions where we noted an emerging literature on support of their absorptive capacity through clusters and related initiatives. In summary, we may have here problem of policy to handle analytical distinction between diffusion and absorptive capacity. On the other hand, it may also suggest that often conceptual categories which make sense at macro level may be quite mundane when it comes to policy design and analysis. For example, distinction between mission-oriented countries and diffusion-oriented countries and policies (Ergas, 1987)<sup>113</sup> may be relevant as analytical distinction but difficult to discern not only at micro (individual program) but also increasingly at macro (country) level (Park, 1999).

### **System (R&D) evaluation**

In a world in which innovation is perceived as a systemic activity evaluation of individual programs or R&D systems evaluated outside of systems of innovation context run behind the need of policy makers. Erik Arnold (2004) has phrased it nicely through the sub-title of his paper: a systems world needs systems evaluations.

*'In the field of R&D policy at least, reality, theory and therefore the needs of evaluation users seem to have moved well ahead of evaluators' conceptual apparatus. The way we think about both innovation and how knowledge is produced has moved towards a systems perspective, while much of the research and innovation evaluation toolkit has been developed to tackle interventions at the lower levels of projects and programmes'* (Arnold, 2004)

---

<sup>111</sup> Paul Stoneman and Paul Diederer (1994) Technology Diffusion and Public Policy *The Economic Journal*, Vol. 104, No. 425, (Jul., 1994), pp. 918-930

<sup>112</sup> Yong-Tae Park Technology diffusion policy: a review and classification of policy practices, *Technology in Society* 21 (1999) 275-286

<sup>113</sup> Ergas H. (197) Does technology policy matter. In: Guile B, Brooks H, editors. Technology and global industry. Washington DC: National Academy Press, 1987.

A growing complexity in the innovation processes and the need for increased integration of disparate pieces of knowledge increases need for evaluation of R&D system within the broader system context, not necessarily system of innovation context. This emerging trend in policy would need new evaluation tools and frameworks for which exclusively system of innovation perspective as defined and framed in the surveyed literature above may not be sufficient. This calls for a variety of new methodological and theoretical advances focused around benchmarking and comparison of national policies. An example of work in this direction is Bodas and von Tunzelmann (2008)<sup>114</sup>.

## 2. *Broad innovation policy*

A majority of literature that we have addressed so far could be defined as a literature on explicit innovation policy. It assumes that there are clear boundaries of research and innovation policies vis-à-vis competition, health, education, welfare, defence, energy, environment, etc. policies which is far from true. In fact, it could be argued that these (implicit) policies which are not directly focused on innovation may have often bigger effects on innovation activities than explicit policies. For example, David Hart, a contributor to thematic issue on innovations in US/EU research policy points out that ‘*regulatory policies outside the conventional instruments of science and technology policy need to be recognized as essential elements of contemporary national innovation policy*’ (*Research Policy*, 2001)<sup>115</sup>.

The problem is that if we decide to ‘recognise’ policies outside the conventional innovation policy as its essential element where do we start from and how far do we go i.e. where do we stop? There is surprisingly little that policy analyst can rely in trying to capture this problem. The idea that we should try to capture the innovation effects of non-innovation policies is elsewhere defined as ‘the third generation innovation policy’ (EU, 2002)<sup>116</sup>. The traditional innovation policy was primarily oriented towards R&D, i.e. the supply side of innovation. A current mainstream is the second generation which is oriented towards systems and clusters. The emerging at present third generation of innovation policy assumes that there is a potential for innovation which is embedded in other sectors or policy domains. This potential can be realized by ensuring cross-sectoral optimisation of the components of various sectors’ innovation policy through co-ordination and integration. This cross-sectoral optimisation could be horizontal, vertical and temporal. According to an OECD (2005) MONIT study ‘*horizontal coherence ensures that individual, or sectoral, policies, build on each other and minimise inconsistencies in the case of (seemingly) conflicting goals. Vertical coherence ensures that public outputs are consistent with the original intentions of policy makers. Temporal coherence ensures that today’s*

---

<sup>114</sup> Bodas Freitas, I.M., von Tunzelmann, N., Mapping public support for innovation: A comparison of policy alignment in the UK and France, *Res Policy* (2008), doi:10.1016/j.respol.2008.05.005

<sup>115</sup> Editorial, Innovations in European and US innovation policy *Research Policy* 30 (2001) 869–872

<sup>116</sup> EU (2002) *Innovation Tomorrow, Innovation policy and the regulatory framework: Making innovation an integral part of the broader structural agenda*. Available at [http://cordis.europa.eu/innovation-policy/studies/gen\\_study7.htm](http://cordis.europa.eu/innovation-policy/studies/gen_study7.htm)



*policies continue to be effective in the future by limiting potential incoherence and providing guidance for change’.*<sup>117</sup>

However, this study addresses the issue of administrative or organisational context of cross-sectoral coordination. This does not yet address the issue of content i.e. what policies should be coordinated and what should be the content of coordination. Once this is clarified then the issues addressed by the OECD MONIT study should come on the agenda. Hence, in continuation we are only able to highlight several issues that fall within this area, especially within competition policy and regulations. An area which should be part of this review is finance and innovation system but it is simply too complex and can be dealt only within dedicated survey<sup>118</sup>.

