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Entendiendo el Rol y Funcionamiento de los Consejos Nacionales de Política Científica, Tecnológica y de Innovación

Rodrigo Alberto Cevallos González

Director: Carlos Merino Moreno

Tutor: José Miguel Rodríguez Antón

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Dedicada a Paz, la que tantos años después continúa siendo mi eterna fuente de alegría

"Compañeros para su camino busca el creador, y no cadáveres, ni tampoco rebaños y creyentes. Compañeros en la creación busca el creador, que escriban nuevos valores en tablas nuevas."

Friedrich Nietzsche, Así habló Zaratustra

"En la vida hay que ser monje, fakir y guerrero, o sencillamente te pierdes!"

Eduardo Guillermo Bonvallet

AGRADECIMIENTOS

El desarrollo de este programa doctoral fue una motivación secreta - y no tan secreta - en distintos momentos de mi vida, tanto por su componente de desafío intelectual como desde lo vivencial. En ese contexto, muchas conversaciones, algunas primitivas y otras sofisticadas, se desarrollaron en función de esta idea, con distintas personas que he conocido en el transcurso de mi vida académica y profesional y que me dieron sus valiosos consejos, apoyo y tiempo. Entre estos puedo nombrar y agradecer (sin un orden particular más que el alfabético) a María Elena Boisier, Pedro Bouchon, Jani Brouwer, José Díaz, Carlos Fortín, Andrés Hernando, José Jara, Claudia Labbé, Mauricio Olavarría, Carlos Ruíz, y Denise Saint-Jean. Muchos de ellos me dieron también distintas oportunidades de desarrollo profesional y académico, de las que les estoy nuevamente agradecido.

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RESUMEN

La presente tesis doctoral es parte de los requisitos para la obtención del grado académico de Doctor en Economía y Empresa de la Universidad Autónoma de Madrid, conforme a lo establecido por la Universidad y su Escuela de Doctorado. Su objetivo es realizar un aporte a la literatura académica del campo de la política científica y los estudios de innovación, desde el prisma de la profundización en el conocimiento y entendimiento de las organizaciones que desarrollan las actividades propias del nivel estratégico de los dominios de política científica, tecnológica y de innovación. Para cumplir con lo anterior, se desarrolla un proceso de investigación exploratorio y descriptivo que permite alcanzar un nuevo nivel de entendimiento de un tipo específico de organización para la gobernanza y la prospección estratégica de la ciencia, tecnología e innovación; los Consejos Nacionales de Política Científica, Tecnológica y de Innovación. Este nuevo nivel se basa en una herramienta heurística de clasificación global para estos Consejos, así como casos de estudio sobre su gestión general y específica. Los resultados obtenidos cuestionan en términos teóricos las aproximaciones previas - no-problematizadas - sobre este tipo de organizaciones, presentando distintas categorías y evidencia en la línea de sus características estructurales, además de las implicancias para su agencia. Lo anterior, permite como resultado de esta tesis aportaciones tanto teóricas como metodológicas, además de nuevos desarrollos a partir de estas consideraciones.

INTRODUCCIÓN

En la actualidad, el objetivo de los gobiernos de distintos países para lograr que sus naciones y poblaciones puedan optar a mayores niveles de progreso suele adoptar la forma de distintos tipos de conducción y direccionamiento desde el Estado, en particular en el ámbito de la ciencia, tecnología e innovación (Borrás & Edler, 2020). Lo anterior es propio de escenarios en los que la multiplicidad de actores, como: universidades, empresas, gobierno, agencias, institutos científicos y tecnológicos privados o públicos, centros de estudios, incubadoras de negocios, asociaciones gremiales, entre otros; se relacionan de distintas formas para la obtención de nuevo conocimiento y sus potenciales aplicaciones. En este contexto, el concepto de gobernanza, de carácter polisémico pero en este caso entendido como la capacidad del estado de convocar y conducir actores externos y múltiples hacia objetivos comunes, surge como una necesidad imperiosa para lograr los objetivos propuestos.

Sin embargo, la gobernanza de la política científica, tecnológica y de la innovación (CTI) se caracteriza por ser un objeto que no ha recibido principalmente atención desde la academia (Borrás & Edler, 2014; Edler & Fagerberg, 2017) lo que dificulta una aproximación analítica consolidada. Sin perjuicio de lo anterior, esta gobernanza se erige como parte relevante de los marcos analíticos actuales, tanto por los enfoques sistémicos entre los que destaca el de "Sistemas Nacionales de Innovación" (Weber & Rohracher, 2012), en el que se enfatiza la interdependencia de los distintos actores que participan del sistema; como de los enfoques del "giro normativo", principalmente el "Cambio Transformacional" (Daimer, Hufnagl, & Warnke, 2012). Esta relevancia se adquiere por los roles de *promotor* y *moderador* del Estado - entre los múltiples roles que debe ejercer en la gobernanza de los sistemas (Borrás & Edler, 2020) - y de los restantes *stakeholders* en la definición estratégica de las políticas de CTI.

En el contexto de las políticas de fomento a la CTI, la coordinación de estas se suele presentar en la literatura como algo natural y espontáneo, lo que no se profundiza en términos de sus mecanismos específicos (Braun, 2008). El problema de coordinación se releva particularmente en el contexto de los sistemas nacionales de innovación. En este marco la complejidad viene dada por la cantidad de actores (habitualmente organizaciones) y relaciones que se desarrollan entre ellos (típicamente mediadas por la institucionalidad) (Edquist, 2005); por lo que en este escenario, las instancias de mediación e instrumentos de acuerdos entre los actores gubernamentales, empresariales y académicos promueven la coordinación de esfuerzos y de miradas de futuro comunes. Por otra parte, en el cambio transformativo se busca no sólo la convergencia, sino también la coordinación específica en áreas, misiones (Mazzucato, 2018), (grandes) desafíos (Kuhlmann & Rip, 2018), dimensiones de la (investigación e) innovación responsable (Stilgoe, Owen, & Macnaghten, 2013), entre otros objetivos superiores en los que estos dispositivos de acuerdos nuevamente pueden facilitar la convergencia e incorporar valor estratégico.

En el campo académico de la política científica y estudios de innovación, caracterizado habitualmente por su rol prescriptivo (Flanagan & Uyarra, 2016), se ha presentado - en distintos

momentos y por distintos autores - a los Consejos Nacionales de Política Científica, Tecnológica y de Innovación (CNP-CTI) como organizaciones que permiten mediar entre estamentos, con el objetivo de desarrollar una visión y dirección común (Fagerberg & Hutschenreiter, 2020) y perfeccionar la coordinación de las políticas de CTI (Edler & Fagerberg, 2017; Foxley, Saez, & Valenzuela, 2015). Sin perjuicio de esto, esta presentación habitualmente se realiza de forma "monolítica", como suele realizarse bajo las lógicas de convergencia de las organizaciones (DiMaggio & Powell, 1983), sin profundizar en las distintas características y realidades que estos CNP pueden presentar. En el proceso, distintas investigaciones y estudios se han realizado por organizaciones de cooperación internacional (Borowiecki & Paunov, 2018; OECD, 2009; The World Bank, 2008), organizaciones gubernamentales nacionales (Schwaag-Serger, Wise, & Arnold, 2015), y académicos y *policy makers* (Edquist, 2018; Fagerberg & Hutschenreiter, 2020; Pelkonen, 2006) respecto a las características – que probablemente se acercan a una aproximación macro-estructural del diseño organizacional (Puranam, 2018) – y operación de algunos de estos CNP. Lo anteriormente descrito se puede ilustrar en la tabla a continuación, en la que se agregan de acuerdo a los países considerados, las investigaciones y estudios que los han abordado.

Tabla 1. Investigaciones y Estudios sobre Consejos Nacionales de Política Científica, Tecnológica y de Innovación

País	Investigaciones y Estudios
Alemania	(Schwaag-Serger et al., 2015)
Austria	(OECD, 2009; Schwaag-Serger et al., 2015)
Canadá	(OECD, 2009; Schwaag-Serger et al., 2015)
Corea del Sur	(Schwaag-Serger et al., 2015)
Chile	(OECD, 2009; The World Bank, 2008)
China	(Schwaag-Serger et al., 2015)
Dinamarca	(Schwaag-Serger et al., 2015)
Finlandia	(Fagerberg & Hutschenreiter, 2020; OECD, 2009; Pelkonen, 2006; Schwaag-Serger et al., 2015)
Holanda	(Fagerberg & Hutschenreiter, 2020; OECD, 2009; Schwaag-Serger et al., 2015)
Irlanda	(OECD, 2009)
Japón	(OECD, 2009; Schwaag-Serger et al., 2015)
Reino Unido	(OECD, 2009; Schwaag-Serger et al., 2015)
Suecia	(Edquist, 2018; Fagerberg & Hutschenreiter, 2020)
Suiza	(OECD, 2009; Schwaag-Serger et al., 2015)
Países OCDE	(Borowiecki & Paunov, 2018)

Fuente: Elaboración Propia

Junto a lo anteriormente descrito, otros estudios como el desarrollado por Escobar y Valenzuela (Escobar & Valenzuela, 2015) relacionan algunos CNP-CTI, junto a otras organizaciones consideradas equivalentes por las autoras, con distintas métricas de resultados de innovación para una muestra amplia de países. Lo anterior se complementa con el esfuerzo de asociatividad realizado entre los CNP-CTI correspondientes a distintos países con la creación del *Global Forum of National Advisory Council on Science, Technology and Innovation*, del que han participado aproximadamente dos

decenas de países (Center for International Affairs, Korea Institute of S&T Evaluation and Planning (KISTEP), 2016) para compartir buenas prácticas y articularse en pos de enfrentar desafíos comunes.

Este proceso de profundización en el conocimiento sobre las organizaciones relacionadas a la política de CTI ha sido recientemente desarrollado también para la clasificación de organizaciones del nivel de gestión, tanto sobre las agencias de fomento de la investigación (Lepori & Reale, 2019) como sobre las agencias de fomento de la innovación (Breznitz, Ornston, & Samford, 2018). Sin embargo, las otras capas de organizaciones relativas a la política de CTI no han sido abordadas de la misma forma. En base a la línea anteriormente indicada, esta investigación está orientada al objetivo general de comprender el funcionamiento de los Consejos Nacionales de Política Científica, Tecnológica y de Innovación, definiéndose para esta investigación los siguientes objetivos específicos (OE):

OE1. Identificar las características estructurales que se consideran para definir un CNP-CTI.

OE2. Integrar estas dimensiones para caracterizar, clasificar y analizar los CNP-CTI de acuerdo a sus características estructurales.

OE3. Describir diferentes modelos de CNP-CTI y la relación existente entre estos modelos y su funcionamiento.

OE4. Explicar la relación existente entre la estructura y el funcionamiento de diferentes CNP-CTI y sus mandatos.

OE5. Ilustrar el rol de diferentes CNP-CTI en el proceso de definición de estrategias particulares para la CTI derivado de un proceso de selección estratégica.

OE6. Comparar las opciones de política derivadas del proceso de gobernanza en que participan los CNP-CTI, en particular respecto a la relevancia del diseño organizacional de estos en relación a su rol en el proceso de definición de una estrategia particular para la CTI.

Con el propósito de dar respuesta a los objetivos de investigación definidos para este proyecto, se desarrolló un estudio exploratorio y descriptivo, basado en estrategias metodológicas que se profundizan en la siguiente sección, pero que se pueden resumir como una representación global de los consejos en base a una herramienta heurística de clasificación y a partir de esta, casos de estudio para obtener aproximaciones a su gestión general y específica. Lo anterior se presenta en un formato de compilación de manuscritos, con el siguiente diseño: en primer término se desarrolló como marco general (Manuscrito 1 – M1, orientado a abordar los OE1 y OE2), un esquema de clasificación y un índice para los Consejos Nacionales de Política Científica, Tecnológica y de Innovación a partir de su estructura. Con los resultados de este índice se desarrolló un estudio de casos polares, para los consejos de Chile y de España, (Manuscrito 2 – M2, con el objetivo de avanzar en OE3 y OE4) sobre la relación entre la estructura y la operación de estos consejos, y (Manuscrito 3 – M3, encargado de aportar en el abordaje de OE5 y OE6) la participación de estas organizaciones

en la definición de estrategias de Ciencia, Tecnología e Innovación para áreas específicas, la Resiliencia frente a Desastres Naturales en el caso de Chile y la Inteligencia Artificial en el caso de España.

En términos teóricos, como se introdujo anteriormente, esta tesis se enmarca en el campo académico de la política científica y estudios de innovación (SPIS en inglés, como sigla de Science Policy and Innovation Studies), área particularmente interdisciplinaria y que acostumbra recibir aportaciones disciplinares desde la ciencia política, la economía, la historia, entre otras; así como de campos académicos cercanos como los estudios sobre ciencia y tecnología (STS en inglés, como sigla de *Science and Technology Studies*); sin embargo, es desde la administración – en este caso la administración pública – y en particular desde la ciencia de las organizaciones que se plantea el enfoque metodológico para su problematización. De esta forma, resultará habitual en el desarrollo del documento que se integren ambas tradiciones para resultar en una composición con un grado relativamente alto de novedad.

