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STRATEGIC INNOVATION POLICY

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STRATEGIC INNOVATION POLICY*

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ACRONYMS

SIP - Strategic Innovation Policy; SIPC - SIP Council; IMC - Inter - ministerial Committee

CIM - Inter - ministerial Committee [Chile's IMC]

CNIC - Concejo Nacional de Innovacion y Competitividad [Chile's SIP Council]

CONACyT - National Council for Science and Technology [Chile]

I - Business Innovation; BERD - Business Sector R&D; GERD - Gross Expenditures in R&D

ST - Science and Technology; STE - ST and Higher Education

HLO - Higher Level Organization [a sector, cluster, market, etc]

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Table of Contents

Cover page and acknowledgements	1
Introduction.....	3
Vision Strategy Priority	5
Knowledge-based overarching goals – Vision and Strategy.....	5
Some Characteristics of Strategic Priorities	7
Strategic Innovation Policy Institutions and Process.....	9
Key Institutions: SIPC and IMC	9
On-going existence.....	10
Apolitical – Independent.....	10
Complementary strategic and operational level functioning.....	11
Creating Policy profiles.....	11
Monitoring/Evaluation	12
Coordination.....	12
Top down and bottom up	12
Methodologies for generating vision	13
Policy targeting (in traditional vs. cutting edge industries)	15
An Illustrative Case: Chile’s Innovation Council	17
Background and Motivation for creation of Chile's SIPC.....	17
Chile's SIPC’s Agenda and Contribution.....	18
From National Goals to Focal Areas/Priorities.....	19
Selected Policy Lines of Action	20
Policy Coordination.....	22
Influencing the STE& I budget	23
Concluding Remarks on the Impact of Chile's SIPC	23
Conclusions.....	23
BIBLIOGRAPHY	27

Introduction

The emerging, Systems-Evolutionary (S/E) perspective to Innovation Policy (Metcalf 1994, 1995, 2007, Teubal 2002, Avnimelech et al 2010) incorporates and integrates a number of novel Innovation Policy views that emerged in the last two decades. This new perspective is also based on a growing realization that Innovation policy has to be approached on a Strategic Level; one that has precedence – hierarchically and chronologically – over the operational level and it is this that the present paper will focus on.

Our view of Innovation Policy is a broad one: it includes components of *direct support* of commercial Innovation in firms and *indirect support* of commercial Innovation through the promotion of Science, Technology Higher Education. It also includes monetary incentives and incentives programs on the one hand and institutional and regulatory changes on the other. Past analyses of Innovation Policy have focused on the creation and implementation of Innovation Policy at an operational level that is: policy design and implementation. It is the aim of this paper to show that good/successful innovation policy needs a strategic dimension and to propose a structure that will help the practical implementation of the theoretical analysis of this dimension.

The last 10-15 years have seen a steady change in the way academics on the one hand and Policy Makers on the other conceptually view and/or implement Innovation Policies, particularly but *not exclusively* as related to developing and industrializing economies. The onset of the global crisis in September 2008 made this issue quite relevant for advanced countries as well. These conceptual changes occurred in parallel to broader changes in economic thinking which relate also to the role of the State in the economy and in promoting economic growth.

Up to and including the 1990s - the so-called ‘Washington Consensus’- asserted that a set of generic ‘reforms’ (which to a large extent are independent of context and economic/social structure) were required for the economic development of industrializing economies. The reforms included fiscal discipline, tax reform, liberalization on various fronts (trade, capital markets, exchange rates, and inflows of foreign direct investment), privatization, deregulation, etc.¹ This view, which ignored the crucial importance of ‘capabilities’ in development, and of ‘structural aspects’ more generally speaking (both central for Innovation Policy), seems to be undergoing a series of changes.

Others like Rodrik (2009) go against the ‘one size fits all’ policy perspective: ‘There is no universal rulebook; different countries achieve these ends differently’. Rodrik’s focus on

¹ For the principles of the Washington Consensus see Williamson (1990) who originally coined the phrase “to refer to the lowest common denominator of policy advice being addressed by the Washington-based institutions to Latin American countries as of 1989” (Global Trade Negotiations (GTN), Center for International Development, Harvard University, April 2003). Despite some differences we will not make a distinction in this paper between this approach and a *Neoliberal perspective*. For an opposite view see (GTN 2003).

experiments and deep suspicion of universal remedies bear a strong similarity to the 'heterogeneity' feature of Evolutionary Theory (Nelson 2007)².

Paralleling the above developments and at times preceding them, we observe important changes both in Innovation Policy and in its conceptual underpinnings. These include **(i)** the growing emphasis on the importance of 'capabilities' for development (Westphal et al 1985, Dahlman et al 1987; Teubal 1997; Dodgeson ; Metcalfe 2008 ; Sercovich et al 1999; Kim 1997; Gore 2000, 2005; Katz 2006; UNCTAD 2006, 2007, 2009; Fagerberg et al 2007 among many others); **(ii)** the "Systems of Innovation" perspective (Freeman 1988, Nelson 1993, Lundvall 1992, Edquist 1996, Galli and Teubal 1996, Saviotti 1996, Metcalfe op. cit., and Dodgeson et. al 2009) which incorporated the notion of 'system failure' as a central justification of Innovation Policy; **(iii)** Evolutionary Economics (Nelson and Winter 1982, Andersen 1994, Nelson 1994, 2007; Saviotti 1996 , Nelson (ed.) 2005 among many others) with its broad view of institutions, the notion of co-evolution, the adaptive policy maker perspective which underlies SIP, and various forms of learning and links of policies through time (Metcalfe 1995, Metcalfe and Gheorghiu 1997, Avnimelech and Teubal 2008a, Dodgeson et al 2010 among others); and **(iv)** other 'hybrid approaches' (Antonelli 2008, Cimoli et al 2008 among others).

The evolutionary perspective is also 'responsible' for an emerging view of economic growth as an outcome of innovation / structural change with 'policy targeting' becoming an important option for innovation and industrial policy (Lall and Teubal 1998; Rodrik 2004; Saviotti and Pyka 2004, 2008; Avnimelech and Teubal 2008a,b, Sercovich and Teubal 2009 and Fagerberg et al 1999 among others).

It is noteworthy that many, if not most of the above-mentioned academic approaches have rarely emphasized the need for a **Strategic** Level of Policy making, as a fundamental guiding principle underpinning of the post Washington consensus world.

The need or rationale for strategic policy making lies in Metcalfe's *Adaptive Policy Maker* who has to operate in a world of radical uncertainty – a world in which some future events – or so called "states of nature" – are not known let alone predictable (Metcalfe 1995, Metcalfe and Gheorghiu 1998). The global crisis which erupted slightly more than a decade later, in September 2008, and swept through the industrialized world's economies demonstrates the magnitude of that uncertainty and the extent of its impact.³ Taleb's notion of black swans further reinforces Metcalfe's analysis (Taleb N. 2009, 2010)

Furthermore, the economic environment of the 21st century is one in which the ever-growing interconnectedness of countries makes for growing complexity and diminishing predictability in all domains (Taleb, N. 2009, 2010). Examples are the unfortunate ability of diseases to be carried overseas within a day (e.g. SARS, the H1N1 flu virus), the impact of a single volcano on global trade (in Iceland 2010), industrial pollution at a global level, the uncontrolled spread of ideas through the Internet, a single trader's ability to affect the markets within seconds etc . This turbulent global environment and the Radical Uncertainty facing economy/society agents and policy makers, make it crucial to analyze and **continuously** update policy priorities at a *strategic* level.

² 'Heterogeneity' contrasts with the 'one size fits all' view of policy, which - in contrast to the evolutionary view - to some extent characterizes the 'traditional' approach to VC policy. See Avnimelech et al 2010.