### *Competition policy*<sup>119</sup>

‘Competition is an essential dimension of the business environment. Competition policy aims at preventing excessive market power and other distortions. In the absence of competitive pressures toward innovation market shares may easily turn into market power and monopoly rents without benefits on growth. Usually, competition policy is designed on the basis of the assumed ability of competition to maximize static allocative efficiency. However, from innovation point of view competition policy should be seen as a mechanism ‘to foster economic progress through innovation, which could be understood, from an evolutionary perspective, as a kind of dynamic efficiency that could be called *selective* efficiency’.<sup>120</sup> In this case, the issue is to assess ‘the extent to which a market, as a selective environment, induces the *evolution* along any innovative trajectory to be as close as possible to an objectively defined *progress* along such trajectory’.<sup>121</sup>

Most empirical research has found evidence of a positive correlation between innovation and competition.<sup>122</sup> However, recent research shows that this relationship is a somewhat more complex and that effect of competition depends on how far are firms from technology frontier.<sup>123</sup> Reduced barriers to entry to foreign products and firms have a more positive effect on economic performance for firms and industries that are initially closer to the technological frontier. In contrast, performance in firms and industries that are initially far from the frontier may actually be damaged by liberalization.<sup>124</sup> This polarising effect of liberalisation has important effects on competition policy which has to take into

---

<sup>117</sup> OECD (2005), *Governance of Innovation Systems, Volume 1: Synthesis Report*, Paris: OECD, p. 23.

<sup>118</sup> See forthcoming survey on finance and innovation by the UNECE

<sup>119</sup> First two para are from my paper prepared for the UNECE

<sup>120</sup> Mario L. Possas and Heloisa L. Borges (2005), “Competition Policy and Industrial Development”, Institute of Economics, Federal University of Rio de Janeiro (UFRJ), IPD Industrial Policy Task Force.

<sup>121</sup> *Ibid.*

<sup>122</sup> C. Gianella, and W. Tompson (2007), “Stimulating Innovation in Russia: The Role of Institutions and Policies”, *OECD Economics Department Working Papers*, No. 539, Paris: OECD.

<sup>123</sup> Philippe Aghion, Wendy Carlin, Mark Schaffer (2002), “Competition, Innovation and Growth in Transition: Exploring the Interactions between Policies”, William Davidson Institute Working Paper No. 501; Wendy Carlin, Mark Schaffer and Paul A. Seabright (2004), “Minimum of Rivalry: Evidence from Transition Economies on the Importance of Competition for Innovation and Growth”, *Contributions to Economic Analysis and Policy*, Vol. 3, No. 1, pp. 1-43.

<sup>124</sup> Philippe Aghion and Evguenia Bessonova (2006), “On entry and growth: theory and evidence”, *Revue OFCE*, June.

account the technological level of local industry when assessing effects of competition on performance. In policy terms, this would require coordination between competition and industrial policy. In traditional static perspective, this would be interpreted as conflict between objectives of competition and industrial policy. However, in a new environment, the trade-offs between competition and industrial policy may be lower than traditionally assumed<sup>125</sup>.

This problem is nicely defined by Gaffard and Quere (2006)<sup>125</sup> paper: what's the aim for competition policy: optimizing market structure or encouraging innovative behaviors?. They point out that *'market imperfection remains a concept difficult to understand from a normative viewpoint insofar as the same behavior (read as noncompetitive behavior in the standard analysis) may favor dynamic efficiency (in fact, innovative choice), while it is an obstacle to the achievement of static efficiency. Thus, antitrust authorities have to address a market imperfection–market failure dilemma (...). This dilemma is intrinsic to any innovation process, as coordination among firms is required (market imperfections) but should not lead to abusive market power that would block innovative choices (market failures)'*.

Their conclusion is that *'competition policy cannot be conducted in isolation without considering the distortions that are in the nature of the growth process. Instead of targeting any optimal market structure, it must be aimed at enforcing viability (and growth) conditions'*.

Another side of this issue is argued by David Teece (1992)<sup>126</sup> *'complex forms of cooperation are usually necessary to promote competition, particularly when industries are fragmented. Very few firms can successfully 'go it alone' any more. Cooperation in turn frequently requires interfirm agreements and alliances'*

The aim of this is not to review the area but to highlight that when we move outside the innovation policy 'proper' innovation scholars and innovation policy 'practitioners' are into a complex area where it is quite difficult to draw policy implications. There are not across the board solutions and policies require intimate knowledge of innovation and markets in a dynamic perspective.

Another example of complex relationship between innovation and seemingly non-technological policies are regulations of energy markets. Policies for transition of the energy sector towards a renewable-based system have been dominated in Europe by the liberalisation of energy markets and the introduction of new economic instruments. However, it seems that there is *'little if any evidence that simple, market-based models can facilitate the need for future energy technology innovations in a satisfactory way, which leads to a need for more complex and heterogeneous sets of measures'* including policies directly focussing on innovation and diffusion of new technologies (Jorgenson, 2005)<sup>127</sup>. It is needless to say that opinions regarding this

---

<sup>125</sup> Jean-Luc Gaffard . Michel Quéré (2006), What's the aim for competition policy: optimizing market structure or encouraging innovative behaviors?, *J Evol Econ* 16:175–187

<sup>126</sup> David J. Teece (1992) Competition, cooperation, and innovation Organizational arrangements for regimes of rapid technological progress. *Journal of Economic Behavior and Organization* 18: 1-25.

<sup>127</sup> Ulrik Jorgensen, (2005), Energy sector in transition—technologies and regulatory policies in flux, *Technological Forecasting & Social Change* 72 (2005) 719–731

widely differ. In survey of literature on environmental policy and technological change Jaffe et al (2002)<sup>128</sup> conclude:

*‘The empirical evidence is generally consistent with theoretical findings that market-based instruments for environmental protection are likely to have significantly greater, positive impacts over time than command and-control approaches on the invention, innovation, and diffusion of desirable, environmentally-friendly technologies’*

Obviously this would lead us to debates on philosophy of economics and what constitutes ‘proof’ in social sciences. However, our point here is that by crossing into ‘border areas’ of innovation policy issues of methodology, what constitutes empirical evidence and what the basis for policy further increases in complexity is. The best ‘proof’ of this is the absence of references in these ‘border areas’ in general, and for developing countries in particular.