El resto de la tesis se presenta de la siguiente forma, en la sección 3 se exhibe un breve resumen del desarrollo de la investigación, conteniendo a su vez una subsección para cada uno de los tres manuscritos que la conforman, en su versión previa a la publicación. La sección 4 condensa las conclusiones generales de la investigación. A continuación de esta sección se presentan en el Anexo 1 las comunicaciones de aceptación de los manuscritos correspondientes, y en el Anexo 2 un resumen sinóptico con las principales aportaciones de esta tesis doctoral. Finalmente la sección 5 detalla la bibliografía general utilizada, correspondiente al cuerpo de la tesis (la bibliografía de cada manuscrito se encuentra al final del mismo).

DESARROLLO

Como se adelantó en la sección anterior, con el propósito de responder a los objetivos que sustentan la presente investigación, ésta fue desarrollada de acuerdo a las siguientes estrategias metodológicas (EM):

EM1. Revisión de literatura académica, principalmente en el campo de la política científica y los estudios de innovación y, de forma accesoria en los campos de la economía de la innovación, la teoría de las organizaciones y la estrategia organizacional, entre otros. Además de la literatura académica, se realizó una revisión de literatura asociada al desarrollo de políticas públicas, tanto a nivel global como de algunos países en particular.

EM2. Revisión específica de la literatura académica y de política pública sobre clasificaciones de Consejos Nacionales de Política Científica, Tecnológica y de Innovación (CNP-CTI).

EM3. Desarrollo de un esquema de clasificación basado en la estructura de los CNP-CTI, a partir de las características identificadas en EM2. El esquema consiste en una herramienta heurística que presenta patrones visuales, un sistema de puntuación y clasificación de los CNP-CTI en categorías en base a los resultados posibles.

EM4. Transformación de los resultados de la encuesta RESGOV, desarrollada por la OCDE, al esquema indicado en la EM3; obteniendo una representación de la realidad de los CNP-CTI informados por la encuesta para 31 países[1].

EM5. Identificación a partir de los resultados obtenidos en EM4, casos de comportamientos extremos, que permitan profundizar en un análisis cualitativo de los resultados obtenidos sobre variables de interés.

EM6. Desarrollo de entrevistas semi-estructuradas a alrededor de veinte actores clave de los CNP-CTI, de los cuáles quince[2] correspondían a consejeros cuyos testimonios fueron utilizados para representar la operación, primero a nivel general y después a nivel específico, de los CNP-CTI.

[1] Notas específicas respecto a los casos considerados de CNP-CTI se pueden observar en el manuscrito. Se definieron como criterios básicos la respuesta afirmativa a la sección de la encuesta relacionada a los objetivos y la representatividad a nivel nacional.

[2] La tasa de respuesta a las solicitudes de entrevista fue de alrededor de un 50%. No se consideraron para efectos de estas entrevistas los consejeros que habían sido nombrados en función de su cargo político de gobierno, debido a que la expectativa era lograr visiones lo más neutrales posibles respecto al funcionamiento de los CNP-CTI.

Si bien esta deriva de estrategias metodológicas se observa lineal y evidente, por muchos momentos estas estrategias fueron desarrolladas en paralelo e incluso recursivamente de acuerdo a los hallazgos que se iban generando en el proceso de investigación y de la disponibilidad de nuevos recursos de interés, tanto a nivel de datos como de aproximaciones teóricas, metodológicas y analíticas. Además de lo anterior, el desarrollo de esta tesis doctoral se benefició significativamente del intercambio de visiones en actividades presenciales de nivel internacional, como se puede apreciar en el siguiente cuadro sinóptico (Tabla 2).

Tabla 2. Actividades Internacionales de Formación e Investigación

Actividad	Lugar y Fecha	Co-Financiamiento
Escuela Doctoral: Eu-SPRI Summer School (ECS) in Oslo: The Science System in the 21st Century	Oslo, Noruega 17 – 21 09 2018	**Eu-SPRI**
Congreso Internacional: Eu-SPRI Early Career Researcher Conference (ECC): Public R&D Funding and Evaluation: Methods, Trends and Changes	Roma, Italia 26 – 28 09 2018	**Eu-SPRI**
Foro Doctoral: 25th Science Policy Research Unit (SPRU) PhD Forum	Brighton, Inglaterra 16 – 17 05 2019	-
Escuela Doctoral: Eu-SPRI Summer School (ECS) in Manchester: Research & Innovation Policy and Governance	Manchester, Inglaterra 24 – 28 06 2019	**Eu-SPRI**
Congreso Internacional: Gobernanza de la Ciencia y la Innovación. Hacia el desarrollo inclusivo. Red GCTI	Bogotá, Colombia 31 07 – 02 08 2019	-
Foro Doctoral: Encuentro Doctoral en Innovación	Barranquilla, Colombia 02 08 2019	**Universidad Simón Bolívar**
Escuela Doctoral: Globelics Academy 2019: International Ph. D. School on Innovation and Development	Tampere, Finlandia 13 – 22 08 2019	**Globelics**
Curso: Buenas Prácticas Científicas FG-CSIC	Valencia, España 21 – 24 10 2019	**Fundación General CSIC**
Curso: PhD Course Problem-Oriented Innovation Policy: Key Organizational Dynamics and Issues	Copenhagen, Dinamarca 09 – 13 12 2019	**Eu-SPRI**

Fuente: Elaboración Propia

En consideración de las estrategias y actividades señaladas, los manuscritos correspondientes a la investigación fueron desarrollados de la siguiente manera:

M1. Este manuscrito se realizó en base a las EM 1, 2, 3 y 4 para responder a los OE 1 y 2, con el objetivo de proponer un esquema de clasificación para los CNP-CTI en base a su estructura, y de esta forma problematizar sus características y categorías en función de las expectativas generadas por la literatura académica respecto a estos.

M2. Este manuscrito se realizó en base a las EM 1, 4, 5 y 6 para abordar los OE 3 y 4, con el objetivo de presentar las tensiones existentes en la operación de los CNP-CTI en base a las definiciones estructurales extremas que presentaban, y cómo estas se relacionaban con la literatura académica correspondiente.

M3. Este manuscrito se realizó en base a las EM 1, 4, 5 y 6 para dar respuestas a los OE 5 y 6, con el objetivo de presentar la tensión entre la aproximación de la literatura académica sobre los CNP-CTI y su rol efectivo en el desarrollo de ciertas actividades propias de su naturaleza, basándose nuevamente en las definiciones estructurales extremas que presentaban.

Como se señaló en la introducción de esta tesis doctoral, a continuación se presenta cada manuscrito en una subsección.

Manuscrito 1: National Policy Councils for Science, Technology and Innovation: A scheme for structural definition and implementation

Este manuscrito fue presentado en una versión primitiva a la revista especializada Technovation, la que consideró estaba fuera de su ámbito de acción. De acuerdo al análisis de los autores y a la recomendación del Prof. Charles Edquist, el manuscrito fue entonces presentado a la revista Science and Public Policy en la que fue rechazado de acuerdo a su aproximación metodológica. Tras una revisión de los comentarios de los pares evaluadores, la metodología fue modificada y el manuscrito fue reenviado a la misma revista especializada. El proceso de revisión de pares determinó que la propuesta era interesante pero requería de modificaciones mayores. Los investigadores complementamos el manuscrito en función de las solicitudes de los pares, logrando la aceptación definitiva de la publicación sin modificaciones en el siguiente envío. El proceso de intercambio editorial anteriormente descrito se puede resumir en la siguiente tabla de actividades:

Actividad	Fecha
Envío a Technovation	28 02 2019
Rechazo por ámbito y aproximación de la publicación	06 03 2019
Envío a Science and Public Policy	10 03 2019
Rechazo por contenido	07 05 2019
Envío a Science and Public Policy	02 09 2019
Solicitud de modificaciones mayores por contenido	18 11 2019
Envío a Science and Public Policy	12 01 2020
Aceptación Definitiva por Science and Public Policy	18 05 2020
Publicación	30 12 2020

El proceso de publicación de este manuscrito junto con la aproximación teórica fueron los componentes más beneficiados de esta tesis por las actividades internacionales que se señalan anteriormente en esta sección, debido a la retroalimentación de distintas audiencias en distintos períodos de desarrollo. Lo anterior es refrendado en los agradecimientos de la correspondiente publicación.

A continuación se presenta el manuscrito reseñado[3].

[3] El manuscrito en su versión final se encuentra publicado en https://doi.org/10.1093/scipol/scaa052 .

National Policy Councils for Science, Technology and Innovation: A scheme for structural definition and implementation

Rodrigo A. CEVALLOS and Carlos MERINO MORENO

Abstract

National Policy Councils for Science, Technology and Innovation have become a common institutional arrangement in supporting governments to overcome the problems of coordination derived from the complexity of National Innovation Systems. These organizations are expected to involve stakeholders with strategic capacity in defining long-term goals for science, technology and innovation, to coordinate efforts and to monitor execution. However, governments face several options to devise the proper council for their purposes, and the absence of a common framework may induce theoretical and analytical difficulties. This exploratory and descriptive study proposes a scheme for defining the structure of such a council and a comprehensive approach that is based on a novel OECD database; analyzing the results obtained for thirty-one countries. The results obtained from the index confirm heterogeneity, while the clustering suggests three types of councils. The proposed scheme provides a standard tool for the study and implementation of these councils.

Keywords: science policy, technology policy, innovation policy, governance, councils, scheme

1. Introduction

Governments have tried to steer and foster the development of science, technology and innovation (STI) for many years and through many mechanisms, to improve directly or indirectly the wellbeing of their constituents. These efforts are commonly framed as science policy, technology policy, or innovation policy. Even when these concepts are somehow entangled and frequently used together or merged, each has a life of its own. Their objectives span from enhancement and augmentation of knowledge to fulfilling the practical need to develop the communities of a country (Lundvall & Borrás, 2005). Despite this overarching interest, the governance of these policies is commonly assessed as an understudied subject (Borrás & Edler, 2014). To champion this governance, one of the recurrent formal types of organizations that are appointed is the broad family of National Policy Councils (NPCs) for STI (OECD, 2012). However, this definition is often presented in a general way as an unproblematic black box. Since governments devise these organizations, their authorities are in the position to decide and define these organizations' scopes, aims, management, boundaries, and resources. There are therefore multiple interpretations of what constitutes an NPC for STI, which poses difficulties in the theoretical construction of their role in the governance of STI. Analysis of the object thus remains fuzzy, and the practitioners do not have a universal source for their devising. The overarching aim of this article is to complement the existing stock of studies on organizations for STI, focusing on the governance and the strategical level, by addressing the NPCs for STI.

The academic literature of Science Policy and Innovation Studies (SPIS) and that of Science and Technology Studies (STS) agree about the absence of ideal types of National Innovation Systems (NIS) to use as a template when developing a particular nation's system (Edquist, 2005). Since the aims of NISs are standard goals for almost every government, governments usually strive to steer their performance. The NIS approach 'emphasizes the active role played by government policy and specific institutions' (Furman, Porter, & Stern, 2002) and 'government policy is a major enabling factor in the generation of linkage mechanisms and incentives' among different components of a system (Galli & Teubal, 2006). In the field of STI, policy formulation has transcended from a 'governmental or state concept to one of public' interest, increasing society's involvement in the process (Dutrénit, Natera, Puchet Anyul, Vera-Cruz, & Torres, 2018). However, in the context of more deliberative democracies – a concept tied with the more horizontal approach of the idea of governance (Lynn, 2012) – there is also a perspective of not having enough information about the design of these institutions (Lövbrand, Pielke, & Beck, 2011), which is confronted with the prescriptive nature of a relevant share of innovation policy studies (Flanagan & Uyarra, 2016). More specifically, the strategic level of STI policy definition is facing increased social concern and pressure –related to responding to the Grand Challenges (Kuhlmann & Rip, 2018), Missions (Mazzucato, 2018a; Mazzucato, 2018b), and the Dimensions of Responsible Innovation (Stilgoe, Owen, & Macnaghten, 2013), among other demanding definitions– on the design and implementation of the concerning tasks and activities by the organizations and their capacities, in a context in which, as pointed out by Breznitz et al., '(facing the missions) there is no single blueprint for an effective organization' (Breznitz, Ornston, & Samford, 2018:893).