³ The crisis was predicted by several individuals including Roubini and N.N. Taleb.

Due to pervasive market and system failures associated with economies of scale, learning and other cumulative processes with positive feedback, unaided market forces will frequently fail to allocate sufficient long term investments both to the Science, Technology and Higher Education (STE) infrastructure and sometimes *also to some Innovation (I)* areas. Depending on case, a reliance on markets alone, may dangerously bias resource allocation towards the short term, thus probably reinforcing even further the inherent short term bias of many or most governments. Furthermore, the set of markets is incomplete and at times an innovation or a set of innovations will trigger the creation of a market or markets.

Considering the rate of technological development in today's world and the qualitative social changes it engenders, any set of policies currently implemented - simply by virtue of having been planned in the past – is likely to be no longer well adapted to the current global/domestic context, including the challenges and opportunities it presents. An ongoing evaluation of the relationship between current policy and updated strategy is therefore necessary in order to keep the gap between policy and current context as narrow as possible.

Another cause of the gap between priorities and de facto policies is the inherent inertia prevailing in operational policy institutions. The effect of this inertia becomes greater and more harmful when the environment requires flexibility. Bureaucratic inertia that may have been considered an operational issue in the past now has strategic implications, and must be contended with at the highest level. A strategic discussion may reveal that policies under review may have to be given quite a different priority – promoted or demoted, as the case may be.

Finally, our notion of SIP *is not central planning*; rather it is a sophisticated and upgraded variant of Innovation Policy which, under certain circumstances, could enable market economies to successfully adapt to the complex changing and fragile global and/or domestic environment.

Vision Strategy Priority

The above noted need to adjust policies in response to reality does not mean they can be adjusted ad libitum.

We envision a Strategic Innovation Policy Process (SIPP) as a continuum running from the delineation of overarching goals for the country (a Vision) through creating a set of strategic priorities and only then proceeding to concrete "operational" policy. Within this overall SIPP central milestones range from the definition of Vision & Priorities to STE&I policy implementation.

Knowledge-based overarching goals – Vision and Strategy

It is clear to us that in formulating a country's overarching goals one cannot avoid political issues, about which parties in a democracy may contend⁴. However, we maintain that there are strategic aspects that are apolitical, and it is those we are focusing on when discussing this level of strategy formulation.

⁴ This is different in other political regimes.

In the proposed conceptualization, the less politically tinged aspects of a country's **Vision** should be based on the following:

- (i) Identification both of central trends and tendencies in the global environment (technological, markets, etc) and of idiosyncratic country-specific (or region-specific) strengths/weaknesses considered within the global context.
- (ii) determining *overarching national goals* – contingent on (i)
- (iii) identifying *key foci, possible types of development trajectories* or possible types of *growth engines* including types of 'higher level organizations' such as new industries, clusters, etc.

When the above are clearly established the next step – determining strategic priorities - becomes clearer.

In order for strategy to be effective, the Vision guiding it must be **valid** i.e. based on a reliable, valid identification of trends and central tendencies. It follows that in this paradigm, vision creation and the strategic priorities stemming from it are a **knowledge-based** activity, conducted with the aim of maintaining as close a link as possible between a country's de- facto policies, its overarching national goals, and the environment in which the policies are implemented. A policy based on wrong premises about the environment will rarely – if ever – give consistent, reliable, positive results.

It should be noted that upholding operational effectiveness when confronting the turbulent, radically uncertain environment that has been described above demands that an ongoing evaluation and re-evaluation take place at all levels of the Strategic Innovation Policy continuum. This includes a dynamic identification of overarching national goals, which must refer to the present and future contexts and therefore, that too must be an on-going process. Our SIP continuum is thus (i) a knowledge-based, and (ii) a continuous process⁵. Both characteristics have organizational implications that will be discussed in the next section.

The continuously updated, knowledge-based platform of overarching national goals and strategic priorities will be the foundation for the **articulation of a portfolio of 'operational' policies**. The goals set in this system must be explicit, with an eye to their future articulation into actual policies. An 'overarching general national goal' such as **Economic Growth** is not specific enough – despite the fact that an extreme neoliberal view might advocate an unregulated market economy as an objective in itself, with the resultant growth being a subsidiary outcome. The importance of having an *explicit* Economic Growth 'target' has been emphasized in the Committee on Growth and Development report on Chile, when it compared the successful countries of East Asia (who had this target) with those of other less successful countries e.g. in Latin America (see Committee On Growth and Development 2008). Thus having such a target in mind might immediately imply something about future GERD/GDP, BERD/GERD and STE levels/growth, and correspondingly of strategic priorities and Government support required to underpin such efforts. "Economic Growth" as a goal

⁵ One of the major reasons for the eventual collapse of dictatorial regimes is the masking of valid data by the need to feed a dictator's self-image of infallibility.

can be further specified e.g. nowadays there is strong concern about *Inclusive Growth* (OECD 2010) in contrast to growth based on a relatively narrow base and with relatively weak employment effects as was the case of high tech growth in Israel during the 1990s and possibly the US (see Teubal 1999, Trajtenberg 2005, Tassej 2007). Finally in certain countries like Chile and other middle income countries where a large share of exports is based on natural resources with the accompanying high risk and potential depletion effects, *Growth with Diversification and Structural Change* may be an important goal to aim at (Hausman & Klinger 2006).

Priorities are related to policy objectives, but they're not identical to them, for 3 reasons

1. priorities have to be specified before they can lead to policy objectives.
2. a particular policy may be related to, or associated with more than one priority, and conversely, for one priority we may have many policies⁶.
3. unexpected budgetary and bureaucratic constraints may appear during the operationalization of priorities with consequent change in de facto policy objectives.

This complex relationship between priorities and policy objectives is another reason why a continued search, research and discovery activity is required. A knowledge-based strategic analysis would contribute to a policy portfolio based on reasoned priorities, and not on the victory of a political agent who happens to have had the upper hand temporarily.

Within the proposed SIP system, priority setting and its articulation into new policies will rarely be a purely top down process; it is inherent to the knowledge based process that agents from business, academia, and Government etc will be involved in all stages and bottom up considerations should always be important if not central.

Some Characteristics of Strategic Priorities

Specificity

There are several levels of specificity for any strategic priority: priorities can be framed in very general terms e.g. 'Promote Biotechnology', or in more specific terms such as 'Promote a Biomedicine Cluster focusing on generics and orphan drugs'. Effective articulation or translation of priorities into policies requires, that the relevant priority or priorities be sufficiently specific (what economists would call, a relatively low level of aggregation). A thorough job of specifying priorities should precede the attempt to articulate priorities into policies, in order to assure fitness of a country's portfolio of policies to its domestic and global environment. Specificity is also needed to assure a reasonable level of cooperation among competing Ministries and or implementation agencies. When priorities are couched in general terms, the competition between ministries – each wanting a dominant share of the resources flowing from articulating a priority – may become detrimental to the whole process. Avoiding the skewing of priorities by misallocated resources at the operational level is one reason why priority specification is crucial. With sufficiently specified priorities it will

⁶ These facts imply that there are relations of complementarity and substitution among policies, both at one point of time and through time. Once implemented, policy may cause a change of context in a way that will have an impact on future priorities and policies.

be easier for the system to assure an adequate allocation of the priority-articulated policies and therefore of resources across the various Ministries⁷.

A balance must be attained between *sufficient specification* of a priority – which will facilitate its implementation in terms of new policies – and *flexibility*, that is, the capacity to adapt priorities to a changing environment. While the former could be important for articulation of policies and coordination, a measure of flexibility should remain to allow for unexpected changes in the global/domestic context that could modify the desired priority. Finally, at any point in time, some priorities will be *rather well specified* while others, due to insufficient information and/or an ongoing radical change in technology will be formulated in *rather general* terms.