### **3. Evaluation of specific innovation policy instruments**

A literature which evaluates specific innovation policy instruments should not be in vogue in a period when policy focus is on systems. However, we know that in all countries with developed evaluation cultures there is a considerable pool of analyses of individual policy measures. What out of that appears as a ‘literature’ is actually quite limited and is confined on assessment of patent protection and tax incentives. Our search of references in *Web of Science* has actually identified only a few references which fall within this area. One of these is the assessment of US patent system by Jaffe (2000)<sup>129</sup>. The other is conceptual analysis of public procurement with the focus on the EU by Edler and Gheorgiu (2007)<sup>130</sup>. The absence of references in relation to developing/catching up countries (with exception of venture capital) points to a limited number of evaluations of individual innovation policy instruments. In innovation studies evaluations serve as ‘inputs’ into a broader process of collection of evidence which is needed for generating ‘birds’ eye’ picture of innovation system. As these pieces of evidence are lacking or are not used by innovation scholars this suggests that interaction between theory and practice of innovation policy or micro – macro interaction is poor. This contradicts our general conclusion that innovation policy area is a dynamic one with close interaction between policy analysis and policy theory. It is most likely that this conclusion vary in dependence of whether we look at the problem from ‘trenches’ or from ‘bird’s eye’ position.

---

<sup>128</sup> Adam B. Jaffe, Richard G. Newell and Robert N. Stavins (2002) Environmental Policy and Technological Change, *Environmental and Resource Economics* 22: 41–69

<sup>129</sup> Adam B. Jaffe (2000), The U.S. patent system in transition: policy innovation and the innovation process *Research Policy* 29, 2000.531–557

<sup>130</sup> Jakob Edler and Luke Georghiou (2007), Public procurement and innovation—Resurrecting the demand side *Research Policy* 36 (2007) 949–963

## V. POLICY IMPLICATIONS OF EVOLUTIONARY PERSPECTIVE IN ECONOMICS

A point of departure for this literature survey is a proposition that although being much closer to technical change and innovation evolutionary perspective has not generated a body of policy knowledge which would make it really useful for policy making.

This point has been clearly articulated by Bartzokas and Teubal (2002)<sup>131</sup> when stating:

*'Despite the fact that Evolutionary and Innovation Studies theories have offered new ways of incorporating policy, little explicitness in this regard has yet been achieved and there is a risk that academic research following the new perspectives will be of little relevance for policy'.(my underlying)*

Jan Fagerberg<sup>132</sup> in an extensive review of evolutionary economics concludes bluntly that based on evolutionary perspective *'one cannot draw very firm conclusion on policy matters'*. However, he points out that *'for what it is worth (...) evolutionary economics provides a different perspective on policy than the one advocated by neoclassical economics. (...) The evolutionary approach (...) downplays the public-good aspect of much economic knowledge and hence puts a question mark on policy prescriptions that are solely based on public-good assumptions.*

This answer which basically says: 'maybe we are not better than our neighbours but we are different' is not the one that will be of much use to enlightened policy maker. But before we try to summarise policy implications of evolutionary perspective we should try to explain whether there is a common evolutionary perspective.

### A. Evolutionary or structuralist - evolutionary perspective?

In a review of evolutionary economic Jan Fagerberg (2002) tries to answer whether there is a common perspective in evolutionary economics? His answer is based on several factors that different strands of literature share and which suggest that there is a common approach:

1. Innovation is the main factor behind long run economic development and innovation generates variety
2. Evolutionary processes are characterized by strong regularities. These are:
  - a. the sequence of innovation and imitation (innovation is a pointer to further change i.e. clustering based on 'window of opportunity'; the cumulative effects of learning (incremental innovations))
  - b. the influence of users (and other parts of the "selection environment") in inducing, improving and selecting innovations

---

<sup>131</sup> Anthony Bartzokas and Morris Teubal (2002), A Framework for Policy Oriented Innovation Studies in Industrialising Countries, *Economics of Innov. New Techn.*, 2002, Vol. 1 1(4-5), pp. 477-496

<sup>132</sup> Fagerberg, J., 2002. A Layman's Guide to Evolutionary Economics, *TIK Working paper* no. 17, <http://ideas.repec.org/p/tik/wpaper/17.html>

- c. economic knowledge as a set of routines (for action) that are reproduced (remembered) through practice.

However, from our perspective these commonalities suggest that the common perspective should be better described as structuralist – evolutionary than evolutionary. Why and why is that relevant for our survey?

First, variety is essential to economic and technological dynamics but its generation is not costless. Variety is limited and strongly shaped by costs (technological, institutional) and by ability of economic and social system to absorb it. Hence, mechanisms of selection are essential and these are most often structural in nature (cf. markets are always organised or in a process to be organised).

Second, the recognition that evolutionary processes are characterised by strong regularities indicates that there are systemic features of both technological and institutional nature which give much more prominence to structural dimension of the evolutionary perspective.

Whether there will be a sequence of innovation and imitation depends on the appropriability regime which is largely the issue of institutional system. For example, tightening of IPR on global scale aims to reward innovators and slow down imitation. Clustering of innovation which follows from radical innovation follows largely along a specific technological trajectory while technological surge of several related radical technologies implies the existence of techno-economic paradigm. The cumulative effects of incremental learning lead to organisational capabilities which are rare, difficult to imitate and which persist over time thus creating a kind of firm level system of innovation which strongly shapes sectoral and national systems innovation. The selection environment is a mixture of market and non-market elements which are created in path dependent manner and which we recognise as nationally rooted systems and institutional trajectories. Fundamental uncertainty of innovation processes leads to routines behaviour which further reinforces those institutional forms and ‘practices that work’ and which we recognise as some kind of a ‘system’.

The institutional dimension of evolutionary perspective originates from recognition that technological and market decisions are not guided only by price signals but also by non-market signals and responses mediated through diverse country and sector specific institutional fabric. Moreover, learning as a social activity par excellence does not take place only through prices but much more through organisations, networks and various forms of social interactions (conferences, associations, informal know how exchanges). Thus, as pointed by Edquist and Hommen (1999) *‘there is an implicit institutionalist perspective in evolutionary theory (...) institutions matter to this school of thought because it bases explanations of evolutionary patterns of change on the decisions and actions of agents in relation to institutions and organizations’*.