Despite the relatively understudied subject of organizations for STI, most of this research has been linked, following Braun's conceptualization, to the hardware –understood as the 'formal rules and regulations'- rather than to the software – 'norms, scripts, causal stories and structures of consensus-building' – of this policy domain (Braun, Benninghoff, Ramuz, & Leresche, 2003:7). Following this, recent publications focus in the operational layer of STI policy -agencies for research (Lepori & Reale, 2019) or innovation (Breznitz et al., 2018)- and there is a scarce but growing amount of scholarly and policy-making-oriented literature on the strategical and political layer; e.g., national and international reports that have studied the characteristics of subsets of existing NPCs for STI (Borowiecki & Paunov, 2018; Escobar & Valenzuela, 2015; OECD, 2009; OECD, 2018b) and a few country-specific research cases (Edquist, 2018; Pelkonen, 2006). The reports mainly focus on the characterization of these organizations' structures, and the research cases deepen current characteristics and processes for specific organizations; following the classic differentiation in organizational theory between their formal structure and daily work activities, made more than forty years ago by Meyer and Rowan (Meyer & Rowan, 1977). Due to this, there is a gap of a general framework for both implementation and analysis of these NPCs. The purpose of this exploratory and descriptive article is to address this gap, in a twofold way: providing a general scheme for defining NPCs for STI, i.e., their structure and therefore the policy options for every dimension that are faced by the authorities when defining these organizations; and proposing a qualitative and quantitative approach for assessing these definitions and analyzing the results observed, by answering the following research questions:

1) What structural characteristics are considered to devise and identify an NPC?

2) How to integrate these dimensions to characterize, classify and analyze NPCs for STI according to their structural characteristics?

The scheme is a step towards bridging the prescription of councils with their implementation, by building an analytical tool with heuristic value for the characterization of NPCs for STI and the policy options derived from it. Also, within the devising process, it maximizes its usefulness for policy implementation while synoptically simplifying complex arrangements. Therefore, as an empirical paper, while introducing some concepts and a scheme this article aims to address one of the setbacks identified in the academic literature regarding the research about the governance of Science and Technology (Borrás, 2012), by providing a common ground for analysis, in this case for these particular organizations and how they relate to other participants of the systems – specifically with the state.

The article is organized as follows. Section 2 introduces some of the definitions and theories that support this study and position it theoretically. Section 3 divides into three subsections: the first (3.1) deepens the dimensions of the analysis and integrates them into the proposed scheme; the second (3.2) operationalizes the scheme as an index, and the last (3.3) presents the analysis of the results obtained. Section 4 presents our conclusions and some avenues for future research.

2. Concepts and definitions

This section divides into two subsections: Subsection 2.1 relates NIS theory to its specific feature of governance, and Subsection 2.2 deepens to include the particular organization of the NPCs for STI.

2.1. National Innovation Systems and Governance

As recognized by Bengt Ake Lundvall, the concept of 'Systems of Innovation' was developed coincidently both in the US and in Europe in the late 1980s, by Freeman and Lundvall (in a 'seminal application' and 'conceptual prototype' for each case, according to Park (Park, 1999)). The adoption of the concept by international economic cooperation organizations such as The World Bank and the OECD helped to make it widely used, providing a unique lens for both scholars of the field and policymakers focusing on the systemic view of STI (Lundvall, 2007). Among the features of the NIS approach is that it is nation-specific; it recognizes the cultural and political dimensions of states, and their differences in the degree of cultural homogeneity and political centralization (Lundvall, 2016). In the same direction, given that the systems are inherited and have the potential to evolve, the coherent efforts needed to govern and receive the benefits of coordination of the STI system are focused at the national level (Acs, Audretsch, Lehmann, & Licht, 2017). This systemic coordination among the actors of an innovation system is expected to promote competitiveness and, therefore the wellbeing of the inhabitants of a country (Schot & Steinmueller, 2018). For that purpose, extensive reviews of Innovation Policy (that commonly includes Science and Technology Policies) have been developed by the OECD and other international organizations for their associated countries. These assessments aim to recommend direct actions of governments, particularly regarding the context in which they are produced, such as NIS governance and the complex, changing nature of the institutional and economic relations between agents (The World Bank, 2010).

The concept of governance has received significant scholarly interest in the past decades, given the complex process of hybridization of the institutional arrangements of control and order related to the state (Levi-Faur, 2012). Governance embraces relations between institutions and actors, beyond the boundaries of traditional government and with a shift in the forms through which power is executed (Stoker, 1998). The OECD has defined governance for STI, highlighting the role of innovation:

[T]he definition of STI governance is limited to the set of publicly defined institutional arrangements, including incentive structures and norms, that shape the ways in which various public and private actors involved in socio-economic development interact when allocating and managing resources for innovation. The emphasis on interaction naturally raises issues of coordination, and 'failures' in governance are, more often than not, related to failures of coordination. (OECD, 2012:149)

As part of a complex system – with multiple actors, mechanisms, norms, and levels – the governance of STI policy is an issue of the utmost importance for expected outcomes. This complexity has been addressed empirically by the OECD, specifically by the MONIT project (OECD, 2005) and by studies devoted to small regions, such as the Basque Country (Magro, Navarro, & Zabala-Iturriagagoitia, 2014). Moreover, The World Bank has spoken of 'building blocks of a strong governance framework for innovation' in terms of the following: clarity of vision, objectives and strategy; clear jurisdiction

and mandates over objectives, strategy and programs complemented with budgetary and human resource capacity; coordination mechanisms (within the government and between the government and non-public participants of the national innovation system); accountability mechanisms, checks and balances on decision making; transparency and openness to support accountability; and periodic and systemic evaluation and related adjustment mechanisms (The World Bank, 2008). The aims commonly defined by governments for the NPCs address most of these building blocks; however, when exercising governance in public organizations, the processes for making decisions matter –it is not just about the 'what' but also about the 'how' (Bovaird & Löffler, 2009).

The organizations, following Edquist differentiation between institutions and organizations, in charge of the design and implementation of STI policy have been subject to pressures from different directions. In the early definitions of the NIS framework, B.A. Lundvall promotes the sharing of national experiences between countries, also advising against the näive copying between them (Lundvall, 2016). This notion, also related to the concept of mainstream models (Dutrénit & Puchet, 2017) coined by scholars interested in the Global South , have impacted the definitions surrounding the organizations for STI policy, also due to the context of institutional isomorphism (DiMaggio & Powell, 1983) that shapes policy domains heavily exposed to international experiences comparison such as the ones that have been previously mentioned.

2.2. National Policy Councils for Science, Technology and Innovation

According to Braun, the NIS approach fails to explain how the coordination of policies and innovation will occur, and governments should increase the interfaces and networks for gathering the actors (Braun, 2008). The NPCs and other arrangements –such as STI ministries- emerge as part of the process of specialization of policies for STI to elevate the political relevance of the subject (Rivas, Rovira, & Scotto, 2014), according to their observed experience in developing countries specifically in Latin America, and as stated in the STI Outlook 2012 Report developed by the OECD, High-Level Policy Councils are among the preferred arrangements for STI policy coordination (OECD, 2012) and are also part of the system in a few Non-OECD countries (UNCTAD, 2017). Research and Innovation Councils are commonly recommended for addressing more and better coordination –by researchers, as a 'suggestion for achieving more coordination in innovation policy' (Edler & Fagerberg, 2017); and by policymakers, as 'a policy response to have a more effective innovation governance' (Foxley, Saez, & Valenzuela, 2015)– and also highlighted as a means to enhance the strategic orientation of policies (OECD, 2005). Conscious of their potential and current contests, a subset of NPCs founded an organization to define better practices and share views about their challenges. This organization – the Global Forum of National Advisory Councils on Science, Technology, and Innovation – has already had three consecutive annual meetings and hosts sixteen member countries (Center for International Affairs, Korea Institute of S&T Evaluation and Planning (KISTEP), 2016).

As mentioned in the introduction, the literature on NPCs is scarce but has been rapidly growing in the last decade. In this article, the idea of NPCs for STI will be considered as an overarching concept then differentiated from Research Councils, Innovation Councils and STI Councils. The concept National is used to geographically and legally frame the organization's scope, and the concept Policy

is aimed to stress the difference between these councils and the Funding councils that have the mission to make the calls and allocate funding on STI initiatives, such as the UK's former Research Councils. Following the publication of the MONIT project, the OECD characterized a few 'Science and Innovation Councils' regarding their establishment, membership and activities (OECD, 2009). VINNOVA's 2015 report developed a similar analysis for 'National Innovation Councils' for a partially different subset of countries while defining these categories as the 'most notable differences': mandate/task, focus, anchoring, composition, resources, and output (Schwaag-Serger, Wise, & Arnold, 2015). These categories are critical for the characterization of these councils, but some of them are a direct result of the previously defined ones, i.e., the type of outputs is highly dependent on the mandate and focus that a council has. CIEPLAN's 2015 report, focusing on the output of the councils, analyzed direct and indirect measures of productivity of 'national authorities for the promotion of innovation', some of them labeled as 'National Innovation Councils', in a thorough study that considered fifty-one countries (Escobar & Valenzuela, 2015). For the year 2018, the OECD developed a new database focusing on the 'governance of public research policy for 35 OECD countries from 2005 to 2017' and including some descriptive and comparative cross-country analysis (Borowiecki & Paunov, 2018). Some of the results obtained are also highlighted in the 2018 version of the periodic OECD publication OECD Science, Technology and Innovation Outlook (OECD, 2018b). Concerning NPCs, this report stresses that 89 per cent of the countries have councils, and within this subset 90 per cent of the councils provide advice and 74 per cent develop strategic priorities. In 48 per cent of the countries, the councils are mandated to develop coordination between government and stakeholders.

More specific research cases have been developed by Charles Edquist, based on his participant observation while appointed to the Swedish National Innovation Council (NIC) (Edquist, 2018), and Antti Pelkonen, based on reflections and interviews about the Science and Technology Policy Council of Finland (Pelkonen, 2006). In his article, Edquist addresses the issues of making the NIC more holistic and questions its potential as a role model for other countries. Meanwhile, Pelkonen focuses conceptually on the council's move towards a more horizontal innovation policy and goes deeper into the functioning of the council. The Chilean Council (CNIC) was thoroughly assessed in its early years by both the OECD and The World Bank (OECD, 2009; The World Bank, 2008), who complemented their analyses with recommendations for future improvements and have been considered in the global reports produced by these organizations in this regard.

In the previously highlighted literature, two definitions for this type of organization – that share a significant basis – emerge. These definitions are presented in Table 1, and they rely heavily on the councils' functions instead of other types of characteristics. For this research, NPCs for STI will be considered as VINNOVA's core definition indicates, as considering experts and/or stakeholders (otherwise they will be regarded as just internal inter-governmental bodies) that are commanded to the functions depicted by the OECD (OECD, 2018a). As a summary, NPCs for STI could be defined as organizations commanded by governments to enhance policy coordination and drive the strategic role of society for science, technology and/or innovation policy. Councils are characterized for being horizontal organizations – with low levels of hierarchy within them – that involve several

parties from various backgrounds, in order to improve their execution and coordination capacities. These improved capacities are difficult to measure since they cannot be monitored by specific outputs, only in terms of overarching outcomes. In this context, NPCs emerge as a 'consensus device' among stakeholders, either with the mandate of producing outputs and outcomes due to this consensus or to give a 'seal of approval' of legitimacy to work performed by other governmental departments. In this process, trust is generated among the councillors helping the decision-making process and assessing the development of the initiatives either mandated by the council or commanded to evaluate. By making a parallel with previously stated concepts such as 'soft instruments' (Borrás & Edquist, 2013), due to the formerly characterized features, NPCs could probably be understood as a meta-instrument in itself, to promote governance from a 'soft organization'; since they entail unique features that differentiate them from other organizations in terms of their summoning of actors, operation and performance, in which governance has the potential to become flesh for strategic and coordination purposes.

Table 1. Definitions of Councils in the literature

VINNOVA 2015	OECD 2018
National councils for innovation or for science, technology and innovation are non-temporary bodies composed of experts or high-level stakeholders (or a combination of both), explicitly (e.g., by law) tasked by government with doing one or several of the following: a) producing reports b) overseeing policy evaluation c) giving advice d) coordinating policy areas e) driving change f) making policy decisions (sometimes including decisions regarding budget allocations).	**Research and Innovation Council**, i.e., a non-temporary public body that takes decisions concerning Higher Education Institutions (HEI) and Public Research Institutions (PRI) policy, that has explicitly mandated by law or statutes to do one or several of the following: a) providing policy advice b) overseeing policy evaluation c) coordinating policy areas relevant to public research (e.g. across ministries and agencies) d) setting policy priorities (i.e., strategy development, policy guidelines) e) joint policy planning (e.g., joint cross-ministry preparation of budgetary allocations)

Source: Authors, based on VINNOVA (2015) and OECD (2018).

3. A scheme to understand national policy councils for science, technology and innovation

This section divides into two subsections: the first (3.1) presents the process of defining a scheme for structuring NPCs; then, the second (3.2) proposes an index regarding this scheme and discusses the results obtained from its application.