Functional vs. Thematic

Gassler et al 2004 when discussing STE make a major distinction between *Functional* and *Thematic* strategic priorities. More broadly speaking functional priorities could include ‘strengthening innovation in the business sector, independent of sector, technology, product class’ (one possible articulation of this priority is an incentives program supporting a *particular function such as R&D* in firms).⁸ Others could be ‘promotion of excellence in Science, whatever the area’, ‘promoting University-Industry relations in general’, or ‘promoting external networking and links of the domestic innovation system’.

Thematic priorities in STE would support specific STE areas like Nanotechnology; while thematic priorities concerning Innovation could aim, in the first instance, at a specific sector (or ‘small’ group of sectors) and/or technology (or small set of ‘technologies’) and/or region (or ‘small’ group of regions). Thus strengthening innovation in the aeronautical industry’s could be a Thematic Priority of a particular country. It may co-exist with a Functional Priority of Strengthening Innovation in general independent of sector, technology, etc.

When focusing on innovation and its impact, the set of thematic priorities should be further expanded and clarified by considering the strong links between invention/innovation on the one hand and the possible emergence of *Higher Level Organizations (HLO's)* like new sectors, clusters, markets, large domestic companies, networks of innovators, etc.⁹ Examples of such thematic priorities could be ‘emergence of an entrepreneurial, ICT-oriented high tech cluster’ and ‘emergence of a biomedicine cluster’, etc.

To sum up: there are two different profiles of Innovation-related Strategic Priorities: one which focuses on invention/innovation exclusively; and the other both on this and on its *scaling up* impact in terms of new HLOs triggered by and related to invention/innovation.

⁷ There is a link between the process of specification of priorities for SIP and the process of specification of a need according to the Evolutionary Theory of Demand. In that theory a central dimension of the preferences related to any ‘*want*’ or *need area* is a qualitative one involving a weaker or stronger degree of specification in terms of product classes, functions and specifications (Nelson and Consoli 2010 and Teubal 1979 who has used the term ‘need determination’ or ‘need determinateness’). Thus the specification of SIP priorities is also a specification of needs - although not of a particular good or service through learning processes and market creation, but rather of Collective or Public Needs for STE and Innovation. Note that in both spheres success in specifying needs could lead to a scaling up process with high economic impact: of an invention by creating a new industry/market of a new portfolio of STE&I policies leading to structural change and a new growth trajectory for the economy.

⁸ This has been termed a ‘Horizontal Technology Policy’, see Teubal 1983, 1997 and Breznitz 2007.

⁹ The link between invention and innovation on the one hand and emergence of new economic sectors or clusters has a long history in the literature e.g. Kuznets 1973 and many others. For the notion of HLO and its links with ‘hierarchies’ from a complexity theory perspective see Potts 2000.

Strategic Innovation Policy Institutions and Process

Key Institutions: SIPC and IMC

A Strategic Innovation Policy Council (SIPC) of one form or another lies at the heart of a reinforced innovation policy system, the SIP system. This is the institution in charge of assuring that a reasonable, valid Vision and coherent set of Strategic STE&I priorities are **defined**. Given its responsibility in orchestrating the generation of a country Vision and a set of coherent STE&I priorities, SIPC should be a largely independent supra-ministerial organization or institution, similar in its independence to a state comptroller or central bank. It should be given full authority and support at the highest executive level of the State or Government (in democracies those would be President or PM).

The requirement for this new type of policy institution is a corollary of the need for strategic policy analysis to be conducted as a *continuous activity*. A case in point is Chile's CNIC (Concejo de Innovación para la Competitividad, see Section 3) during the 2005-10 period, and Korea's National Science and Technology Council.

True to its knowledge-based function, the SIPC should be highly capable, with a *knowledge creation focus* – as opposed to an operational or political one. It would operate on the basis of a new set of distinctive capabilities and routines. Most of the search, research and discovery activity required would be outsourced to outside institutions and individuals, although some of that work, together with overall orchestration and integration of knowledge whatever the source, would be undertaken in-house.

The SIPC's need for new *and distinct* policy capabilities results from the distinctive functions that have to be fulfilled. Furthermore, SIP implies a need to create and/or adapt specific *methodologies* for setting the strategic STE&I priorities.

Complementing the SIPC – and contributing in the inevitable political sphere, we envision a politically oriented Inter-Ministerial Committee (**IMC**), headed by the PM or President, whose main functions are approval of the vision and strategy proposed by the SIPC; leading the process of budgetary approval, and initiating the process of implementation and high-level ministerial coordination.

A central phase in the articulation of strategic priorities into new policies is *policy profile selection*. It is based on a prior process of search for alternative policy profile options, i.e. "policy variation". This will involve, among other things, study committees analyzing alternative policy options to be evaluated and compared. The evaluation and comparison of alternative policy options will be followed by the "selection" of one policy profile, and this will become the basis for the specific design and specific implementation of the policy profile selected. Both the SIPC and the IMC will be involved in varying proportions in the different phases of the overall SIP process: *Priority Specification, Policy lines of Action and Specific Policy Design and Implementation*. Generally speaking we think there will be a relative decline in the role of the SIPC, and a relative expansion in the role of the bureaucratic and political institutions starting with the Ministries and the implementation agencies and to some extent the IMC.

One outcome of the systematic functioning of the SIPC and the IMC would be a de facto pattern of coordination and division of labor between ministries in the implementation of priority-articulated STE&I policies.

On-going existence

We mentioned the factors which make the setting of strategic priorities important: Radical Uncertainty, Turbulent Global/Domestic Environment and the interactions of explicit and implicit priorities and policies: these are also the factors which make it **difficult**. The radical uncertainty of important global markets results from three interrelated factors: the accelerated spread of globalization; rapid and significant technological change and associated structural changes; and the current global economic crisis¹⁰. The implication is that Innovation Policy objectives are frequently (i) not self evident; (ii) not easily determinable, nor are they (iii) reasonably stable through time. Moreover as mentioned above, due to these factors, the *policy portfolio* in effect in many countries is probably not well adapted to the current and expected global and domestic environments.

While many countries do have innovation policy institutions, the majority of those are focused on the design and implementation of policies, frequently in the context of rather *implicit policy objectives*. In some cases it is the Ministries or funding/implementation agencies themselves that set their own priorities, unmindful of those set by other ministries or agencies. These institutions comprise what we term the 'operational' dimension of Innovation policy.

Some countries like New Zealand undertook ad hoc exercises to set strategic priorities (which started with evaluation of present policy, proceeded with discussions and analyses, and ended with a foresight program which led to the setting of priorities for 140 sectors see Gassler 2004 et al). However a central issue raised by this example is the frequency of these exercises. In our analysis, ad hoc exercises cannot suffice, since the process of defining and redefining strategic priorities must be a continuous one: it does not end even after the setting, in some sense, of *all of the required* priorities has been successfully accomplished. Any set of priorities, whether implemented or not, may have to be further specified or redefined, either as part of the implementation process or because the global/domestic environment will be changing, or because of both.

Apolitical – Independent

The SIPC's independence from the operational level is critical. Policy implementation agencies tend to 'lock in' into specific trajectories or lines of action (the lock-in phenomenon of B. Arthur 1994)¹¹. It is even conceivable that in the process of introducing a strategic dimension into an existing operationally-oriented innovation policy configuration, existing policy institutions might attempt to block or truncate any such efforts – viewing them as encroachments on their turf or even – at times justly so – as a threat to their very existence. One of the aims of the council is to contribute to overcoming these types of inertia.