However, it does not necessarily follow that system of innovation approach necessarily contains the evolutionary perspective. A view of national innovation systems in narrow sense where it is often reduced on public system to support innovation or on public – private institutions in high tech sectors is not necessarily based on evolutionary perspective. For example, World Bank framing of innovation system within four building blocks of Knowledge Assessment Methodology is not

rooted in evolutionary perspective as it really looks at this system as external rather than co-evolving with other blocks.

Why is this important for our survey? Evolutionary policy perspective could be divided into two streams in dependence of the role to which ‘evolutionary’ aspects are given importance as opposed to ‘structural’ or ‘systemic’ aspects.

A ‘Narrow’ evolutionary policy perspective is primarily focused on two major mechanisms of evolution: variety and selection. By being narrowly focused only on these issues it is not able to generate much useful for policy making. Hence, although being radically new it is able to generate very limited policy implications which I would label as ‘*poverty of evolutionary policy*’.

A ‘Broad’ evolutionary policy perspective takes mechanisms of evolution (variety and selection) as drivers of economic dynamics but also recognises that this dynamics is strongly shaped by technological and institutional regularities which co-evolve. In the core of technological change is learning which is essentially social process and hence technical change is inseparable from institutional fabric of society and economy. In view of much stronger weight given to structural or systemic features of evolution policy implications of this evolutionary perspective are much more embedded in history and institutional context. Hence, policy implications of this perspective are inevitably difficult to generalise across time and space which results in strong ‘*indeterminacy of evolutionary policy*’.

In the narrow perspective policy implications are derived from evolutionary theory and their relevance or usefulness may not be always obvious. For example, Fagerberg (2002) points out as important policy implication of evolutionary perspective the system’s ‘carrier capacity’ or the economic system’s capacity to absorb innovations. This concept which originally has been developed for the firm level has been increasingly used at a country level which seems appropriate analytical category. However, its policy usefulness is highly dubious as it is not quite clear how the absence of ‘carrier capacity’ could be translated into policy. Could this capacity be improved by training and education policies? Or, by horizontally focused policies aiming to strengthen generic capabilities for technology management of SMEs? Or, by focusing on support to a few large firms which could then operate as promoters of new best practices for their suppliers? Obviously, without taking into account policy, technology, country and sector context policy implication of generic kind will have limited relevance.

A reader should bear in mind that these two methodological perspectives are much less clear cut in literature than they have been delineated here. In particular, it would be misleading to try to group individual contributors into one or another group. If there are groupings they are usually applicable only with respect to whether analysis is mainly theoretical or empirical. So, with these limitations in mind in continuation we focus on policy implications of evolutionary perspective understood in broad terms where system of innovation perspective plays important role.

## B. Policy implications of evolutionary perspective

In this section we summarise whether broad evolutionary perspective in economics can provide insights and guidance to innovation policy. A literature argues that evolutionary economics should have some advantages in that respect when compared to neo-classical mainstream thinking. It is a perspective about dynamics i.e it tries to explain how technological change takes place over time and how selection between different technologies takes place. It assumes that individuals, firms, government and other policy stakeholders 'learn' and 'adapt' their plans, strategies and behaviour as a result of feedback from what has been tried and the consequences of those actions. A learning is imperfect (mistake ridden) and policy itself is a discovery process (Kash and Rycroft, 1994)<sup>133</sup>.

An important aspect of evolutionary perspective is that innovation process is a systemic activity involving various players in an interactive process of generation, absorption and diffusion. We should bear in mind that evolutionary and innovation system perspectives are not necessary identical but do overlap to a large extent, i.e. *'there is a close affinity between them (ibid)'*<sup>134</sup>. They form what we call here 'broad' evolutionary policy perspective. Hence, the important feature of evolutionary perspective is emphasis on interdependency and interactive learning. From system of innovation perspective innovation policy is largely about supporting interactions in order to identify existing technological and market opportunities or create new ones.

Evolutionary perspective is basically neo-Schumpeterian which means that growth is driven by innovation and its subsequent diffusion. From policy perspective this would suggest that *'the degree of innovation opportunity should be the deciding criterion in allocating support for certain types of interactions and hence for certain technologies and sectors. Moreover, the feasibility of alternative directions for innovation must also be evaluated, so that policy does not remain "blind" and support all alternatives in an indiscriminate way'* (Edquist and Hommen, 1999)<sup>135</sup>

However, the focus of evolutionary perspective on generation of variety is not costless which opens the problem of selectivity. What are mechanisms that select among the entities (firms, technologies) present in the 'system'? The selection process is either market selection or political-institutional selection or most often these two operate in mutual and co-evolving fashion. When it comes to policy there is little that narrow evolutionary perspective can say on this except that *'policymakers should develop selection criteria, such as the impacts on economic growth and employment, while supporting the creation of novelty'* (ibid). However, by stating that these criteria should be explicit in terms of the economic and technical dimensions of innovation opportunities does not solve the problem what these criteria should be, particularly in conditions of strategic uncertainty which are inherent in such choices.

A system of innovation dimension of evolutionary perspective generates somewhat more insights or policy implications. Edquist and Homen (1999) have derived policy

---

<sup>133</sup> Don E. Kash and Robert W. Rycroft (1994) Technology Policy: Fitting Concept with Reality, *Technological Forecasting and Social Change* 47, 35-48 (1994)

<sup>134</sup> Edquist and Hommen (1999) argue that *'evolutionary theory, in addition to interactive learning theory, is one of the theoretical perspectives that has strongly influenced the development of SI approaches'*. See their paper for lengthy discussion on this issue.

<sup>135</sup> Charles Edquist and Leif Hommen (1999), Systems of innovation: theory and policy for the demand side *Technology in Society* 21 (1999) 63-79

implications of different strands or antecedents of system of innovation approach arguing that *'each antecedent of SI approaches considered (..) is associated with particular policy implications'*. Here, we will take these policy implications as all belonging to a broader SI perspective and build on it.