3.1. Defining a scheme for national policy councils for science, technology and innovation

Following the inductive nature of research on STI policies (Morlacchi & Martin, 2009), the methodology performed in this subsection is a revision of the existing literature on NPCs, stressing the perspective of governmental authorities' decision-making processes and catalyze it into a scheme for their definition and categorization. These decisions are not independent; they require significant interdependence to remain coherent. The studies described in the previous section outlined the main characteristics of a set of existing councils in a subset of countries. These studies are complemented by the authors' observations on other councils, e.g., Chile and Spain, their interviews with councillors of these councils -presenting them drafts of the scheme for their comments-, discussions on the subject with councillors of other countries' councils, reviewers, scholars, staff and experts, and a process of conceptual rearrangement also improved by the process of filling in the gaps for potential policy intentionality and options.

Initially, a first dimension was easily recognized when addressing the NPCs, the domains involved in the (1) Scope of the councils differ significantly among countries in terms of the policy domains considered and also in their combinations. Then, from the already mentioned structural dimensions highlighted by VINNOVA's report, their observed characteristics were differentiated by considering their rationales into the ones that foster the (2) Executive or the (3) Coordinative capacities of a council. For the second dimension, the scheme consolidates the mandate/task and focus characteristics of VINNOVA into the definition of the Council's Role, since they appear highly intertwined and could also be defined as two levels of the same dimension. Following this, the characteristics of anchoring defined by VINNOVA is broadened to consider the more holistic approach of the Executive's Role that embraces more than just the 'highest sit' involved, but the potential of whole-of-government . Regarding the third dimension, the features of Composition and Resources were kept from VINNOVA's report. The output characteristics identified by VINNOVA was discarded for this scheme, due to the causality expected between the definition of the council's role and the output expected from it. The options within the scheme were defined from the differentiation made by the observation of the profiles studied by the OECD and VINNOVA, later complemented by the input of the already mentioned interviews. Once differentiated these features, through the above-mentioned process of integration based on their rationales, the following three overarching dimensions were defined:

1. the Council's scope, to set its policy domains;

2. the Council's Executive Capacity, constructed by (2.1) the Council's role, characterized by the activities commanded to the council by the government, and (2.2) the Executive's role to determine the level of involvement of the executive regarding the council; and

3. the Council's Coordinative Capacity, which considers (3.1) the Composition, i.e., the designation of the sources and persons that will constitute the council and in what capacity, and (3.2) the Resources, detailing the types of resource that the council can devote to fulfilling its mission.

These dimensions follow a two-step configuration: the first regarding the council's scope, and a second regarding the structural features of the council (executive capacity and coordinative capacity). These latter dimensions are expected to thoroughly incorporate the underlying structural rationales of councils as identified by OECD and VINNOVA reports. An in-depth revision of the aspects considered follows, after which these aspects will be addressed and aggregated in the resulting scheme presented at the end of this subsection.

3.1.1. Scope

The first stage in the decision process is to define the scope, framing the discussion and expected results. Defining the scope between science policy, technology policy and innovation policy, jointly or exclusively, is of the utmost importance. On the one hand, it will probably catalyze in the name and brand of the council, and therefore will have a signalling effect on the different stakeholders. On the other hand, it will define the ethos of the council, and then the array of discussions that will host. As summarized by Lundvall and Borrás, these policy domains may share some perspectives but differ significantly in their motivations and objectives (Lundvall & Borrás, 2005). As a result, this first decision will set the stage for defining the next dimensions (Subsections 3.1.2 and 3.1.3).

The boundaries regarding STI policy have changed over time (Martin, 2012), making it a difficult task to delineate this scope. The term 'science and technology policy' is usually used as just one concept in the academic literature. However, some authors, such as Lundvall & Borrás (2005), have made attempts to define each term on its own. The authors stress that these are ideal types, but that they serve their analytical purposes, and also the purposes of this article. The objectives of science policy are recognized as mixed for different countries, in a span that covers national prestige, cultural values, social and economic goals, and national security. For this purpose, within the innovation system, science policy is in charge of the strategies, mechanisms, and assessments of funding allocation for science, the institutions and organizations, and their relations, while Technology Policy aims to address 'policies that focus on technologies and sectors' with a more instrumental focus on nations' objectives for their economies. Expectedly, a Research Council or a Science and Technology Council will address the domain of science policy and in some cases, at least partially, the domain of technology policy.

Meanwhile, in the literature regarding Innovation Policy, there are currently different approaches to the concept of innovation and, therefore to Innovation Councils. As cited above, the OECD and more recently Schot and Steinmuller (Schot & Steinmueller, 2018) consider that innovation policy includes research policy (or science and technology policy). On the other hand, authors such as Charles Edquist advocate for innovation and science and technology (S&T) being two different domains that deserve their own mechanisms of coordination, albeit with alignment and coordination between them; however, stress that being in the company of science and technology cements the notion of a linear model in devising innovation policy (Edquist, 2018). Moreover, these views have to deal with Fagerberg's 'narrow definition' of innovation policy as against a broader understanding of the concept (Fagerberg, 2017). All of this polysemy surrounding 'innovation' as a term (Edler & Fagerberg, 2017) implies that before we can begin to define the scope of a council, we must first define innovation clearly as a concept, i.e., do we understand it in a broad or narrow

sense, and does it include research policy? This process could lead to a definition of either an Innovation Council or a Council for STI that will commonly capture research policy and promote a linear model of innovation. However, innovation policy is concerned with economic and welfare objectives (de la Mothe, 2004) and this relevance has shifted the direction of some former NPCs for S&T to include the concept of innovation, e.g., Spain shifted its Advisory Council for 'Science and Technology' to 'Science, Technology and Innovation'; while Finland did something in the same direction by converting its world-renowned Science and Technology Policy Council into the Research and Innovation Council.

As seen in this subsection, these policy domains may partially overlap among themselves or even with other policy domains such as education policy and healthcare policy, but their defined boundaries could mean significant differences for councils' focus. It follows that defining the dominant policy domain(s) is essential for councils' input–output configuration and their expected executive and coordinative capacities.

3.1.2. Executive Capacity

Executive capacity relates to the potential of the councils to enforce given their government-assigned activities and the involvement of the executive within the council. For the purposes of this research, it will be addressed from the perspective of the government's mandate to the council's, and also from the position that the government itself will have. This synoptic table summarizes the concepts that will be presented in the following subsections.

Executive capacity	**Council role**	Joint planning	Coordination	Advice
	Executive role	Involvement of the top level (President / Prime Minister)	Involvement of the ministries level	Involvement of the upper management level

Council's role

Following the OECD classification, governments have to choose the role and structure of councils from among three broad types (OECD, 2009): 1) the joint planning model, where the council acts as a new ministry that encompasses other ministries' STI efforts; 2) the coordination model, where the council communicates between ministries to align them with policies, though not always bindingly; and 3) the advice model, where the government is not bound to accept the advice of the council. As the advice model does not bind governments, or more specifically ministries, to council resolutions, it has diluted coordinative and strategic value; the council must depend on the will of the authorities to enforce its suggestions. The OECD approach is nuanced in this research by considering as the critical factor the involvement of the Council in specific types of activities, and not in the binding quality of their mandates to the governments.

Executive's role

Governments have to decide which council position best fulfils their objectives. A new decision for authorities is whether to participate directly on the council or to receive its inputs. This decision can be seen as a dichotomy of governance with/without the government (Lynn, 2012). In the first direction, there are three possible levels of engagement: at the top government level, e.g., president/prime minister, at the ministries level, or the upper public management level. For some countries, involving the top level of the government has ensured an arena for direct discussion of the subjects related to the Council with the president or prime minister (Edquist, 2018). There is a flip side to involving government at such a high level, though, because if the executive's decisions are not on par with the council's expertise, it may have to face criticisms of not matching expectations. In the context of the new strengths gained by 'directionality' (Martin, 2016), having a council to rest in these decisions and bargain a socially agreed 'seal of legitimacy' would be a satisfactory result for a government. This commitment fades out with a lower level of interplay. A subsequent question is who is going to chair the council when the top government level is not leading it? In cases where the president has the mandate to set the council's agenda, the government would likely want to keep control of the council. A weaker binding comes from the government not participating directly in the council; in this case, a specific office or cabinet has to be designated the council's official counterpart.

3.1.3. Coordinative capacity

In this research, the coordinative capacity is defined as the capacity to gather different resource types in order to put initiatives into practice through strategic coordination, by considering both the composition and the resources of the council. The following table will be explained and described in the next paragraphs.

Coordinative capacity	**Composition**	Government officials	Outstanding personalities	Representatives of society (stakeholders)
	Resources	Funding for external capacities	Funding for internal capacities	Funding for logistics

Composition

Definitions of councils' composition have to deal with at least three dimensions: the number and sources of the councillors to be appointed and the representation that is expected from them. Regarding the number of councillors, giving more representation to different stakeholders should increase the number of councillors, on the one hand, but make it more challenging to reach an understanding and necessitate lengthier discussions, on the other. The capacity in which councillors act should be viewed as a matter of analysis, too; will they act on their behalf or as representatives of a guild, sector, group, or community

Once the number and the capacity of councillors have been decided, their sources should be assigned. STI policy has been defined as 'multi-stakeholder' (Dutrénit & Suárez, 2018), meaning that there are potentially abundant sources for council participants. To gain political leverage, and according to how involved in decisions they are, governments commonly participate in councils with a share of the councillors related to cabinets such as economy, industry, and education. These councillors act on behalf of their organization and may help to enhance horizontal coordination, in concordance with the definition of the council's role. Following the objective of gaining the support of society in general and some factions in particular, outstanding personalities of various sources – e.g., science, industry, academia – are often named councillors as well. This representation may be as individuals or as representatives of their backgrounds, which will depend on the scope defined for the council. To have the chance of integrating the visions and support of collectives – e.g., the Universities Guild and vocational schools in Chile, the business associations and labour unions in Spain – councils also incorporate councillors that act on behalf of society stakeholders. Finally, some councils have a few 'guest' councillors who can be either international, to provide an outside perspective, or national, to push through specific objectives, e.g., Chile's council invites the STI agencies' chairperson to meetings to help achieve vertical coordination. These guests may be considered full councillors with all the rights, or with partial rights or no rights, or as part of the council but not councillors. All of these categories are enriched by the 'evolutionary paths' of the actors (Dutrénit et al., 2018), 'seated on different chairs' such as government, universities and/or companies.

Resources

This feature involves different types of resources, including funding to commission studies to external experts, managing an organizational structure that provides support – administrative, professional or both – to the council, branding, publishing, and per diems, among other expenses. For analytical purposes, we propose three broad options. The first, the most agile, acknowledges that the council has sufficient available resources to allow its councillors to meet regularly in proper conditions to fulfil its objectives. The intermediate, recognizes the relevance of organizational learning within the council, by having internal capacities such as administrative and professional staff to support the councillors, mostly as a Secretariat or equivalent, which is particularly relevant for councils that are mandated to assess agencies, devise future scenarios, and organize civil society, among other time-consuming functions; recognizing the relevance of developing specific organizational capacities. According to the OECD's last report, 47 per cent of the OECD countries that have councils have dedicated staff for accomplishing their purposes (OECD, 2018b). The third option of funding is related to resources to commission studies by external experts in order to comply with the council's information requirements. These last two characteristics acknowledges that councillors mostly devote their time to the council freely, of their own will rather than because of any competitive compensation, and at the same time the necessity of administrative and analytical independence that these organizations require for organizational learning and independent forecasting, among other activities.

3.1.4. Scheme for national policy councils on science, technology and innovation

The way in which councils are setup and developed is systemic and intertwined. For example, if the role involves joint planning activities, then the executive's role will be to lead, or if the scope of the council is to address science policy, the composition must consider some outstanding personalities or representatives of this sector. In the same way, if a council is being deployed in part to improve coordination, defining its characteristics seems critical. Obtaining vertical coordination requires a different mechanism than the needed to obtain horizontal coordination (OECD, 2005). If the role chosen includes joint planning activities or coordination, having representatives from various ministries is likely to help in achieving horizontal coordination with the government; having representatives from the private sector would assist in achieving horizontal coordination with society, and having agency representatives would ensure vertical coordination.

That said, there are some instrumental considerations to bear in mind while using this scheme. Any definition of a council is likely to be summative of the options available at a given time. Moreover, given the dynamic nature of these domains, there is also the possibility that any definition made at a specific moment in history could be replaced with newer versions. The choices made at a particular time by a government are not expected to last forever, so room for a periodic process of assessment of the council should be incorporated when installing it. The previous categories could be integrated into the scheme presented in Table 2 for profiling NPCs for STI.

Table 2. Scheme for profiling National Policy Councils for Science, Technology and Innovation

Stage 1: Defining a scope

Scope		
Science Policy	Technology Policy	Innovation Policy

Stage 2: Defining a structure for the council

NPC scheme				
Executive capacity	**Council role**	Joint planning	Coordination	Advice
	Executive role	Involvement of the top level (President / Prime Minister)	Involvement of the ministries level	Involvement of the upper management level

Coordinative capacity	**Composition**	Government officials	Outstanding personalities	Representatives of society (stakeholders)
	Resources	Funding for external capacities	Funding for internal capacities	Funding for logistics

Source: Authors, with adaptations from OECD (2009) and VINNOVA (2015).