Innovation, almost by definition, "rocks the boat", and it is therefore critical that the SIPC work should be viewed as coming from an a-political source.

¹⁰ Also the radical uncertainties in nature and in society such as those emphasized by Taleb.

¹¹ This seems to have been the experience in Israel in the 1st decade of the 21st century. Despite important achievements such as the new R&D law of 2004, the "Traditional Industry Support" program in 2005 and enhanced support to biotechnology there are grounds to state that Israel has reacted slowly and insufficiently to the changed domestic and global environments: for example little systematic preparatory and new knowledge-oriented analytical work was done for the eventual possibility of targeting a biomedicine cluster in that country.

Mechanisms should be found to assure the hiring of the best possible talent available, as well as assuring significant investments in building capabilities, especially initially, when a "big push" is required.

Complementary strategic and operational level functioning

Creating Policy profiles

Once vision and priorities have been specified, a central additional role of SIPC is active participation in the process of translating or articulating priorities into policies. Translating abstractly formulated priorities into practical policies is no trivial affair; rather it is a non-linear process which may go far beyond 'getting the money and the politics right' and involve bona fide 'functional considerations'. An example of functional considerations is selection of a policy profile, or what we term policy lines of action. Priority articulation up to this point involves priority specification while beyond this point it involves specific policy design and implementation i.e. operationalization. As mentioned above, the underlying articulation process may require creation of a set of alternative optional policy profiles and a subsequent selection among them based on analysis and experiments.

Receiving data from the operational agencies is an integral part of the SIPC's knowledge creation focus. Whereas the SIPC's knowledge-based analysis might be less limited by practical (i.e., budgetary) considerations, implementation may require difficult reality based choices: the final decision to select one policy profile and discard others, by necessity has political implications. This is the point at which there is danger the SIPC will be blamed for political bias – which will undermine its function. Therefore there is a role both for the IMC and other inter-ministerial coordination mechanisms - be they ad-hoc or permanent. The overall outcome will be one assuring the linking of specific priorities with specific policy objectives and policies. This is also the point at which interactions between policies should be taken into account.

For example: once 'emergence of a biomedicine cluster' priority has been justified and sufficiently specified, three alternative sets of policies or policy profiles might be proposed: one emphasizing subsidies to biomedicine companies; the second emphasizing reinforcement of the Intellectual Property Regime of the country as part of attracting high profile MNEs to undertake R&D domestically; and the third emphasizing the promotion of specific applied STE biomedicine areas and infrastructures. Characterizing these options and experimenting or simulating them (or analyzing relative impacts 'in the head' rather than 'on the ground') could take a significant amount of resources and time, and involve significant search, research and discovery. It may be that, as a result of interactions with the operational level, with stakeholders, and with selected ministries, further specification of the priority itself will be necessary before 'selection' is made.¹² But even in this case, it will not be the end of the implementation process: the actual money flows, resource allocations and institutional changes will have to take place as well.

The upshot would seem to be that priority articulation is complex, might have to involve additional search/research and discovery activities, including policy evaluations and ex-ante policy assessments of alternative policy profile options. Moreover, the process of priority articulation may easily fail to converge to a functionally useful articulation of the relevant

¹² In Ireland, financing intermediate policy organizations like FORFAS, had to undertake further specification of Strategic Priorities set by the Government (See Gassler et al 2004).

priority. A major implication is that all the phases of the priority articulation process should be recognized as an explicit part of the process and attention should be given to capabilities and the institutional and governance framework underpinning them.¹³

Monitoring/Evaluation

A major issue is to what extent the SIPC should be involved in the evaluation of existing Policies. The Chilean case (see below Section 3) strongly suggests that this is or could be an essential function, especially so in the early phase of operation of the SIPC (in Chile, the 'CNIC or Consejo de Innovación para la Competividad'). One reason for this is that the process of identifying the divergence between a country's policy portfolio operational in the present, and its 'true' or updated (in contrast to implicit and possibly outdated) priorities, necessitates an evaluation of the adequacy and impact of existing policies in terms of such priorities. The downside of such an involvement by the SIPC is that it puts the council squarely in the political arena, putting it at risk of losing the credibility of its 'supra-ministerial' status.

Coordination

Policy coordination is a frequently voiced problem and a central reason for having this new supra-ministerial policy institution. Above and beyond political reasons, there seem to be objective reasons why coordination is becoming more difficult. One of these would seem to be the increased complexity of STE policy making (Sercovich and Teubal 2009, Section 1). Often the implementation of a single priority i.e. a process leading to the design/implementation of the associated policies, may require the involvement of many government agencies, with each Ministry struggling to get a higher share of the total budget allocated for this purpose.¹⁴ It is here that the IMC may have another function. While the SIPC is to be focused on assuring that its knowledge based decisions are implemented according to the spirit in which they were given, the IMC is there to make the political decisions about budgetary allocations among ministries.. This is necessary to assure that the SIPC remain untainted by what are clearly political preferences.

Top down and bottom up

While in our conceptual framework the responsibility for identifying priority areas and setting priorities lies at the highest level of the State (the SIPC), this does not mean that the SIP process is necessarily a purely top down process. There are two reasons for this. First, *the* initial identification of a new priority area may come from the private sector, from civil society or from 'lower levels' of Government e.g. Ministries or Implementation/funding agencies. Second, both private agents and lower levels of government will be involved in *specifying the priority*, either in the context of requests or commissioning of such work by the SIPC or in the case of Ministries or other Government Agencies, in the context of their in-house efforts at furthering the articulation of priorities into new policies. An example of the first reason for a bottom up component of SIP is Singapore's selection of 'Promoting a Biomedicine Cluster', the initiative having come from a key individual in an important implementation agency (Kaufman and Gore, 2010). An example of the second reason is Korea's case in the early years of this decade as reported in Gassler et al 2004.

¹³A parallel could be drawn between implementation of R&D in a firm (with the need to access complementary assets and to obtain feedback from clients at great cost and risk) and 'articulation of a Strategic Priority'. In both access to non-R&D or non-/technological capabilities may be crucial.

¹⁴ While academics and politicians are aware that STE and Innovation policy coordination is crucial, we are not aware of statements indicating that effective coordination requires an adequate set of explicitly formulated priorities.

At the same time, South Korea is or was probably the paradigmatic example of a strongly formalized, top down & Government driven STE&I priority setting process. According to Gassler et al 2004, the National Science and Technology Council of the government of that country—a new ‘strategic’ policy institution apparently established in 2001 and headed by the Prime Minister – was the main player in the STE&I priority setting process, together with the Ministry of Science and a few other, less important, ministries¹⁵. Together they identified 10 priority industries and 90 target technologies as strategic priorities in order to promote Industrial Growth. This reflects a relatively high level of specification or alternatively a low level of aggregation, at least of technologies, than those in most other countries. In addition, Korea promotes some STE&I priorities relevant to other overarching national objectives (termed by Gassler op cit ‘mission oriented’ priorities) related to National Security, Health and Nuclear Energy. These governmental decisions were then passed down to individual Ministries and Agencies for implementation.¹⁶

In contrast to this, according to Gassler op cit, bottom up processes of determining strategic priorities involve various levels of government i.e. individual ministries and agencies in charge of financing and implementation¹⁷.

Methodologies for generating vision

We would like to emphasize again that a pre-condition for being able to set a coherent set of strategic priorities is a sufficiently well developed Vision of the future development of country or region, one which takes into account global trends and domestic capabilities, with a relatively small number of loci or foci of action and a clear set of overarching national goals. An increasing number of countries are paying significant attention to this aspect of strategic policy-making.