The most important feature of a system of innovation perspective for policy making is focus on linkages between producers and users and thus on demand side. It is true that the notion of demand for technology is completely undeveloped in innovation theory and that it cannot be equated with market demand. Demand for technology operates through organisational structure of economy and hence the organisational features of economy like size of firms, their interactions and macro-context play an important role. However, as long as demand can be equated with the existing or potential users the system of innovation perspective has a large potential for policy implications. This is very much opposite to the original Schumpeter who, as Lundvall (undated) points out: *'took an extreme position assuming that the demand side would simply adjust to the supply side. It is true that he defines the opening of new markets as one kind of innovation. But, in general, consumers and users are assumed to be ready to absorb whatever new innovations is brought to them by entrepreneurs or firms. Actually, it might be argued that the innovation system perspective came out of a criticism of Schumpeter's relative neglect of the demand side'*.

Policy implications of SI perspective are the following (Edquist and Hommen, 1999):

- A variety of firms should be supported and policy should recognise *'complementary strengths of different types of firms and seek to coordinate their efforts through creation of viable "chains of innovation" involving linkage structures among firms and other actors'* (Edquist and Hommen, 1999)
- As product innovation does not always reside with product manufacturers but also with lead users this justifies and calls for public technology procurement, enhancing user – producer links or strengthening innovation capacities of users.
- The quality of demand and supply is often much more important than only quantity. For example, supply and demand for new telecom services requires much tighter competition policies which take into account innovation and not only market structure;
- Policy support to networks is unlikely to be dynamic unless it is built around 'focal organisations' (Teubal et al, 1991)<sup>136</sup> or network organisers. Who could be these organisations will largely depend on specific context. They could be large firms or public agencies or any other organisation whose advantage lies in networking capacity (for this approach in the context of post-socialism see Radosevic, 1999)
- Policy support to networking is unlikely to be effective without critical mass of organisations and demand. *'Public agencies may have to play this role where no "natural" entrepreneur is present—especially where technologies are extremely complex and demands for resources and influence are large'*(Edquist and Hommne, 1999)

---

<sup>136</sup> Teubal M, Yinnon T, Zuscovitch E. (1991) Networks and market creation. *Research Policy* 1991;20:381–92.



### C. Is there evolution of evolutionary perspective?

This question, which has been explicitly stated in ToR, is difficult to answer in a systemic manner. The overall area which has been reviewed is large and relatively young. However, the most important is that the area lacks a coherent research paradigm whose emergence, growth and cognitive development could be traced over time. An innovation policy research and practice are 'messy' area which is characterised by a strong interaction between theory and practice but in ways which are not easily discernable. Nevertheless, it is possible to identify several trends and their drivers.

First, the growing importance of technology and innovation for growth has made innovation policy one of central economic policies.

Second, empirical understanding of innovation has improved and is changing at relatively fast pace. This is reflected in sequence of innovation models that have emerged and are now party of textbook knowledge.

Third, systemic nature of innovation has led to conceptualisation of innovation as technical objects to networks, knowledge and systems

Fourth, this later trends had led to increasing focus from R&D to issue of 'hidden innovation' and knowledge. Innovation is seen as a non-linear process of learning.

## VI. CONCLUSIONS, POLICY AND INSTITUTIONAL IMPLICATIONS

In this section we derive main conclusions of analysis (5.1.) and draw policy and institutional implications (5.2.).

### A. Innovation System as a Dominant Policy Discourse

Innovation policy analysis encompasses a diverse body of literature that span several relatively autonomous areas which have been analysed in section 3. This area includes highly theoretical, conceptual and general inquiries as well as descriptive analyses of individual policies and systems. The area does not have a coherent research paradigm as reflected in a variety of disciplinary origins, methodologies, and empirical/theoretical orientation. The essential feature of the area is its continuous communication with policy which gives its unique dynamism. The area is structured in several communities with quite diverse degrees of mutual communication and with differing degrees of links to policy making bodies. The representation of area only through academic literature cannot reflect knowledge links and their effects on generation of new knowledge which makes standard academic reference databases quite poor proxy of developments in the area.

However, despite this pre-paradigmatic nature of the area innovation policy analysis shares one broad and vaguely defined but nevertheless common perspective. Innovation policy challenges are today thought largely through innovation system (SI) perspective. This does not necessarily mean that SI perspective on innovation policy is quantitatively more present than alternative, descriptive and non-conceptual analysis. However, this perspective dominates theory discourse and is the dominant policy discourse in Europe and many Asian economies. Also, irrespective of the discourse a wide range of policy instruments directed at networking, clustering and joint R&D present in developed countries, including US, confirm the implicit impact of this perspective. In developing countries, SI perspective is increasingly perceived as an alternative to mainstream policies and as a framework which may assist structural change towards knowledge based economy. However, we have also pointed to significant weaknesses of this approach and need to build stronger analytical foundations. The views on need for this largely differ.

This conclusion may sound trivial and obvious but is far reaching in terms of understanding gaps in the knowledge that lies in between ‘theory’ and ‘practice’. In fact, almost all that we can say about challenges for positive innovation policy falls within this perspective. In addition, it is quite difficult to find out whether these issues originate from ‘theoreticians’, ‘practitioners’ or through their dialogue.

Our limited search of literature which is based on above 200 references has shown that significant share of innovation policy analysis is undertaken within the non-SI/non-evolutionary perspective. Should this be interpreted as a sign of weakness or inadequacy of this perspective? Not really. We should bear in mind that economics is non-Popperian science where one model does not displace another in terms of understanding of analysts and researchers. The earlier models or perspectives have continued to influence policy in parallel with new perspectives. This is present even within individual analysis where authors sometimes use neo-classical (production function perspective) to argue the neo-Schumpeterian point.