This scheme could be filled following either of two paths with different sources: 1) by reviewing the legal and administrative information to shade the corresponding cells, in an interpretative exercise by the researchers, or 2) by surveying the NPCs with questions related to each of the cells in order to profile them in a self-reported way. The resulting matrix could be easily interpreted in terms of heuristic value by looking at the resulting visual pattern: a darker matrix will represent an NPC with a strong structure while a lighter matrix will represent an agile structure, and, given the order of the policy options, a vertical pattern will indicate more or less coherence by their alignment.

3.2. Developing an index to characterize national policy councils for science, technology and innovation

The information collected and applied in the scheme explained above could be easier to understand from a quantitative measure rather than using the matrix and visual patterns. We thus propose an index in order to quantify the potential of NPCs' structural characteristics. The index has the explicit purpose of characterizing policy options, avoiding the assessment of NPCs' performance. This index, from here on called iNPC , moves on a scale of one to twelve, with the range of policy options for an agile NPC having lower scores and a strong NPC having higher ratings. Both extreme cases, highest and lowest scoring cases (Bailey, 1994), have their advantages and setbacks. A strong and coherently designed NPC is expected to have more executive and coordinative capacity but to involve higher costs and potentially be harder to gather and implement. On the other hand, an agile and coherently designed NPC could be easier to reunite and less costly, but its capacities may be nuanced.

The index considers scoring each shaded cell with a magnitude of one; adding the sub-dimension scores will deliver the score by sub-dimension, with every sub-dimension scoring up to a magnitude of three. The options that are not present in the scheme are not scored. Then, adding the scores of the corresponding sub-dimensions will give the sub-index per dimension. Following the same idea, the sub-indexes are scored to respond to the two sub-dimensions of the NPCs' structure, their executive and coordinative capacities. Both sub-indexes can obtain a magnitude of up to six with the higher scores indicating stronger characteristics and the lower scores indicating a more agile organizational approach. Finally, adding the sub-indexes will give the iNPC scoring up to a magnitude of twelve. The iNPC aims to summarize the structural characteristics of a given NPC synoptically. The final score ranges from one point to twelve, where lower scores indicate a more agile NPC, and

higher scores are a demonstration of stronger NPCs. This magnitude could be understood as a proxy of the effort –involving different types of inputs– that a given country's government is doing in involving and capturing the approaches of their stakeholders to enhance coordination and improve the strategical foresight and governance of their STI policy.

In order to operationalize this index, this research used the OECD-RESGOV database; specifically, the answers provided by the different governments to the questions 2.1 to 2.4 of the questionnaire (OECD, 2018a). This database was collected by the OECD for the information of the year 2017 and covered thirty-five countries concerning their policies for higher education, research and innovation policies. Regarding the options defined in the previous subsection about the sources of the information, in this case, this is self-reported by each country. Questions 2.1 to 2.4 were directed to Research and Innovation Councils, and their answers are quantitative. Most of them could be straightforwardly assigned to the corresponding policy option of the index. However, the sub-dimension Resources are not as abundant in answers as the scheme requires, so, with the available options, a proxy is considered to supplement this shortage. A synoptical view of the obtained results of the survey for the questions of interest for the universe of the sample can be reviewed in Table 3, and also a detailed matrix which aims to explicitate the decisions of matching between the analytical level of the scheme and the operational level of the survey is available at the annex . From the results to the survey, at a first glance, the most common features arise, expectedly a mandate of advisory, participation from the governments at a ministerial level and a composition based on stakeholders; while the main differences are based on more complex mandates, the participation of the head of state and the availability of resources.

Table 3. Survey results showing a summary of positive answers (PA)

Question	Results									
2.2. Does the council's mandate explicitly include:	a) Policy coordination 17 PA		b) Preparation of strategic priorities 26 PA		c) Decision-making on budgetary allocations 7 PA		d) Evaluation of policies' implementation 18 PA		e) Provision of policy advice 34 PA	
2.3. Who formally participates in the council?	a) Heads of state 13 PA	b) Ministers 23 PA	c) Government officials 16 PA	d) Funding agency representatives 10 PA	e) Local and regional government representatives 8 PA	f) HEI representatives 35 PA	g) PRI representatives 30 PA	h) Private sector 31 PA	i) Civil society 18 PA	j) Foreign experts 6 PA
2.4. Does the council have its own staff and/or budget?	a) Own staff 16 PA					b) Own budget 12 PA				

Source: Authors, based on (OECD, 2018).

The database initially considered thirty-five countries, but four of them declared not having a Research and Innovation Council (Ireland, Italy, Norway, and New Zealand). Due to the national scope of this research, the results for regional councils were not considered (four of Belgium and two of the United States of America). A couple of countries (Germany and Portugal) declared having more than one council that fulfils the definition of the survey, so all of the cases were considered for each case (Germany's three councils and Portugal's two councils). Finland, due to its transitioning between councils, declared both of them; however, the acting council was not considered given that it did not answer positively to any of the questions regarding the primary activities of the councils. As a result of this process, thirty-four councils of thirty-one countries were considered for the index calculations. The results obtained from the scoring are presented in Table 4.

Table 4. Scores and index results

COUNTRY / INDICATOR	Council	Executive	EXEC	Composi…	Resources	COORD	iNPC
AUSTRALIA (AUS)	1	2	3	3	0	3	6
AUSTRIA (AUT)	1	1	2	3	3	6	8
BELGIUM (BEL)	1	0	1	2	0	2	3
CANADA (CAN)	1	1	2	3	3	6	8
CHILE (CHL)	2	2	4	3	3	6	10
CZECH REPUBLIC (CZE)	3	0	3	1	0	1	4
DENMARK (DNK)	1	0	1	2	3	5	6
ESTONIA (EST)	1	3	4	3	0	3	7
FINLAND (FIN–(86'–16'))	2	3	5	3	1	4	9
FRANCE (FRA)	2	3	5	3	0	3	8
GERMANY (DEU–CSH)	2	1	3	3	1	4	7
GERMANY (DEU–ECRI)	2	0	2	1	3	4	6
GERMANY (DEU–ID)	2	2	4	3	3	6	10
GREAT BRITAIN (GBR)	2	1	3	3	0	3	6
GREECE (GRC)	1	0	1	2	1	3	4
HUNGARY (HUN)	3	0	3	2	0	2	5
ICELAND (ISL)	2	2	4	3	0	3	7
ISRAEL (ISR)	2	1	3	2	3	5	8
JAPAN (JPN)	3	2	5	3	3	6	11
LATVIA (LVA)	2	3	5	3	0	3	8
LUXEMBOURG (LUX)	1	1	2	3	0	3	5
MEXICO (MEX)	3	3	6	3	0	3	9
NETHERLANDS (NLD)	1	0	1	2	3	5	6
POLAND (POL)	2	1	3	1	0	1	4
PORTUGAL (PRT–NCEI)	1	2	3	3	0	3	6
PORTUGAL (PRT–NCST)	1	1	2	3	0	3	5
SLOVAKIA (SVK)	2	3	5	3	0	3	8
SLOVENIA (SVN)	1	1	2	3	0	3	5
SOUTH KOREA (KOR)	2	2	4	3	0	3	7
SPAIN (ESP)	2	2	4	2	0	2	6
SWEDEN (SWE)	1	2	3	3	0	3	6
SWITZERLAND (CHE)	1	0	1	1	3	4	5
TURKEY (TUR)	3	3	6	3	0	3	9
UNITED STATES OF AMERICA (USA)	1	0	1	2	1	3	4

Source: Authors

3.3. Results of the iNPC

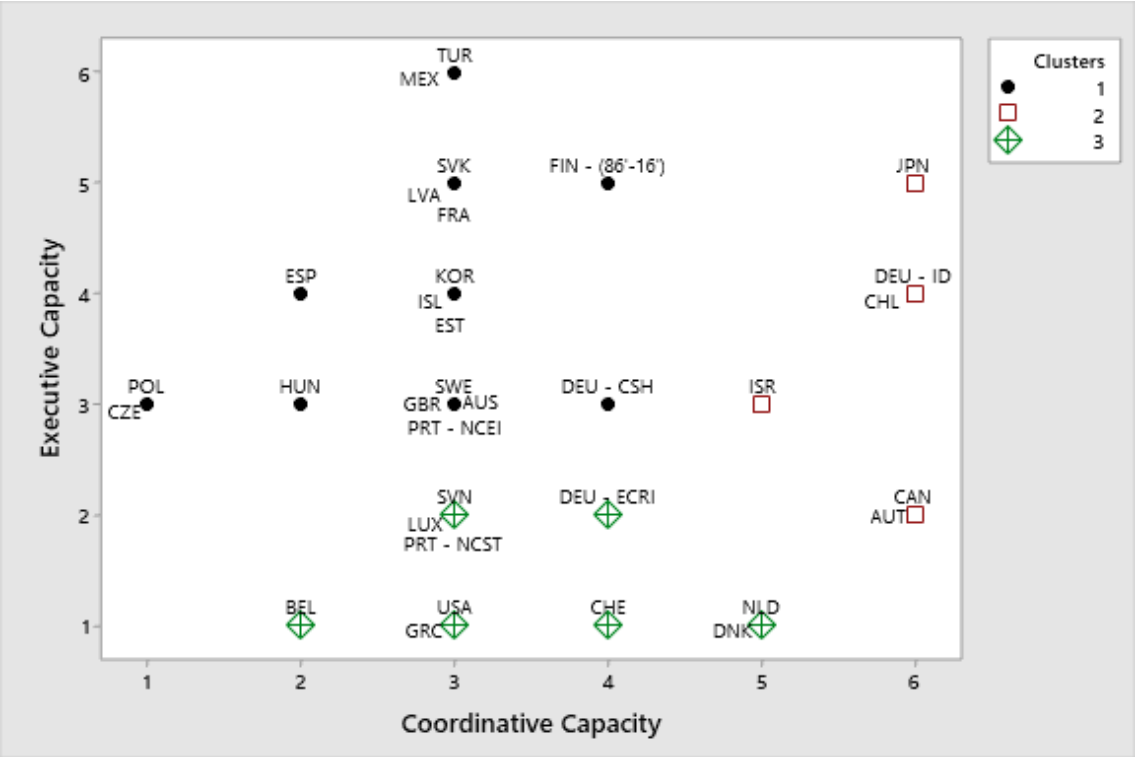
The iNPC delivered scores for the thirty-four councils that met the requirements established above. The scores highlight the Japan Council as having the strongest potential and the Belgium Council as having the most agile. As explained before, these positions are not desirable or undesirable per se but are expected to lead to different outputs and outcomes. Between the span of scores, there is a slight concentration on the right of the distribution. The distribution proves that the extreme positions are less observed than the more central ones.

As explained in the above sections, the variables defined in the scheme were considered in previous studies and have been enriched by the testimonies collected and the authors' experience to comply with what could be understood as a cognitive approach in choosing these variables (Ketchen & Shook, 1996). Due to their scale, the variables have not been standardized, and, after testing them, they do not present a significant correlation between them. Following a k-means – non-hierarchical – method for clustering, the results obtained are steady in defining three groups (Chart 1): Cluster 1 for medium-high executive capacity and low-medium coordinative capacity NPCs with eighteen observations, Cluster 2 for low to high executive capacity and high coordinative capacity with six

observations, and Cluster 3 for lower potential but easier to steer NPCs, low executive capacity and low to high coordinative capacity, with ten observations. The concept of potential is used to stress the fact that what is measured in these variables are capacities that may or may not permit the NPCs to achieve higher standards of execution and/or coordination. Theoretically, more homologous behaviour of the clustering between capacities would have been expected. In this sense, agile councils present more homogeneity than the stronger councils, given the dimensions evaluated.

On a more conceptual approach, by defining and differentiating the quadrants of the chart, having high capacities –both executive and coordinative– leads to sketch a potentially transformative council (four observations on the upper-right quadrant), that encompasses a high level of all the features currently considered to foster new strategies in a whole-of-society approach. Meanwhile, a council with high executive capacity and low coordinative capacity points to a potential driver council (nine observations on the upper-left quadrant), with an orientation still based on the enactment potential of the governments (almost like another governmental office) and not taking advantage of the grasp that stakeholders can foster. On the contrary, a council with a low executive capacity and a high coordinative capacity could be seen as an orchestrator council (eight observations on lower-right quadrant), with the concern that while gathering relevant knowledge from the stakeholders, it does not have the means to enforce them into strategical and coordinative actions. Finally, a council with low capacities suggests an advisory or consultant council with a more traditional bounded rationality due to their councillors approach on the matters. This type of council is the more abundant in the reviewed subset, with fourteen observations in the lower-left quadrant. The theoretical typology of the quadrants does not coincide with the observed distribution of the subset of councils considered in RESGOV. The empirical distribution is concentrated on councils with combinations of lower to medium capacities, casting doubts on the management of the high potential councils and their policy implications. The concepts regarding the quadrants should not be confused with the sub-dimension of the council's role, which is initially mandated by the governments, but with the expected impact of the council due to the coherence of its design. As usual, these differentiations should not be seen as canonical, but rather as a continuum.