A major trend is the undertaking of formal exercises for setting Strategic STE&I Policy priorities by a number of countries, both advanced and industrializing. These include Austria, Korea, Sweden, Canada, New Zealand, Holland, the UK, and Chile. Concerning specific techniques, while it is clear that Technological Foresight exercises and systematic international benchmarking may be important, they are not the only (nor necessarily, the main) techniques to be used. The Austrian 2004 report on “Priorities on Science and Technology Policy-An International Comparison” (Gassler et al 2004) suggests the existence of a continuum of methodologies: at one extreme, a detailed foresight process integrating huge numbers of actors and stakeholders from the policy community, the economy, science/technology communities as well as from society as a whole e.g. NGOs. Alternatively,

¹⁵ It is not clear whether this high level SIP institution was closer to the IMC type institution or to our knowledge creating SIPC (or involves elements of both)

¹⁶ This description of the largely top-down Korean case would seem to hold for the early years of that decade, but we don’t have information concerning the second half of the decade. However even in this case, the Gassler et al document states that ‘industry and research institutions are involved in *consultation for priority setting* including foresight exercises and roadmaps which are regularly used for identification of thematic priorities” (Gassler et al op. cit. p. 6), a fact which hints at a measure of bottom up activity. The same authors also emphasize that the top down process-while very successful during the catch up phase of Korea’s development-may not be well suited to stay in the forefront of technological development (they implicitly assume that a more eclectic approach would be required, see Policy Targeting section below) . They also suggest that a more balanced mix between Functional and Thematic priorities may be required.

¹⁷ To these we must add, as mentioned above, private sector individuals or knowledge oriented institutions.

the process of priority setting may be based upon a more narrow expert-orientation approach.

Several countries have undertaken Vision exercises using a number of different techniques and methodologies. Finland undertook a 'Vision' exercise prior to the process of re-defining policy objectives. These strategic exercises "...do not consider questions related to the allocation of innovation activities' resources between different content areas." Rather, "the action plan of the strategy highlights key new or changing tasks and focal points [Finnsight 2015 (2006)]."¹⁸ Another report suggests that one of the key foci in Finland's Vision is the promotion of a broad view of innovation which goes beyond technological, commercial and product/process innovation to include organizational innovations, innovations in services, and innovations in the delivery of public or semipublic services. 19

New Zealand's above mentioned ad hoc exercise while not explicitly engaged in vision - creation, was indeed an attempt to set strategic priorities.

Some of these countries and others too have also created SIP institutions e.g. Taiwan's Science and Technology Advisory Group, a special permanent advisory body for Science and Technology created during the 1970s, which reported directly to the Premier Sun (Brenzitz 2008, Chapter 3). The Austrians initiated a benchmarking exercise across a number of countries whose objective was to understand both the process of priority setting and the set of priorities themselves. The exercise was part of the initial capabilities for or background activities undertaken to sustain the setting of such priorities.²⁰ To these we may add studies undertaken under the aegis of international organizations e.g. Unido (Sercovich 1999)²¹.

More generally speaking, it is our view that the process of determining a set of STE&I strategic priorities for a country/region should start with assembling a list of 'relevant' areas/technologies/sectors and other HLO's in which such priorities should be established,

¹⁸ Work on the report began at the beginning of 2005 when the Academy of Finland –an expert organization in basic long-term research funding- joined forces with Tekes (The Finnish Funding Agency for Technology and Innovation) to launch a foresight project entitled Finnsight 2015. The foresighting work was done in panels (120 experts were involved). The aim was to identify *trends* and *focus areas of competence* for the future in science, technology, society and business and industry, and to establish priorities among them. The project also helped define Finland's Strategic Centers of Excellence in STE&I as part of development of the public research system.

¹⁹ This is probably the key untapped innovation frontier of our time, as Japan and current difficulties to address the health issue in the United States dramatically illustrate.

²⁰ According to Gassler et al 2004, what would seem to be a *preparatory phase* of the Austrian benchmarking exercise included a number of steps. Fifteen OECD countries were chosen to be screened with respect to the following set of questions concerning priority setting: *existence or not of explicit priorities; type of priorities, description of priorities, institutions in charge of priority setting and methods of implementation*. Based on the screening results (published in a special interim report), a sample of six countries were chosen by an interactive process between the project team and the Austrian Council for Research and Technology which commissioned the report. The sample included Canada, Ireland, the UK, New Zealand, Korea and the Netherlands. During the *execution phase* for each country selected the same set of guiding questions were asked: existence of explicit STE&I priorities; if yes, frequency of adoption or reformulation (is it a relatively frequent process or is it essentially random when such a process is undertaken..

²¹ http://www.unido.org/fileadmin/user_media/Publications/Pub_free/Policy_benchmarking_in_DCs_and_the_economies_in_transition_principles_and_practice.pdf

with 'areas' being 'broad multi-technology need categories' like Health and Energy or 'broad multi-applications or multi-industries (or other HLOs) technology categories' like ICT. This is no easy task, partly because of what seems to be an inherent impossibility in unambiguously classifying STE&I activities into categories which are valid and relevant for all countries. Priority categories may run 'horizontally' (i.e. functionally) like a generic technology serving many specific industries) or 'vertically' (i.e. thematically, like a specific industry serving a specific market or need using a number of technologies); and a choice will have to be made about alternative ways of classifying a common set of underlying activities.

Despite the need for high levels of specificity of priority formulation, in the early stages of the priority setting process it may be necessary to refer to broader focal areas.

Policy targeting (in traditional vs. cutting edge industries)

Whereas the full specification of priorities relating to industries or clusters with more stable traditional, technologies/product classes may be relatively easy to determine because of the relative ease in determining their configuration or structures a priori, and with relative specificity, the full specification of priorities for ICT/high tech industries or clusters is more difficult.

This distinction between industry types would correspond to the distinction between industries/clusters whose underlying technologies are mature (and therefore relatively stable) as opposed to those whose underlying technologies are cutting edge or lie at the technological frontier. This is a major distinction for LDC's where industrialization policies based on imitation of foreign technologies or development of Infant Industries (which by definition already exist in AC's) is considered much easier than industrialization based on frontier or cutting edge technologies. Thus, the above mentioned 2004 Austrian report which surveys the STE aspects of Strategic Innovation Policies in a number of countries, states that Korea's Top Down process of identifying 90 priority technologies & around 16 priority industries) was much easier than what it would be in the future where frontier technologies/industries would be relevant (Gassler et al 2004).

The priorities determined when the relevant HLO-area involves cutting edge technologies with strong dynamism, would seem to be a priori less specifiable, especially as far as the structure of innovative activities/ supporting innovative organizations and relevant markets/submarkets/applications are concerned. This because of the inherent difficulty of predicting important segments or sets of applications/submarkets/specific areas of technology etc which may become relevant to the future cluster aimed at. These uncertainties may result either because of the dynamism of the global environment (technological and market wise) or because of path dependent effects and the importance of random events e.g. discoveries, unexpected future applications of existing or new technologies, etc.

It might be inferred from the above difficulty in determining priorities that policy targeting, while possible for industries/clusters involving relatively stable technologies/product classes, is not possible for ICT or other high tech industries or clusters. However, the Israeli case

(Avnimelech and Teubal 2008a) suggests otherwise: a measure of policy targeting of cutting edge ICT clusters is possible. How do we resolve this apparent contradiction?

Assume that in the areas involving cutting edge frontier technologies start-ups play a critical role in exploring and selecting specific ST areas and inventions and their links with actual and future market needs. Policy targeting in this case would aim at these critical mechanisms: at the startups, or at critical elements of the relevant startup related ecosystem. This would essentially be the targeting of entrepreneurial activity undertaken under conditions of radical uncertainty: an indirect targeting of the final – as yet unclear – cluster configuration.