## B. Limits of (evolutionary perspective) policy implications and need for explicit analyses grounded in (broad) evolutionary perspective

An observer of the policy making process will notice the contrast between the theory which underpins policy and the implementation of policy. As pointed out by Jorgensen (2005)<sup>137</sup>: *‘Policy implications of academic research are often discussed in idealised form without any specific institutional reference of use and without too much reference to the limitations coming with implementation. The idealisation is legitimised through the need for reduced complexity of the policy context and limitations in the access to factual data’.*

Yet, policy is impossible to develop and apply without some prior stylized model. Moreover, disciplinary knowledge becomes a part of the policy programme and

---

<sup>137</sup> Ulrik Jorgensen, (2005), Energy sector in transition—technologies and regulatory policies in flux, *Technological Forecasting & Social Change* 72 (2005) 719–731

practical problems of policy are often resolved by reference to disciplinary knowledge. On the other hand, *'disciplinary arguments and models are often superficial in their combination of empirical experience, simplified and stylised expectation, and general assumptions leading to proposed solutions that later turn out to perform quite differently when implemented. This may also reflect details added in the specific development of rules and routines during implementation, due to bureaucratic interests not directly reflecting the intended policy, or maybe to solve ambiguities in the policies decided upon'* (ibid).

In areas like innovation policy which is pre-paradigmatic in terms of research program the contrast between theory and policy implementation should be smaller. Moreover, the dynamism of the area rests on 'bringing to surface' practitioners' challenges. On the other hand, there are real dangers that challenges of theoreticians are presented as challenges of innovation policy. It is essential for further development of this area as Nelson and Winter (1982) pointed out that research into innovation policy is shaped by practitioners' problems not by an agenda of how economic theory can be developed to deal with innovation. This would lead to a situation where a practitioner's challenges remain hidden while theory induced challenges may be irrelevant for policy.

So, we point to natural limits of deriving policy implications from discipline based theory and research. As Bartzokas and Morris Teubal (2002) point out: instead of *'abstract and un-grounded 'policy implications' - a new type of link between positive and normative economics in the field is required'*. So, there is a need for explicit policy analysis and this survey has hopefully demonstrated need for integration of policy analysis with "positive" analysis of the transformation of systems of innovation.

### C. Co-evolving Theory and Policy and Policy Learning

ToR assume that there is a gap between theory and practice of innovation policy and that there are challenges faced by practitioners which are hidden to theoreticians. Unfortunately, based on this review we have not been able to demonstrate that this is the case. A pre-paradigmatic nature of the area favours a close interaction between innovation scholars and practitioners. A 'bird's eye' view and view of practitioners are difficult to discern. Rather than sharp distinction our survey conform conclusion of Mytelka and Smith (2002) that *'the process of policy learning cannot be separated from the development of the field of innovation research itself. Theory and policy are best seen as co-evolving: so this is a process of interactive learning, in which a social science field, and a policy arena, have been jointly and interactively shaped'*.

On the other hand, we have not explored the actual processes of interaction between theory and practice but only outcomes as depicted in innovation literature, both theoretical and empirical. So, our conclusion may be criticized by sceptic who would argue that the absence of significant innovation policy theory – practice gap is actually the case of 'practitioner capture'. By this we mean that theoretical

perspective has ‘contaminated’ practitioner who has been actually captured by a ‘theoretician’. This is a situation well described by Keynes in the following statement:

*‘...Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back.’ (J.M. Keynes, 1936)*

However, this proposition can even more be subject to criticism. We should assume that innovation studies always drive innovation policy and that gap between studies and policy is not driven by other factors like ideology, power, and complexity of theoretical perspective. In fact, conclusion of insiders (at least in the case of US) is quite opposite. Rosalie T. Ruegg<sup>138</sup> in her presentation on Atlanta Conference on Science and Technology Policy 2006 has actually argued that there US ‘innovation studies drive U.S. innovation policy, but not always directly, logically, or promptly, and always within a political context’. (Moreover) U.S. innovation policy has not kept pace with innovation policy studies in the 2000s’. It seems that this interaction between studies and policies currently works much better in the EU which has been confirmed by Mytelka and Smith (2002), Kuhlman (2006)<sup>139</sup> and by authors own experience through involvement in EU ‘policy learning networks’. Among international organisations OCED, unlike World Bank (at least until KAM initiative) has played an important interactive role.

In overall, conclusion of Mytelka and Smith (2002) that: *‘learning in this field has been interactive, with a strong co-evolution of policy ideas and theoretical and empirical studies’* seems to be quite relevant. The way to ensure continuation of this interaction is to further open space for explicit policy analysis as well as for policy experimentation. This is the most effective way to turn policy into ‘discovery process’. Both of these propositions would require further elaboration which goes beyond the scope of this review.

## VII. Policy and institutional implications of the review

### A. Complementarities in growth, systems and innovation policies

Innovation system perspective is focused on interactivity and complementarities as major sources of synergies and increasing returns. (Lundvall, undated) in his review of SI area clearly points out that: *‘it is necessary to develop a better understanding and more efficient analytical techniques to study institutional ‘complementarity’ and ‘mismatch’ in innovation systems’*.

---

<sup>138</sup> Rosalie T. Ruegg (2006), What U.S. Innovation Studies Have to Offer to Innovation Policy, Atlanta Conference on Science and Technology Policy 2006

<sup>139</sup> Stefan Kuhlmann (2006) What European Innovation Studies Have to Offer to Innovation Policy, Atlanta Conference on Science and Technology Policy May 2006.

Institutional complementarities are defined as ‘mutually reinforcing effects’ of institutional arrangements’ (Aoki, 1994)<sup>140</sup>. Chris Freeman (2002) has fully recognised their importance when interpreting long term growth through SI perspective as the issue of (mis)matching of different social subsystems. Within growth theory this issue has been recognised through stylized fact of growth that ‘*the pervasive tendency for all factors of production, including physical and human capital, (is) to bunch together*’ (Easterly and Levine, 2001). Aghion et al (2006)<sup>141</sup> see the importance of complementarities in policy which should focus on the more ‘“*tightly coupled*” elements and gives priority to identifying the ones that are strong complements of the activities or institutional structures that the policy intervention seeks to affect’. Similar to Freeman (2002) they point to policy issues involved in coordination and complementarities between innovation policy and education, labour market, competition and macroeconomic stability.