Chart 1. Scatter plotting of the sub-indexes



Source: Authors.

The results of this study face several limitations that are important to consider and keep in mind. First, the study aims to understand the official structure of the councils in a quantitative approach; this may seem naïve since these are live organizations that sometimes have an unofficial structure more relevant than the former, and further qualitative analysis needs to be developed to address that. Second, the results of the index are part of a subset of institutions that are part of a system and are thus probably not representative of the whole governance for STI of a country. Third, the obtained results are entangled between different policy domains, each having a complex institutionalization. Fourth, the survey was self-reported by each country, and that may bias the answers due to the selection of the specific council or to the understanding of the available answers. Fifth, the policy options of the scheme are translated into indicators that may have different interpretations in different contexts. Sixth, utilizing proxies when the answers were not directly observed in the questionnaire also limited the obtained results. Finally, this is a cross-section analysis for variables that are expected to deploy their impact in the long run; this could be enriched with new waves of the survey. Despite the previously observed limitations, the results remain relevant in the already described context of having a type of organization that is presented in the theory and practice monolithically, while there are several differences, and requires more research in order to identify which designs and conditions are closer to comply with the expectations built on them.

4. Final Reflections

The theoretical goal of this research was to partially unpack the black box of the NPCs, regarding their structure, in order to present a common ground for analysis and discuss the implications of the observed structures. In the process, this article presents a contribution on the analytical level, an operationalization of this contribution into results, and a theoretical contribution regarding these results, as well as identifying new paths for future research. In the following paragraphs, these contributions will be described in detail.

Firstly, this document presents a novel tool for researchers and practitioners in the field of STI policy as it integrates previous literature in an attempt to operationalize the bridge between the theoretical understanding of the high-level governance for STI and its implementation. The process acknowledged the difficulties observed in the literature among broadly used concepts regarding STI. The need for consensus on these concepts remains urgent in order to frame the research objectives of NPCs for STI. In the absence of a unique understanding of these terms, a specification is needed for their analytical and practical use. The councils have been installed by governments to enhance the coordinating capabilities within and outside of the state. However, the councils are organizations that require coherence in their devising and implementation regarding their defined purposes. The absence of this coherence in the definition of such councils seems like a potential threat to their ability to deploy strategic capacity and coordinating efforts. Therefore, the effectiveness of these councils may be jeopardized by governments' decisions. For example, the choices made by a government could accidentally change the proposed orientation of an innovation policy based on a holistic perspective or the chain-linked model shift to a linear model, with the policy implications that this has.

Current literature regarding the object of this research corresponds either to a general view on the structural characteristics of subsets of countries (Borowiecki & Paunov, 2018; Escobar & Valenzuela, 2015; OECD, 2009; OECD, 2018b; Schwaag-Serger et al., 2015) or to country-specific research cases for ongoing NPCs for STI (Edquist, 2018; Pelkonen, 2006). This article consolidates the features of this literature by providing a general scheme and also adding new analytical tools. The scheme offered in this paper is presented in a synoptic form to integrate and summarize the structural characteristics of NPCs addressed by the previous literature, conceptualizing them in three dimensions: scope, executive capacity and coordinative capacity. For each of these dimensions, there is a set of non-exclusive options to be determined according to the literature findings and filling in the gaps of potential options as well. Each of these options has policy implications that should be considered by governments while planning to establish an NPC. Since these options may seem independent but share an interconnectedness component, devising a coherent organization should align the scope of the council; the executive capacity, i.e., the activities mandated to the council and the role of the government concerning the council; and the coordinative capacity, i.e., the composition of the council and the availability of resources provided for its performance.

Among the richness of functions of the proposed tool, first, the scheme provides a framework to organize the options that constitute a council. At this stage, the user of the tool can define a profile either to assess one organization or to parallel it with others. The former function should be useful

for defining specific research cases – because it provides dimensions to select them – for a national or even a regional level, and the latter should be particularly valuable for future comparative reports – by clustering according to the profiles – often developed by international organizations. Having the information for each organization under the same scheme makes them comparable; differences can be stressed in order to obtain a complete assessment. Further, having these organizations under the same frame makes the scheme useful in assessing how these councils are configured in an orderly fashion, and then analyzing and evaluating their internal coherence regarding these policy options. On a different level, regarding NPCs' performance, the outcomes and outputs of the councils are now comparable while being assessed on the same basis. These analyses would complement the assessments that could be performed regarding every dimension, e.g., whether the aim of the council was oriented to specific products, or whether it fulfilled its specific tasks.

This general scheme provides a broad tool to devise, categorize, compare, and assess NPCs for STI. As stated in the previous sections, there is a vast array of structural characteristics and policy options that affect the understanding and comparability of these already complex organizations, and thus any analysis of them. The fuzziness – or hybridization – of key concepts nuances the general knowledge of relevant features of governance for STI policies, affecting the theoretical underpinning of the field, its empirical analysis and the consequent policy implementation. In this direction, this scheme provides a unique lens for understanding complex organizations in terms of their structural characteristics, regardless of their background or location. The requirements to achieve this are related to the need for official definitions and documents, and also a certain degree of field involvement with the councils. However, this approach first requires a more profound understanding of the complexity of NPCs, and this relies on the research and analytical skills of the researcher.

As a summary of the scheme applications, the proposed tool is aimed to be useful in two dimensions. First, for analytical purposes, the approach introduces a tool that could be used to harmonize the comparability of NPCs, either to define subsets of them to parallel in more homologous conditions or to consider these dimensions as nuances of their studies. Second, in terms of policy application, the scheme can provide elements to consider when devising a council for countries that are in search of new organizations for STI governance – or of new paths for their current organizations – or can be used as an auditing tool for governments that aim to assess the coherence of their organizations, among other possible uses.

Secondly, this research presents the results obtained for a subset of countries on the calculation of the index resulting from the scheme. However, if further enhancement and accuracy of analysis and recommendations on this research object are required, endeavours such as the RESGOV database should be scheduled regularly, as with other OECD indicators, and opening up some questions to give more detailed answers should be considered. Following on from this, in order to frame the discussion, it may be a good idea to ask governments to identify the policy domains considered for every reported council instead of an ex-ante definition of these. This decision process deals with the tension of differentiating between National Innovation Councils and Councils for STI and criticisms of the latter by promoting a linear model of innovation instead of a more holistic approach (Borrás

& Edquist, 2019; Edquist, 2018). In this sense, to increase the reliability of results, it is suggested that the self-reported questionnaire is compared with an independent panel review every couple of waves to assess the quality of the responses given by every participant country.

Thirdly, the results obtained suggest a significant variance of designs regarding NPCs. From the evidence gathered, there was no prevalent model of NPC, but some characteristics were systematically found. This is not trivial due to the known signaling effect that a few canonical experiences, or mainstream models, have had in the development of NPCs, granting credit on Lundvall's notion within NIS for policy learning and escape from naïve copying among countries. However, more evidence on the longitudinal perspective of these characteristics would help in defining if convergent or divergent patterns in time can be observed. This finding questions the potential sources of institutional isomorphism and the legitimacy derived from it, giving a lead for further research on this direction, including –due to the increasing categories of organizations for STI- the research on the puzzle resultant from the organizations-mixes for their corresponding policy-mixes. Recognizing the expected impact of the NPCs points to the question of which designs may be better oriented for the roles mandated by the governments on one side, but also by the definitions that the society expects to catalyze through them; again in a context of increasing demands, which model is the better fit for which conditions and expectations. Conceptual differentiations regarding the potential that the capacities endorse to the councils are presented in this document –transformative, driver, orchestrator, advisory-, but the alignment of these potentials into action requires further research on the operation of the councils, and also more and better evidence, in order to make prescriptions more accurate for policy and theoretical constructs more sound for the field.

Finally, even though we have provided this scheme as a result of thorough and extensive analysis, we are confident that, in the future, this could be improved. That said, this study is a valuable step in the right direction, and is expected to provoke further research either to complement it or to replace it with better frames for analysis and implementation. It is likely that a similar exercise could be performed in policy domains other than STI ones, which would give an analogous scheme for their purposes. However, the structural characteristics of NPCs should be considered only as a 'blueprint' for their operation; because of their 'social' features, more research is needed in order to complete a thorough understanding of these organizations. Further ongoing research is needed to assess the concept of NPCs for STI among different countries and to bridge the gap between the potential decoupling between the theory and practice of their devising, functioning and reinvention.

Annex

Analytical Level - Scheme	iNPC																				
	Executive capacity												Coordinative capacity								
	Council Role				Executive role						Composition				Resources						
	Joint planning	Coordination	Advice	Involvement of the top level	Involvement of the ministries level		Involvement of the upper management level		Government officials	Outstanding personalities	Representatives of society (stakeholders)	Funding for external capacities	Funding for internal capacities	Funding for logistics							
Operational Level - Survey	Does the Council's mandate explicitly include?			Who formally participates in the Council?					Who formally participates in the Council?				Does the Council have it own staff and/or budget?								
	Decision-making on budgetary allocations	Policy coordination	Preparation of strategic priorities OR Evaluation of policies' implementation OR Provision of policy advice	Head of State	Ministers		Government officials OR Funding agency representatives		Head of State OR Ministers OR Government officials OR Funding agency representatives	Private sector OR Civil society	HEI representatives OR PRI representatives OR Local and regional government representatives	Staff AND Budget	Staff	Budget							
AUS			1	1	1				1	1	1										
AUT			1		1				1	1	1	1	1	1							
BEL			1							1	1										
CAN			1				1		1	1	1	1	1	1							
CHE			1								1	1	1	1							
CHL		1	1		1		1		1	1	1	1	1	1							
CZE	1	1	1								1										
DEU - CSH		1	1				1		1	1	1	1	1	1							
DEU - ECRI		1	1								1										
DEU - ID		1	1	1	1				1	1	1	1	1	1							
DNK			1		1		1		1	1	1	1	1	1							
ESP		1	1		1		1		1		1										
EST			1	1	1		1		1	1	1										
FIN - (86-16')	1	1	1	1	1		1		1	1	1		1	1							
FRA		1	1	1	1		1		1	1	1										
GBR		1	1				1		1	1	1										
GRC			1							1	1		1								
HUN	1	1	1							1	1										
ISL		1	1	1	1				1	1	1										
ISR	1		1		1				1		1	1	1	1							
JPN	1	1	1	1	1				1	1	1	1	1	1							
KOR	1		1		1		1		1	1	1										
LUX			1		1				1	1	1										
LVA		1	1	1	1		1		1	1	1										
MEX	1	1	1	1	1		1		1	1	1										
NLD			1							1	1	1	1	1							
POL		1	1		1				1												
PRT - NCEI			1		1		1		1	1	1										
PRT - NCST			1		1				1	1	1										
SVK		1	1	1	1		1		1	1	1										
SVN			1		1				1	1	1										
SWE			1	1	1				1	1	1										
TUR	1	1	1	1	1		1		1	1	1										
USA			1							1	1										

Source: Authors, based on (OECD, 2018a).

5. References

Acs, Z., Audretsch, D., Lehmann, E., & Licht, G. (2017). National systems of innovation. The Journal of Technology Transfer, 42(5), 997-1008. doi:10.1007/s10961-016-9481-8

Bailey, K. D. (1994). Typologies and taxonomies : An introduction to classification techniques. Los Angeles: SAGE Publications Inc. Retrieved from https://ebookcentral.proquest.com/lib/[SITE_ID]/detail.action?docID=3032629

Borowiecki, M., & Paunov, C. (2018). How is research policy across the OECD organised? ().OECD Publishing. doi:10.1787/235c9806-en Retrieved from http://dx.doi.org/10.1787/235c9806-en

Borrás, S. (2012). Three tensions in the governance of science and technology. In D. Levi-Faur (Ed.), The oxford handbook of governance (pp. 429-440) Oxford University Press. doi:10.1093/oxfordhb/9780199560530.013.0030 Retrieved from http://oxfordhandbooks.com/view/10.1093/oxfordhb/9780199560530.001.0001/oxfordhb-9780199560530-e-30

Borrás, S., & Edler, J. (2014). Introduction: On governance, systems and change. In S. Borrás, & J. Edler (Eds.), The governance of socio-technical systems: Explaining change (pp. 1-22) Edward Elgar Publishing. doi:10.4337/9781784710194.00010 Retrieved from http://www.elgaronline.com/view/9781784710187.00010.xml

Borrás, S., & Edquist, C. (2013). The choice of innovation policy instruments. Technological Forecasting & Social Change, 80(8), 1513-1522. doi:10.1016/j.techfore.2013.03.002

Borrás, S., & Edquist, C. (2019). Holistic innovation policy (First edition ed.). Oxford: Oup Oxford. doi:10.1093/oso/9780198809807.001.0001 Retrieved from https://doi.org/10.1093/oso/9780198809807.001.0001

Bovaird, T., & Löffler, E. (2009). Understanding public management and governance. In T. Bovaird, & E. Löffler (Eds.), Public management and governance (pp. 3-13) Routledge. Retrieved from http://www.econis.eu/PPNSET?PPN=593724682

Braun, D. (2008). Organising the political coordination of knowledge and innovation policies. Science and Public Policy, 35(4), 227-239. doi:10.3152/030234208X287056

Braun, D., Benninghoff, M., Ramuz, R., & Leresche, J. (2003). Learning capacities in public-funded research systems. ().