*Thus the apparent paradox may be solved by distinguishing between two extreme types of **Strong Policy Targeting with implications for new cluster prioritization: Strong Direct Targeting; and Strong Indirect targeting,***

Strong Direct Targeting aims at a rather specific cluster configuration and whatever it takes to trigger its emergence. When the relevant cluster configuration cannot be adequately specified a priori, then **Strong Indirect Targeting will be required to trigger emergence.**²² Strong Indirect Targeting should focus at supporting those critical components of the new cluster eco-system whose *endogenous* activity is critical to define the new cluster as well as those which will trigger/sustain its emergence (SUs and Venture Capital in the case of Israel during the 1990s).

A central emphasis of the Strong/Direct Policy Targeting process involves determining the relevant HLO configuration aiming at a sufficient level of specificity²³ including its HLO-specific system of innovation²⁴ The latter would include innovative inputs and outputs, types and orders of magnitude of innovative firms and organizations, and relevant support structures and functionalities of various kinds (technological, financial, etc). Concerning STE it would include rather well defined & mature areas & associated institutions such as Universities, Technology Centers, etc. (it would seem that the functionalities would also be 'rather standard' ones).

A number of these elements would be targeted by policy as part of the process of triggering and sustaining HLO emergence. The resultant policy package, which would change through time, would comprise a pretty well defined road map. Note that this package would not involve, in any dominant fashion, the support of a new group of agents or new mechanisms specializing in and/or knowledgeable of both new, cutting edge STE areas and their implications for the marketplace.

Contrary to the case in of Strong/Direct Policy Targeting, the actual **focus of Strong/Indirect Policy Targeting**, is not the cluster configuration itself specified by (or under the

²² For the purposes of this paper, 'Strong Policy Targeting' (whether Direct or Indirect) is required when the **objective** is to trigger/sustain emergence of a **new HLO** (Conversely, **Weak Policy Targeting** relates to the objective of reinforcing or upgrading an **existing HLO**).

²³ The reader must keep in mind that no matter how high a level of specificity is achieved, a sufficient, crucial measure of flexibility is a sine qua non in any policy

²⁴ Traditional policy towards Infant Industries would be one form of *Strong Policy Targeting*

responsibility of) a SIP Council, but a market & entrepreneurial mechanism which would be willing and capable to operate under radical uncertainty and to take risks.²⁵

An Illustrative Case: Chile's Innovation Council²⁶

Background and Motivation for creation of Chile's SIPC

Between the mid -1980's and late 1990', Chile's economy was thriving: success in export markets—with significant concentration of production in a few sectors—and high commodity prices had laid the groundwork for sustained growth.

And yet, by the late 1990's (1998) and the middle of the first decade of the 21st century, growth rates in Chile were only half of the 7.1% achieved during 1984-97, with Total Factor Productivity also dropping sharply. By 2005 some of the once-dynamic sectors were faltering as lower cost competitors took a growing market share (Peru in the fruit sector, Argentina in wines) and a growing crisis was brewing in the Salmon/aquaculture sector resulting from failure to properly manage the environment for production.

The Chilean Innovation Surveys show that companies' innovation expenditures fell significantly between 2004 and 2006 and the proportion of companies that had introduced innovations in the previous three years fell from 38% to 33%²⁷. Also, the learning effects of Chile's innovation expenditure were limited. Fast-growing countries tend to have increasing diversity in their exports but Chile's diversification largely came to a halt by 1995. Moreover the sectors in which Chile's exports are specialized tend to have a poor diversification potential²⁸.

Chile's eroding competitiveness, stagnating performance and insufficient diversification has been clearly documented by, among others, the OECD²⁹, the Growth Commission³⁰, and the World Bank³¹. Returning to high levels of economic growth is a critical policy concern for Chile. Also important was the view that "Chile's continued social progress depends on economic diversification, job creation, and increased competitiveness".

²⁵ Actual policies may also include other supporting functionalities such as cutting edge STE support, support of applied R&D centers and joint University-Industry institutions, and complementary institutional and organizational changes such as (depending on case) creating Technology Transfer Offices at Universities, supporting incubators and facilitating staff to create and manage SUs.

²⁶ What follows has critically benefited from the work of an international panel which evaluated the activity of Chile's SIP Council (called the CNIC, see below) during 2005-early 2010 period with participation of one of the authors of the present paper (Teubal). Many thanks to the other members: E. Arnold, M. Crawford, I. Feller, J.Piquet, M. Sargent, and C. Sabel.

²⁷ CNIC 2009. In that document, innovation is defined to include organizational, managerial and marketing innovations

²⁸ Hausmann and Klinger (2006)

²⁹ OECD 2007

³⁰ Commission on Growth and Development 2008

³¹ World Bank 2008

Those problems were the background to the creation on Chile's "Concejo Nacional de Innovación para la Competitividad" (**CNIC**) which we will henceforth refer to as "Chile's SIPC".

Chile's SIPC was originally set up by presidential decree in 2005 as an interim body which became permanent in 2006 to advise the President on policies in the area of innovation including the education of specialized human resources and the development, transfer and diffusion of technology. The mandate of the Council set out in Decree No 505 was to

- Propose a national strategy for innovation for competitiveness and publish strategic proposals
- Establish mechanisms to consult and enter dialogue with relevant actors, especially the regions (this relates to the coordination function of Strategic Innovation Policy)
- Propose how to allocate the FIC³² tax on mining companies
- Undertake studies
- Make proposals for institutional redesign

Based on this mandate, the SIPC produced Volume 1 entitled 'Towards a National Innovation Strategy for competitiveness' early in 2007 (CNIC 2007) and Volume 2 at the start of 2008 (CNIC 2008).

These comprise a Vision, a set of priorities and associated policies resulting from the articulation process. These were aimed at doubling Chilean income per head by 2020-25, thereby matching the level attained by comparable resource-based developed countries.

Chile's SIPC's Agenda and Contribution

As mentioned in the theoretical chapter, one can't avoid politics, even in the knowledge oriented domain in which the SIPC is meant to function. In Chile's case, Chile's government at the time the SIPC was established considered inclusive and continued social progress an overarching national goal, and this was an integral part of the council's discussions. Hence that became part of the country's vision.

Based on its mandate, the Chilean SIPC/CNIC began tackling the following:

- determining a Vision,
- setting Priorities,
- articulating the latter into policies,
- coordination and influencing the overall national budget for STE and I.

Its Vision includes a view of where Chile's strengths and weaknesses are (in the light of global trends) and a set of overarching goals like growth and diversification, creating a

³² "Fondo de Innovación para la Competitividad", a Government pool of money fed by a special tax on mining companies the proceeds of which were earmarked to support innovation.

dynamic innovative business sector, strengthening STE infrastructure which also attends to social needs and an inclusive view of human capital development.

At the highest level of the state and side by side with Chile's SIPC itself we have that country's "Concejo Inter-ministerial" (CIM), which is Chile's IMC headed by the Economics Ministry. The council was in charge of approving the SIPC's plans (or parts of them) and proceeding with the first phase in implementation namely leading the process of budgetary approval and initial Ministerial coordination. Important actors at a lower level of government are the Economy and Education Ministries and their funding/implementation agencies namely Corfo (including INNOVA Chile) and CONACYT respectively. CIM/Chile's IMC decides what parts of Chile's SIPC's advice to implement. While the Economics Minister chaired the MIC, actors in the system were expected collectively to implement the strategy with no one empowered to tell all the others what to do. They had to work together 'vertically' (between ministries and their agencies), 'horizontally' across administrative boundaries and at regional and national levels.