At the level of specific technology systems studies have indicated that critical to system dynamics are complementarities like ‘*missing key agents, nonfulfillment of required functions, non-availability of required knowledge, and deviations between self- and cross-perception*’ (Wiek et al, 2007)<sup>142</sup>. These network or system failures demonstrate that the network features should serve ‘*as a starting point for discussing and negotiating arrangements among agents and joint action*’ (ibid). Also, complementarities in innovation policy have started to be explored (See Mohnen and Roller, 2005)<sup>143</sup>

We would argue that ‘complementarities’ represent paradigmatic change in evolutionary perspective. This concept is essential to the view of the economy ‘*as an evolving complex system, exhibiting properties of increasing returns and self-reinforcing mechanisms in which the management of complementarities play a major role in determining the motivation for and the performance of decentralized private investments in R&D and the deployment of technological innovations*’ (Aghion et al, 2005).

By pointing to complementarities, we have highlighted the emerging perspective within broad evolutionary perspective which should have strong policy implications. Unfortunately, the issue is still in early stage of development and better analytical techniques are required to advance our understanding of complementarities in growth, system and policies. What this perspective can currently offer as useful to policy in this respect is very limited. So, here we are again faced with the fact that progress in this area may be achieved only through interaction between policy and theory.

---

<sup>140</sup> M. Aoki, The Contingent Governance of Teams: Analysis of Institutional Complementarity, *International Economic Review*, 35(3), 1994, pp. 657–676.

<sup>141</sup> Philippe Aghion, Paul A. David and Dominique Foray (2006), Linking Policy Research and Practice in ‘STIG Systems’: Many Obstacles, but Some Ways Forward, Stanford Institute for Economic Policy Research, *SIEPR Discussion Paper No. 0609*

<sup>142</sup> Arnim Wiek, Stefan Zemp, Michael Siegrist, Alexander I. Walter  
Sustainable governance of emerging technologies—Critical constellations in the agent network of nanotechnology, *Technology in Society* 29 (2007) 388–406

<sup>143</sup> Pierre Mohnen, and Lars-Hendrik Roller (2005) Complementarities in innovation policy, *European Economic Review* 49 (2005) 1431 – 1450

## B. Interaction between domestic and foreign led modernization

Our review of literature has indicated the increasing interaction between national innovation system and global economy. Also, we have pointed out to interaction between national and sectoral systems.

Innovation studies suggest that there are two major forces that will jointly shape national innovation systems: autonomous or indigenous innovation and knowledge creation and technology acquisition through global linkages and partnerships. This issue is very relevant not only for China today<sup>144</sup> but also for all catching up countries. Historically, this challenge is actually not particularly new. Mowery and Oxley (1995)<sup>145</sup> in historical survey demonstrate that ‘the economies that have benefited most from inward technology transfer have national innovation systems that have strengthened their ‘national absorptive capacity’.

This issue has been diagnosed well in the case of Malaysia by Tidd and Brocklehurst (1999)<sup>146</sup>:

*‘In almost all cases transnational companies have confined Malaysian subsidiaries to manufacturing activities, albeit in “high-technology” sectors, and have located development and marketing functions overseas. (...) Nevertheless, there are isolated cases of indigenous companies which have been able to exploit joint ventures as an opportunity for learning from overseas companies, and this approach appears to offer greater opportunity for achieving the Malaysian government’s objectives’.*

The author of this survey has analysed this issue in the context of CEE and has labelled it as distinction between ‘foreign and domestic led modernisation’ i.e. as modes of modernisation based on foreign technology import and autonomous technological development. At global level this issue is increasingly recognised through disappointing expectations that strong process of innovation will emerge as a natural consequence of openness, strengthened IP regimes and larger flows of FDI (Viotti).

Within broad evolutionary perspective this issue could be defined as interaction of NIS and globalization. Although this issue has been recognised by innovation studies scholars there is dearth of empirical studies and there is relatively little that scholars could generate to illuminate policy making which would promote interaction between FDI and NIS. A work by ‘Bell’s circle’ is quite encouraging and we should see more of it applied to other countries. Policy issues like how TNCs could be challenged by innovation policy to give a large contribution to local technology development is not addressed. The issue of transnationalization of NIS and policy issues that this involves are still on periphery of innovation studies communities.

---

<sup>144</sup> Xielin LIU Nannan LUNDIN Toward a Market-based Open Innovation System of China, Globelics, Mimeo

<sup>145</sup> Mowery, D.C., and J.E. Oxley, 1995. “Inward Technology Transfer and Competitiveness: The Role of National Innovation Systems,” Cambridge Journal of Economics 19, 67-94.

<sup>146</sup> Joseph Tidd and Michael Brocklehurst (1999) Routes to Technological Learning and Development: An Assessment of Malaysia’s Innovation Policy and Performance, *Technological Forecasting and Social Change* 62, 239–257

### C. State as a missing actor in evolutionary perspective

A weakness of evolutionary perspective is the neglect of the State, as its important component. This same weakness has been recognised also within a system of innovation perspective which *'lacks a component ('theory') about the role of the state'* (Edquist, 2001). This is actually quite a major problem for analysis of innovation policy which cannot be conceptualised outside of the realm of state as expression of public interest.

On this point Ulrich Witt (2003)<sup>147</sup> argues that *'to adopt an evolutionary perspective does not result in a wholesale rejection of what public choice theory, political economy, theoretical politics, and social philosophy have to say on economic policy making. However, those theories have to be extended and modified to account for the possibility of changing knowledge constraints'*. This introduces the idea of state as a learning entity and policy making as a discovery process into the different theories of states.