Breznitz, D., Ornston, D., & Samford, S. (2018). Mission critical: The ends, means, and design of innovation agencies. Industrial and Corporate Change, 27(5), 883-896. doi:10.1093/icc/dty027

Center for International Affairs, Korea Institute of S&T Evaluation and Planning (KISTEP). (2016). Summary: The 2nd meeting of the global forum of national advisory councils. ().

Dados, N., & Connell, R. (2012, The global south. Contexts, , 12-13.

de la Mothe, J. (2004). The institutional governance of technology, society, and innovation. Technology in Society, 26(2), 523-536. doi:10.1016/j.techsoc.2004.01.009

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review, 48(6), 147. Retrieved from https://search.proquest.com/docview/1289882989

Drucker, P. F. (1973). Management: Tasks, responsibilities, practices. New York: Harper & Row.

Dutrénit, G., Natera, J. M., Puchet Anyul, M., Vera-Cruz, A. O., & Torres, A. (2018). Dialogue processes on STI policy-making in latin america and the caribbean: Dimensions and conditions. Science and Public Policy, 45(3), 293-308. doi:10.1093/scipol/scx044

Dutrénit, G., & Puchet, M. (2017). Tensions of science, technology and innovation policy in mexico: Analytical models, institutional evolution, national capabilities and governance. In S. Kuhlmann, & G. Ordoñez-Matamoros (Eds.), Research handbook on innovation governance for emerging economies (pp. 205-231) Edward Elgar Publishing. doi:10.4337/9781783471911.00014 Retrieved from http://www.elgaronline.com/view/9781783471904.00014.xml

Dutrénit, G., & Suárez, M. (2018). Involving stakeholders in policymaking: Tensions emerging from a public dialogue with knowledge-based entrepreneurs. Science and Public Policy, 45(3), 338-350. doi:10.1093/scipol/scx043

Edler, J., & Fagerberg, J. (2017). Innovation policy: What, why, and how. Oxford Review of Economic Policy, 33(1), 2-23. doi:10.1093/oxrep/grx001

Edquist, C. (2005). Systems of innovation, perspectives and challenges. In J. Fagerberg, D. Mowery & R. Nelson (Eds.), The oxford handbook of innovation (). New York: Oxford University Press.

Edquist, C. (2018). Towards a holistic innovation policy: Can the swedish national innovation council (NIC) be a role model? Research Policy, doi:10.1016/j.respol.2018.10.008

Escobar, B., & Valenzuela, A. (2015). Autoridades para la promoción de innovación: ¿cuán efectivos son los diferentes modelos nacionales?. Santiago, Chile: CIEPLAN.

Fagerberg, J. (2017). Innovation policy: Rationales, lessons and challenges. Journal of Economic Surveys, 31(2), 497-512. doi:10.1111/joes.12164

Flanagan, K., & Uyarra, E. (2016). Four dangers in innovation policy studies - and how to avoid them. Industry and Innovation, 23(2), 177-188. doi:10.1080/13662716.2016.1146126

Foxley, A., Saez, R. E., & Valenzuela, A. (2015). Outcome report on the first meeting of the global forum of national advisory councils on science, technology and innovation. (). Santiago, Chile:

Furman, J. L., Porter, M. E., & Stern, S. (2002). The determinants of national innovative capacity. Research Policy, 31(6), 899-933. doi:10.1016/S0048-7333(01)00152-4

Galli, R., & Teubal, M. (2006). Paradigmatic shifts in national innovation systems. In C. Edquist (Ed.), Systems of innovation, technologies, institutions and organizations () Routledge.

Ketchen, D. J., & Shook, C. L. (1996). The application of cluster analysis in strategic management research: An analysis and critique

Kuhlmann, S., & Rip, A. (2018). Next-generation innovation policy and grand challenges. Science and Public Policy, 45(4), 448-454. doi:10.1093/scipol/scy011

Lepori, B., & Reale, E. (2019). The changing governance of research systems. agencification and organizational differentiation in research funding organizations. In D. Simon, S. Kuhlmann, J. Stamm & W. Canzler (Eds.), Handbook on science and public policy (). Norhampton: Edward Elgar.

Levi-Faur, D. (2012). From "Big government" to "Big governance"? The oxford handbook of governance (pp. 3-18) Oxford University Press. doi:10.1093/oxfordhb/9780199560530.013.0001 Retrieved from http://oxfordhandbooks.com/view/10.1093/oxfordhb/9780199560530.001.0001/oxfordhb-9780199560530-e-1

Lövbrand, E., Pielke, R., & Beck, S. (2011). A democracy paradox in studies of science and technology. Science, Technology, & Human Values, 36(4), 474-496. doi:10.1177/0162243910366154

Lundvall, B. (2007). National innovation systems-analytical concept and development tool. Industry and Innovation, 14(1), 95-119. doi:10.1080/13662710601130863

Lundvall, B. (2016). National systems of innovation: Towards a theory of innovation and interactive learning. The learning economy and the economics of hope (). London: Anthem Press. Retrieved from https://www.jstor.org/stable/j.ctt1hj9zjd

Lundvall, B., & Borrás, S. (2005). Science, technology and innovation policy. In J. Fagerberg, D. Mowery & R. Nelson (Eds.), The oxford handbook of innovation (). New York: Oxford University Press.

Lynn, L. E. (2012). The many faces of governance: Adaptation? transformation? both? neither? In D. Levi-Faur (Ed.), The oxford handbook of governance (pp. 49-64) Oxford University Press. doi:10.1093/oxfordhb/9780199560530.013.0004 Retrieved from http://oxfordhandbooks.com/view/10.1093/oxfordhb/9780199560530.001.0001/oxfordhb-9780199560530-e-4

Magro, E., Navarro, M., & Zabala-Iturriagagoitia, J. M. (2014). Coordination-Mix: The hidden face of STI policy. Review of Policy Research, 31(5), 367-389. doi:10.1111/ropr.12090

Martin, B. R. (2012). The evolution of science policy and innovation studies. Research Policy, 41(7), 1219-1239. doi:10.1016/j.respol.2012.03.012

Martin, B. R. (2016). Twenty challenges for innovation studies. Science and Public Policy, 43(3), 432-450. doi:10.1093/scipol/scv077

Mazzucato, M. (2018a). Mission-oriented innovation policies: Challenges and opportunities. Industrial and Corporate Change, 27(5), 803-815. doi:10.1093/icc/dty034

Mazzucato, M. (2018b). Mission-oriented research & innovation in the european union. (). Brussels: doi:10.2777/360325

Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. The American Journal of Sociology, 83(2), 340-363. Retrieved from http://www.econis.eu/PPNSET?PPN=476614856

Morlacchi, P., & Martin, B. R. (2009). Emerging challenges for science, technology and innovation policy research: A reflexive overview. Research Policy, 38(4), 571-582. doi:10.1016/j.respol.2009.01.021

OECD. (2005). Governance of innovation systems. (). Paris: OECD.

OECD. (2007). Innovation and growth: Rationale for an innovation strategy. ().

OECD. (2009). Chile's national innovation council for competitiveness. ().

OECD. (2012). OECD science, technology and industry outlook 2012. (). FR: OECD Publishing. Retrieved from https://ebookcentral.proquest.com/lib/[SITE_ID]/detail.action?docID=1057622

OECD. (2018a). Oecd database of governance of public research policy (resgov)

OECD. (2018b). OECD science, technology and innovation outlook 2018. (). Paris: OECD Publishing. doi:10.1787/sti_in_outlook-2018-en Retrieved from http://dx.doi.org/10.1787/sti_in_outlook-2018-en

Park, Y. (1999). A taxonomy of national systems of innovation: R&D structure of OECD economies. Science and Public Policy, 26(4), 241-246. doi:10.3152/147154399781782374

Pelkonen, A. (2006). The problem of integrated innovation policy: Analyzing the governing role of the science and technology policy council of finland. Science and Public Policy, 33(9), 669-680. doi:10.3152/147154306781778623

Rivas, G., Rovira, S., & Scotto, S. (2014). Reformas a la institucionalidad de apoyo a la innovación en américa latina. Nuevas instituciones para la innovacion: Practicas y experiencias en america latina () Retrieved from https://statistical.proquest.com/statisticalinsight/result/pqpresultpage.previewtitle?docType=PQSI&titleUri=/content/2014/3230-M166.xml

Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. Research Policy, 47(9), 1554-1567. doi:10.1016/j.respol.2018.08.011

Schwaag-Serger, S., Wise, E., & Arnold, E. (2015). National research and innovation councils as an instrument of innovation governance. (). Retrieved from http://lup.lub.lu.se/record/358845c4-356c-4b46-a5a2-c6cfdfd81a5f

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. Research Policy, 42(9), 1568-1580. doi:10.1016/j.respol.2013.05.008

Stoker, G. (1998). Governance as theory: Five propositions. International Social Science Journal, 50(155), 17-28. doi:10.1111/1468-2451.00106

The World Bank. (2008). Chile: Toward a cohesive and well governed national innovation system. ().Washington, DC. Retrieved from http://hdl.handle.net/10986/28202

The World Bank. (2010). Innovation policy: A guide for developing countries. Herndon: World Bank Group. doi:10.1596/978-0-8213-8269-1 Retrieved from http://lib.myilibrary.com?ID=264535

UNCTAD. (2017). Curso de formación sobre políticas de CTI - MÓDULO 2: Formulación y evaluación de políticas de CTI.

Manuscrito 2: Structure and operation of the National Policy Councils for Science, Technology and Innovation, the cases of Chile and Spain.

El segundo manuscrito se cristaliza como resultado de la invitación de la Red de Gobernanza de la Ciencia, Tecnología e Innovación (Red GCTI) de Colombia, a participar de un libro recopilatorio de las investigaciones que fueron presentadas en el marco de su congreso internacional, desarrollado en el año 2019 en Bogotá, como se señala previamente en esta sección; presentado para su publicación en una de las principales editoriales en ciencias sociales. De esta forma, se presentó en este manuscrito el componente de la ponencia que no se contiene en el M1, pero que a la vez parece el más pertinente temáticamente a las actuales discusiones sobre el objeto de estudio, dada la deriva argumentativa generada en el Congreso.

Este documento desarrolló un proceso de selección levemente distinto al del manuscrito anterior; primero fue seleccionada la presentación al Congreso, después fue presentado el manuscrito tras recibir una invitación, este fue evaluado y modificado en función de los comentarios de los pares evaluadores, para ser posteriormente aceptado dentro del libro titulado "Governance of Science, Technology and Innovation in Latin America" (dos volúmenes) para publicación por la editorial internacional Palgrave MacMillan en su serie "Palgrave Studies in Democracy, Innovation and Entrepreneurship for Growth" (listada en Scopus). El resumen de las actividades señaladas se puede observar en la siguiente tabla:

Actividad	Fecha
Postulación de Presentación al Congreso Internacional Red GCTI	14 02 2019
Aceptación de Presentación en el Congreso Internacional Red GCTI	21 05 2019
Presentación en el Congreso Internacional Red GCTI	01 08 2019
Invitación a participar en libro recopilatorio de investigaciones	15 08 2019
Envío del capítulo a editores del libro	18 10 2019
Solicitud de modificaciones menores por contenido	03 02 2020
Envío del capítulo modificado a editores del libro	15 03 2020
Aceptación Definitiva por parte de Palgrave MacMillan	09 10 2020
Publicación	

Este manuscrito se basa en la clasificación realizada en M1 en términos de la estructura de los CNP-CTI, pero busca profundizar en la relación entre estructura y agencia de dos consejos que parecen extremos dada la distribución previamente definida en M1. Lo anterior permite establecer potenciales límites en la operación de los consejos que sean atribuibles a factores estructurales, así como potenciales semejanzas operacionales pese a las diferencias observadas en el ámbito estructural.

Structure and Operation of the National Policy Councils for Science, Technology and Innovation: the cases of Chile and Spain

Rodrigo A. CEVALLOS and Carlos MERINO MORENO

Abstract

In the past decades, National Policy Councils for Science, Technology and Innovation (STI) have been deployed worldwide to aid governments steering their efforts on STI, and therefore their countries' progress. Growing demands for social participation, representation and legitimation in the science, technology and innovation policy arenas are portraying this type of organisation as key for the definition of future paths for development. Moreover, councils have slowly gained policy and scholarly attention to achieve better coordination and enhance the strategic approach to STI. However, little evidence has supported the best fit of council for every country's governance configuration. Building on this direction, this chapter presents an exploratory and descriptive comparative qualitative case analysis of two diverse cases: the Chilean and Spanish councils. The results suggest that the higher the capacities that the council has, the harder it is to comply with its councillors' mandate and demands; and that the organisation's learning and cultural development seems to help with fitting expectations and outcomes.