In our interpretation, Chile's SIPC considered a number of *national goals*, *focal areas* (which are very general statements about priorities), and *policy lines of action*. In what follows we only consider three out of a wider set of goals comprising Chile's overall Vision (Box I).

BOX 1 : THREE NATIONAL GOALS

I.	<i>A Dynamic and Innovative Business Sector</i>
II.	<i>Reinforcing/Enhanced Relevance of Science, Technology and Higher Education (STE)</i>
III.	<i>Strengthening Human Capital Development from and Inclusive Growth Perspective</i>

We then proceed as follows. First, we identify *Focal Area/Priorities* for each one of these goals. Second, we link *Policy Lines of Action* to individual focal areas, national goals or both.³³

From National Goals to Focal Areas/Priorities

Focal Areas/Priorities related to A Dynamic and Innovative Business Sector (Goal I)

- Growth in Innovation and Innovation capabilities in Firms*³⁴
- Mission Oriented Research at Universities; and greater weight of 'enhanced relevance' criteria in decisions by Chile's National Council for Science and Technology (CONSCyT)
- Strengthening (and in some cases, creating) clusters

³³ In a number of cases such as with *Clusters* where strategic priorities were determined with the help of consultants (CNIC 2008, Annex 1), Chile's CNIC/SIP Council was also involved in further priority articulation in terms of specific policy design. It can be stated that the level of specification of priorities beyond identification of Focal Areas has been uneven till early 2010(end of period of evaluation of CNIC).

³⁴ Focal area for which, in the analysis that follows, one or more Policy Lines of Action was set(see below)

- business sector diversification

Focal Areas/Priorities related to Reinforcing/Enhanced Relevance of STE (Goal II)

- GERD should rise from 0.68% of GDP in 2004 to 2.3% by 2021, and the share of BERD in GERD should rise from 37% to 50%
- the proportion of the cadre of 18-24 year olds entering higher education must rise from 43% today to nearly 80% by 2021
- Enhanced support of Research Infrastructure and greater emphasis on mission-oriented research relevant to national economic priorities

Focal Areas/Priorities related to Strengthening Human Capital Development from an Inclusive Growth Perspective (Goal III)

- Average years of schooling must rise to 12 by 2010 and 14 by 2021
- Creating a national system of competence-based labor certification, overseen by a certifying body
- Creating a market for skills and skill acquisition

Selected Policy Lines of Action

We focus on ***Policy Lines of Action*** which were selected to promote ***Growth in Innovation and Innovation Capabilities of Firms*** (Focal Area/Priority*) and ***Policy Lines of Action*** linked to ***National Goals II and III***

Policy Lines of Action 1: promoting “Growth in Innovation and Innovation Capabilities of Firms” (focal area *)

When analyzing Chile's strengths and weaknesses, CNIC concluded that the Chilean innovation support system had hitherto done strikingly little to address the support needed or encouragement of the early stages of development of company innovation capabilities., While other countries use technology audits, advisory and extension services and schemes to ‘inject’ qualified scientists and engineers in order to create absorptive capacity, *in addition* to financial support, Chile seemed to have limited itself to the latter, and even there, funding for business innovation was found to be small. Moreover, it had grown less rapidly than expected: the extent of direct innovation support to companies having remained static for some time. There were bureaucratic problems in this program³⁵, as well as in the R&D tax break scheme for industry.

To account for these observed weaknesses The SIPC therefore wisely proposed the use of schemes which would hopefully launch a virtuous circle of learning in the companies – teaching them the virtues of endogenous innovation.

³⁵ Due to bureaucratic problems direct incentives to company R&D were extended on condition that the supported R&D would take place in external institutes rather than in the firm itself. The outcome of that was a weakening of company in-house innovation capability development.

The following *policy lines of action* were formulated for this domain:

- Large-scale provision of extension services to modernize technology in companies and to encourage increased innovation
- A significant increase in innovation subsidies, focusing on grants for SMEs and guarantees and tax credits for larger organizations and projects
- Significantly expanded schemes to inject University graduates, including PhD-holders, into industry
- Targeting Clusters
- Promoting the creation of a portfolio of types of risk capital from the seed stage onwards and encouraging ‘business angels’ by giving them tax breaks
- Reforming bankruptcy laws and funding regulations that discriminate against former bankrupts, in order to promote US-style ‘serial entrepreneurship’
- Encouraging companies to engage in collaborative research consortia with each other and with universities, while strengthening universities’ ability and desire to deliver the ‘third mission’ of supporting economic and social development
- Changing the Industrial Property Department into the National Intellectual Property Institute (INAP), enabling modernization of patents and IPR procedures
- Establishing the need to reform and increase the capabilities of the research institute/technology centre sector, in order to support the needs of industry

The innovation-in-firms support system should comprise a mix of horizontal (functionally orientated) schemes with vertically specialized innovation schemes that tackle the specificities of individual branches or clusters. A well functioning, horizontal program, which subsidizes innovation by individual firms, is important for countries like Chile³⁶ in order to provide ‘demonstration effects’ of the importance of innovation, change company culture, promote technological entrepreneurship and contribute to identifying areas of Sustainable Competitive Advantage. A main objective is triggering collective learning (about technology, marketing, management etc), with high program uptake being a major success factor by assuring the critical mass required for collective learning.³⁷

Cluster support was a major aspect of the Business Innovation national goal in CNIC’s strategy and the explicit articulation of cluster priorities and policies represents an important advance in Chile’s policy process. Policy Targeting is appropriate because of the need to provide industry specific public goods whose provision requires coordination among different ministries or agencies of government. Most cases refer to reinforcement or transformation of existing clusters/sectors of obvious economic significance (Weak Targeting) with a minority oriented to stimulate either emergence of new clusters or

³⁶ Teubal, (2008)

³⁷ See Teubal (1996,19977), Much of the econometric work on the impact of government subsidies on business innovation has not yet fully considered either critical mass issues in learning or the existence or eventual appearance of private sources of innovation finance in firms e.g. Venture Capital. A related issue is how to measure correctly the impact of Government support such as subsidies to innovation or company R&D. Thus, the emergence of a VC industry in Israel during the 1990s was a major medium/long term impact of such support programs.

creation of favorable pre-emergence conditions (Strong Targeting) e.g. some services areas proposed by the Chile's SIPC and IMC.

Policy Lines of Action 2: linking with "Reinforcing/Enhancing relevance of Science and Technology and Higher Education " (Goal II)

Within a background of greatly increased funding for university research four main lines of action were defined:

- Creating a comprehensive national system for funding science: Extending CONICYT funding of centers of excellence while simultaneously enhancing 'relevance criteria', thereby reducing fragmentation and strengthening the industry orientation of university research
- Strengthening of that part of the education ministry concerned with Higher Education and the role of CONICYT as the agency responsible for developing research in Chile
- In the medium term, strengthening funding of industrial-academic consortia, a major factor ensuring business innovation-STE co-evolution by providing 'focusing devices' for University based research and education
- An early retirement program at universities, to enable renewal and create career opportunities for young researchers; and Enhancing access to the education system, aiming at 60% coverage of the population by 2015 with training that is relevant to societal needs

Policy Lines of Action 3: linking with "Strengthening Human Capital from an Inclusive Growth Perspective "(Goal III)

According to the SIPC, the entire human capital development system including lifelong learning was in need of improvement and reinforcement; A new System of Occupational Competency (SNCCCL) regulation aimed to create a unified skill and certification system based on competences that would not only improve the operation of national labor markets but eventually connect to international norms. Quality, consistency and accreditation were also considered necessary at university level. More specifically, Chile's SIPC formulated the following lines of action for this domain:

- Consolidating the SNCCCL and a life-long learning system, based on creation of a qualification framework.
- Enhancing the development of general skills via technical and vocational training
- Ensuring the provision of quality training and the targeting of public support towards lower-income workers and smaller companies

Policy Coordination

Coordination among policy agencies was improved, not only through the formal activities of the SIPC but also via the informal links established between the relevant individuals of the various policy institutions. Chile's SIPC also became an important arena for broad discussions

on Innovation Policy, a fact that also increased its public visibility and overall acceptance and awareness of the importance of Innovation for achieving national objectives. Finally, the existence of such an institution triggered the creation of the inter-ministerial committee (CIM), which-despite imperfect implementation, gave Chile a strategy implementation mechanism that spanned several ministries, creating opportunities to implement more holistic policies.