However, that still does not resolve the key weakness of broad evolutionary perspective – abstraction from different political economy models of state and how they are linked to innovation policy. Different political economy models imply different innovation policies. Innovation policy is a long term endeavour and different political economy models have different properties in relation to innovation policy. Many political economy models today are excellent for stability, continuity and the status quo. For example, many Central and East European and some Latin American countries which have successfully implemented structural adjustment programs are now in a sort of low level equilibrium situation which is not really favourable to structural transformation. The core of this transformation should be a new (innovation) policy which unlike previous stabilisation and structural adjustment programs requires a variety of micro and mezzo level changes for which a new political consensus needs to be achieved. The example of Chile demonstrates some of these challenges. In excellent study on these issue authors define some of Chile's challenges:

*'How to lengthen the time horizon of the political process to take on long-term challenges such as improving the national innovation system? How to effectively coordinate across government Ministries and between the public and private sectors? And how to avoid elite capture'* (p.31)(CGD, 2008)<sup>148</sup>

Within evolutionary framework state should operate as *'adaptive policy makers'* which learn through experiments, trial and errors in incremental fashion. However, we cannot ignore that different political economy models have different propensities to experiment and learn. As argued by CGD (2008) study in many east Asian states there is *'a desire to experiment with active government policies and revise them as and when failures occur'* (ibid, p. 27). Hence, evolutionary perspective should study what

---

<sup>147</sup> UlrichWitt (2003), Economic policy making in evolutionary perspective, *J Evol Econ* (2003) 13: 77–94

<sup>148</sup> Commission on Growth and Development (2008) *Chilean Growth Through East Asian Eyes*, A Special Project for the Growth Commission, February 2008

are institutional factors which favour policy experimentation. Do they have to do only with narrowly defined ‘state capacity’ or also with the political economy context?

In addition, as Charles Edquist (2001)<sup>149</sup> points out ‘*we need more knowledge about how innovation policy has actually been designed and implemented and which societal forces that have governed these activities*’. This is basically indicating the absence of studies which we grouped into sociology of innovation policy. What we have now is a situation where analyses and policy implications are derived by abstracting from political economy context including state capacity.

It is encouraging that there are new/old approaches which try to tackle this important dimension. For example, studies by Peter Evans, Alice Amsden, Chang and Erik Reinert have explored some of these issues but much less in a contemporary context. Dani Rodrik’s studies which basically build on this work are pointing to broader perspective of institutional conditions for industrial policy.

A World Bank work on state governance works along these lines but it also completely abstracts from addressing the issue of country specific political economies. It posits the issue of state governance in a broader context but assuming abstract benchmark of the best state governance. Governance is reduced on technocratic process, assuming mechanisms which are predominately managerial and devoid of political factors. Of course, this is also a part of the story and is relevant for many policies but is not of much use for understanding different models and issue of innovation policies.

#### D. Broad innovation policy: a future growing area in innovation policy analysis

Innovation policy studies have demonstrated the importance of a ‘broad’ innovation system for innovation performance. This broader context is determined by institutional factors and policies which do not belong to ‘proper’ innovation policy area. Yet, they are often much more important than narrowly defined innovation policies. For example, diffusion of renewable technologies is much more influenced by specific ‘policy regime’ which includes ownership and role of markets than by narrowly defined programs for promotion of new renewable technologies or their diffusion. For many developing countries, unfavourable macro-economic context with high external debt and high interest rates represent an important constraint to technological development and constitutes ‘implicit’ innovation policy of greater importance than innovation policy proper.

The links between innovation and other policies has been recognised in areas like education, competition, finance, macroeconomics and labour markets. As Aghion et al (2006) recognised there are ‘*critical aspects of interdependence between science,*

---

<sup>149</sup> Charles Edquist, (2001) The Systems of Innovation Approach and Innovation Policy: An account of the state of the art, DRUID Conference paper



*technology, innovation and growth (STIG) policy and the pursuit of related or independent goals by other classes of economic policy’.*

The issue of close interdependence of innovation and other policies has been recognised in the notion of so called “third generation” innovation policy. It has been suggested that there are three generations of innovation policy.<sup>150</sup> The traditional innovation policy was primarily oriented towards R&D, i.e. the supply side of innovation. A current mainstream is the second generation which is oriented towards systems and clusters. The emerging at present third generation of innovation policy assumes that there is a potential for innovation which is embedded in other sectors or policy domains. This potential can be realized by ensuring cross-sectoral optimisation of the components of various sectors’ innovation policy through co-ordination and integration.

In section 3.4.2., we indicated the absence of studies which fall within broad innovation policy and this stands in sharp contrast to obvious need to understand interactions between innovation and knowledge diffusion and broader systems and non-innovation focused policies.

OECD MONIT project has made first strides in direction of pointing to issues of administrative coordination embedded in policy or in governance systems across different policies which make this integration difficult. The idea is to aim for cross-sectoral optimisation which could be horizontal, vertical and temporal. According to an OECD study ‘horizontal coherence ensures that individual, or sectoral, policies, build on each other and minimise inconsistencies in the case of (seemingly) conflicting goals. Vertical coherence ensures that public outputs are consistent with the original intentions of policy makers. Temporal coherence ensures that today’s policies continue to be effective in the future by limiting potential incoherence and providing guidance for change’.<sup>151</sup> However, as we pointed out earlier this does not address the issue of content i.e. what policies should be coordinated and what should be the content of coordination. This is a broad and complex research and policy agenda which will occupy minds of policy makers and analysts in the foreseeable future.

---

<sup>150</sup> EU (2002) *Innovation Tomorrow, Innovation policy and the regulatory framework: Making innovation an integral part of the broader structural agenda*. Available at [http://cordis.europa.eu/innovation-policy/studies/gen\\_study7.htm](http://cordis.europa.eu/innovation-policy/studies/gen_study7.htm)

<sup>151</sup> OECD (2005), *Governance of Innovation Systems, Volume 1: Synthesis Report*, Paris: OECD, p. 23.