Influencing the STE& I budget

CHILE'S SIPC has-through stimulating awareness of the importance of innovation and by achieving some concrete results- influenced the STE and innovation budgets. Direct public expenditure on science, technology and innovation has grown from 0.26% of GDP in 2007 to 0.32% in 2008 and was estimated to reach 0.36% in 2009. This is still considerably less than OECD countries spend but shows the state making the 'kick-starting' investments that should help initiate growth in BERD.

Concluding Remarks on the Impact of Chile's SIPC

We conclude that during the period analyzed (2005-2010) a positive beginning to Strategic Innovation Policy took place in Chile, the central role being played by CNIC ("Concejo Nacional de Innovation y Competitividad") which to a large extent performed the role of Chile's SIPC . CNIC was a supra-ministerial, knowledge creating institution at the highest 'level of the State , a central component of the new policy system which was established at the time. It successfully identified a number of *key focal areas/priorities* including those related to three overarching national goals (which are part of the Vision it formulated /generated): A Dynamic and Innovative Business Sector; Strengthening/Enhancing the relevance of Science, Technology and Higher Education; and Strengthening Human Capital from an Inclusive Growth perspective. Chile's SIPC further articulated some of the focal areas/priorities into lines of action leading to policies, including the important task of assessing the extent to which existing policies reflect these priorities. It yet remains to be seen how Chile's strategic level of innovation policy will continue operating in the future and whether its potential contribution to Chile's economic growth and social development will materialize in the ground.

Conclusions

We propose a *Strategic Innovation Policy (SIP) System and Process*, with "Strategic" being contrasted with customary or operational, and with a broader "Policy system and process" perspective that involves both the explicit identification of STE&I priorities prior to policy implementation and the related need of considerably enhancing the knowledge base underpinning innovation policies on the ground. It is our view that this broader-defined process is sine qua non for high impact policymaking nowadays. Moreover, there will be little or no change in policy outputs without a fundamental change in the policy process as well as in the underlying policy institutions.

The SIP process starts off with identifying and defining a Vision and a set of Strategic Priorities (a distinctive and separate function) and only when that is accomplished does it proceed to the detailed design and implementation of specific policies. There is a

qualitative dimension to this process which adds to the growing complexity of tasks faced by policy makers. These are related to *Priority Specification* the importance of which has been underestimated both in Economics and in policy making. When clearly formulated these priorities are the basis for identifying policy objectives and for creating a road map for the more familiar quantitative dimensions of innovation policy implementation.

Defining a country's overarching national goals and setting strategic priorities must be based on a valid analysis of a country's strengths and weaknesses, as well as the environment in which it exist. It therefore involves knowledge-creation and capability development; and these must take place on an ongoing basis. Priorities may change or be more specified as the environment changes and as a result of policies being implemented. It is therefore important to keep a focus on priorities and to keep them updated. A narrow, immediate focus on policies may be detrimental to this process.

Two central supra-ministerial institutions, located at the highest level of the State/Government (PM or President), carry on the necessary interplay of strategic analysis vs. operational design: the SIPC, a knowledge-focused independent institution, and the IMC, an institution whose role is to give political and practical punch to the SIPC's proposals. This raises the issue of the link between priority setting and knowledge creation and political processes / factors. A measure of separation between knowledge and politics is always healthy – however, it would be naïve to assume priority setting can avoid being affected by politics, and having political repercussion. A real issue is the set of SIP *profiles* that may be successful despite the intermingling of politics with knowledge creation and utilization, and what set of specific coordination institutions are required. Future work, informed by country SIP studies, will gradually strive to give some answers to this question.

Our conclusion is to emphasize the importance of having a national, supra-ministerial SIP system. While every country has some strategic policy making in particular areas, few countries seem to have a national SIPS of which the framework presented here could be one (of a set of possible) profiles. We show that there are clear advantages of embedding area specific strategic initiatives within a broader 'national' SIP system.

Methodology

The paper's intention was not to build a formal model for subsequent testing, a usual procedure in much of Economics. Rather, the objective of the paper was to push forward *appreciative theorizing* in the area of Strategic Innovation Policy; and as mentioned, it represents one possible approach to this effort, with a specific goal of further developing a broad conceptual framework with *multiple SIP profiles* which could be 'applied' to different types of countries.

While its links with the Chilean case is part of the overall 'appreciative theory' view of 'following the facts' (Nelson and Winter 1982), at this phase of our multiyear and multi-country project, we are basically trying to perfect a reasonably coherent and accurate conceptual framework for SIP. The inclusion of Chile as a case study and of

other micro and meso-level illustrative examples throughout the text, are a response to the fact that, frequently when confronted with complex issues, it is impossible to advance in the analysis without reference to specific cases (see Dodgeson et al 2010, p.7 in relation to analyses of National Innovation Systems). Thus, while 'following the facts' requires first a *general theory*, construction of such a theory cannot be based solely on first principles i.e. it also requires some, if possible archetypical, facts. Only then would it be possible to apply the resulting conceptual framework to other countries and contexts, including re-applying it to existing cases. The resulting *appreciative theory* would then, in principle, be applicable to analyze other cases.

Concluding Remarks

In many countries, some form of SIP exists, not a *national* SIP but SIP as applied to specific areas or initiatives concerning STE&I, with the Treasury/MOF seemingly playing a limited supra-ministerial role.

In Israel, several Biomedicine/Biotechnology committees and initiatives took place during the last 20-25 years, some or most without significant *priority articulation* leading to policies on the ground (Avnimelech 2009). While being a matter for further analysis, it does not seem likely that the process of policy design and implementation involved the priority setting institutions in a serious way (some "policy setting institutions" were actually temporary committees which ceased to operate once the policies were formulated) or that significant *knowledge-based search, research and discovery* leading to priority specification took place *prior to* the formulation of policies on the ground.

The above reflects absence of a supra-ministerial institution (a SIP Council) where priority setting and specification, even concerning a particular area, is not a one shot affair, but continues for some time: an activity which eventually morphs into close interaction with policy implementation agencies, thereby assuring *congruence* between priorities and associated policies.

To some extent Israel's Treasury/MOF plays such a (supra-ministerial) role, albeit in a limited way. A major limitation is the extent by which it can also handle a key activity, *the SIP Council knowledge-creation function*. This knowledge function should i) relate not only to short term priorities but also to medium and long term ones; ii) be geared to understand both the *qualitative* and the *quantitative* implications of priority identification/specification and of policies; and iii) be oriented to create *priority implementation options* (i.e. policy opportunities) in key areas not covered by ad hoc, government sanctioned committees. All too often, the system is focused on operational level coordination functions aimed at eliminating waste and duplication, to the detriment of supporting complex undertakings which could add

significant value to the economy and society, activities which would require serious, knowledge creating capabilities.

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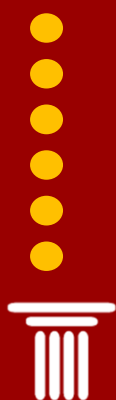
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