Keywords: science policy, research policy, innovation policy, governance, councils

1. Introduction

Steering the efforts in science, technology and innovation has positioned itself as a widespread condition in the path for the development of countries. This intention has several complexities derived from their context, depicted by the National Innovation System (NIS) approach. The Innovation System is a system based on different sources of actors and their interactions, aimed to 'pursue innovation processes' and domains bounded either by a geographical/spatial setting, a sector, or specific activities (Edquist, 2005). These actors participate from different spheres, public and/or private sectors, commonly have different interests, and typically also divergent levels of participation in the policy domains comprised in STI. However, this approach is often confronted with the frame of *neoliberalism*, that allegedly promotes non-interventionism from the government but constraining it to the design of framework conditions (Lundvall & Borrás, 2005), encouraging a passive role of the state mainly in the western countries (Martin, 2016).

However, due to their legitimate interests, governments foster instances for the spheres to connect and interact with an agreed strategy for their countries to aim their efforts. Among the policy options for this purpose, a relevant share of OECD countries – most of them western countries, nuancing the aforementioned passive role of the state and adding complexity – has decided to deploy National Policy Councils for Science, Technology and Innovation (OECD, 2018). The councils are rated one of the most important arrangements to achieve coordination of innovation policy, and also serve as a setting for other preferred methods such as the definition of national strategies and visions (OECD, 2012). In these councils, different stakeholders summoned by a country's government gather to – at least – provide advice on the domains related to STI. The stakeholders of these domains are commonly portrayed as corporative actors (Pelkonen, 2006) referred to STI, such as universities, enterprises, and public and/or private research and/or technological institutes, among other organisations.

In the context of a scarcely studied subject such as the governance of STI (Borrás & Edler, 2014; Edler & Fagerberg, 2017), the even lower scholarly attention paid to the organisations that are aimed to drive this governance may seem accessory. However, in the highly prescriptive context of the academic field of innovation policy studies (Flanagan & Uyarra, 2016), the policy reports based on NIS analysis that policy-orientated organisations such as OECD, The World Bank and UNCTAD have increasingly performed for developed and developing countries (Chaminade et al., 2018); and at the same time confronted to the notion that the NIS approach fails in explaining how coordination is actually going to happen (Braun, 2008), further scholarly work seems critical. Moreover, in an STI landscape that increasingly requires to intertwine stakeholder participation and consensus on the future of STI – to cope and manage demanding objectives in terms of social capillarity, directionality and implementation, such as Grand Challenges (Kuhlmann & Rip, 2018), Missions (Mazzucato, 2018a; Mazzucato, 2018b) or the dimensions of Responsible Innovation (Stilgoe et al., 2013), more and better theory and evidence seems of the utmost importance in order to provide nurturing analyses and advice.

The objective of this chapter is to understand on an empirical basis the relationship between the structure defined by governments for a council and its general operation. In this process, to shed

light on a broader range of options, an exploratory and descriptive study is performed to answer the following research questions:

1) How do different models of councils shape their operation?

2) How does the structure and operation of different councils relate to their mandates?

A qualitative comparative case study analysis was performed in two councils, the Chilean National Innovation Council for Competitiveness (CNIC) and the Spanish Advisory Council for Science, Technology and Innovation (CACTI). These two countries share significant cultural and institutional features but also differ significantly in the history, design and - arguably - in the implementation and operation of their councils. The Chilean Declaration of Independence from the Kingdom of Spain was signed in 1818, but several of the Spanish-inspired institutions still function today in the Chilean institutionalisation. However, these countries have developed following different paths in the last decades. Politically, Chile has had a strong presidential regime while Spain is still a monarchy with a parliamentary system; meanwhile, regarding the economic outlook, the Chilean economic growth has been based on harsh pro-market policies from a small and open economy and in Spain liberal policies have been embraced, with a welfare approach while joining the European Union.

Due to the lack of substantial empirical evidence to address our research questions, rather than a binary response on the compliance of the councils' expected products, the basis for this analysis will be the experience of the councillors who participated in these councils. As can be understood from the above questions, the objective of this research is to assess their operation and the councillors' experiences on them, and not the performance of the councils in terms of their outputs or outcomes. This experience is relevant for both the scholarly field of governance of STI policy, specifically their organisations, and provides valuable lessons for policy implementation.

The rest of this chapter is organised as follows: section 2 frames the theoretical background of this research and showcases previous studies. Then, section 3 explains the methodology and results obtained. Finally, section 4 discusses the findings and provides some conclusions and avenues for further research.

2. Science, technology and innovation policy, governance and policy councils

The high-level governance of STI remains an understudied subject and, in a more specific context, the study of the organisations of the field of STI has not had significant scholarly attention – with exceptions like Lepori and Reale's study on research agencies (Lepori & Reale, 2019) and Breznitz et al.'s thorough work on innovation agencies (Breznitz et al., 2018). The policy domains of STI embrace different objectives; science policy aims to address mixed goals, in a wide range from the national prestige to cultural values, which includes national security, and other social and/or economic objectives; meanwhile, technology policy presents a shift from the purposes of science policy to an instrumental approach to 'national prestige and economic objectives', while innovation policy aims to address 'economic growth and international competitiveness' (Lundvall & Borrás, 2005). However, in the complexity of NISs, institutions it is broadly understood that they act as a guidepost for the actions to be developed by agents and collectives (Lundvall, 2016), and this makes them

complex social systems on their own in which networks and relationships matter (de la Mothe, 2004) . As recognised by Bengt Ake Lundvall, one of the positive impacts of the NIS consists of moving 'the attention in policy circles in charge of research, innovation and industrial development from linear to interactive thinking on innovation' (Lundvall, 2007). In this systemic context, NIS approach points towards 'the desirability of alliances and coordination among the actors within the NIS to avoid system failure – the lack of cooperation and coordination' (Schot & Steinmueller, 2018: 1559). This complexity is also a central part of the notion of NIS since it entails the interaction needed between organisations and institutions to promote innovation, and also the strategic innovation systems management that the policymakers can develop to increase their influence (Fagerberg, 2017). As has been already mentioned, National Policy Councils for Science, Technology and Innovation Policy are one of the available, and increasingly preferred, policy options to deploy by governments to meet this systemic need.

The notion of governance is used by the OECD in the STI field to stress its relationship with coordination, and how the latter is commonly accountable for a substantial share of the failures on the former concept (OECD, 2012). The complexity of STI policy domains and the role of policy councils in their governance were empirically diagnosed in the early 2000s by the MONIT project developed by the OECD, mainly as a negotiation arena between actors, having high expectations on the strategic process but lower aspirations regarding the implementation of innovation policies in a horizontal level (OECD, 2005a). More specifically, councils are defined by Galli and Teubal as part of the organisations of NIS, along with ministries, bureaucratic bodies, regulatory bodies, social bodies, educational bodies, among others; highlighting their role in soft functions such as policy-making (Galli & Teubal, 2005), and are commonly suggested to achieve 'more coordination in innovation policy' (Edler & Fagerberg, 2017) and 'more effective innovation governance' (Foxley et al., 2015). Following the analogy of Kuhlmann et al. (Kuhlmann et al., 2010), the three dancers of innovation policy have in the STI councils a ballroom to compose the melodies for their future dances. Building from these notions, previous studies have defined the councils as could be seen in Table 1. For this research, features from both definitions will be considered, since the first definition explicitly considers the involvement of experts and stakeholders and the second graphically frames their policy domains; both characteristics are essential for the working definition.

Table 5. Definitions of councils in the literature

VINNOVA 2015	OECD 2018
National councils for innovation or for science, technology and innovation are non-temporary bodies composed of experts or high-level stakeholders (or a combination of both), explicitly (e.g. by law) tasked by the government with doing one or several of the following: a) producing reports b) overseeing policy evaluation c) giving advice d) coordinating policy areas e) driving change f) making policy decisions (sometimes including decisions regarding budget allocations).	**Research and Innovation Council**, i.e., a non-temporary public body that takes decisions concerning Higher Education Institutions (HEI) and Public Research Institutions (PRI) policy, that has been explicitly mandated by law or statutes to do one or several of the following: a) providing policy advice b) overseeing policy evaluation c) coordinating policy areas relevant to public research (e.g. across ministries and agencies) d) setting policy priorities (i.e. strategy development, policy guidelines) e) joint policy planning (e.g. joint cross-ministry preparation of budgetary allocations)

Source: Authors, based on VINNOVA (Schwaag-Serger *et al.*, 2015) and OECD (Borowiecki & Paunov, 2018) reports.

STI policy councils could be illustrated as the nervous system of STI policy. The executive capacity resembles the central nervous system by having the chance to analyse and give strategic foresight and then to make things happen. On the other hand, the coordinative capacity shares some properties with the peripheral nervous system, having nerves and nerve fibres, by being sensitive to what is happening in the environment, communicating them to the rest of the system, and gathering resources that will trigger efforts and other systems' responses. Following the same idea, part of the coordinative capacity of gathering actors and resources will happen involuntarily as an autonomic nervous system response, and others will need voluntary efforts as a parallel to the somatic nervous system. As the OECD data states, the transversal evidence for innovation policy coordination stresses the role of the councils into strategic and coordination tasks. This mandate is related to the characteristics of the councils as a proxy of society and an intertemporal consensus device, and this involvement of the society complies with several, if not all, of the features for inclusive development highlighted by Dutrénit and Sutz (Dutrénit & Sutz, 2014). However, not all systems – even those having the same organs – integrate these capacities and operate in the same way. The previous analogy helps to understand the role of the councils on the types of coordination highlighted by Braun , the 'functional/policy coordination' in the context of a consensual agenda and strategy, and the 'administrative coordination' to put the pieces of machinery into action

(Braun, 2008); but it in this case with a span that goes beyond the government boundaries and reach.

The differentiation of these organisations, as suggested above, into their structure and operation is critical due to analytical reasons. The structure of an organisation could be easily copied to be implemented in another country or setting. However, the operation embraces difficulties that are not simple to monitor regarding cultural and idiosyncratic factors among locations. In this scenario, the structure could be understood as a blueprint for an organisation, but the daily operation is what constitutes its performance. Following this idea, comparative studies mainly based on the structure of different STI councils, have been developed by international organisations, e.g., OECD, national agencies – on its own or commanded to international organisations or consultancy companies – or practitioners and scholars of the field (Borowiecki & Paunov, 2018; Escobar & Valenzuela, 2015; OECD, 2009; Schwaag-Serger et al., 2015). These analyses on the structures highlight some features such as the floating role of the councils within different governments (closer to the presidency, or to the ministries levels, or even lower in the hierarchy), the different styles regarding the composition of the councils, the abysmal differences in the resources devoted for them, among other relevant characteristics. Regarding the operation of the councils, besides some of the sources mentioned above, two in-depth research cases have been developed based on the experience of Sweden and Finland councils' activity (Edquist, 2018; Pelkonen, 2006). Further details on the councils considered in this research will be discussed in the following subsections.

National Innovation Council for Competitiveness (CNIC)

By the year 2005, Chile was a thriving small open economy that was concerned about its future competitiveness. President Lagos commanded a commission with the mandate of devising a council for STI in the last semester of his term. The resultant organisation was named National Innovation Council for Competitiveness (CNIC), this council was heavily based in the now replaced Science and Technology Policy Council of Finland (STPC) and gathered personalities from different backgrounds. The OECD stressed that long-term growth forecasts for Chile seemed nuanced by a low R&D investment – more dramatically by an exiguous business investment in R&D – and a fragmented NIS, while being hopeful that the newly devised National Innovation Council can contribute to coordinating policies and actors (OECD, 2005b). CNIC's establishment was considered the 'most important institutional innovation in 30 years' (Benavente et al., 2016), its operation lasted for almost fifteen years – including a slight variation to National Innovation Council for Development (CNID) since the year 2014 – and through four presidential mandates of different coalitions that have mandated the Council by decree . In the year 2020, the Council will give room to a new council in the context of a reorganisation of the public Chilean STI institutionalisation.

Advisory Council for Science, Technology and Innovation (CACTI)

The Spanish Law for Science, Technology and Innovation of the year 2011 consolidated a second phase of the Spanish development in Science, Technology and Innovation. As highlighted by Cueto (Cueto Pérez, 2012), the law recognises the development of capacities of the autonomic communities, the full integration of Spain to the European Union , the need for a new framework for the science system, the growth in the scientific community, and the necessity of new ways to

promote economic growth. The law crystallised the position of the Council, with the possibility to intervene in the strategic process of STI and act as a bridge for the society to influence these policy domains (Díez Bueso, 2013). In this context, CACTI acts as a successor of a previous government body in charge of advising on the fostering of science and technology, Advisory Council for Science and Technology (CACT), now including the involvement of the dimension of fostering innovation. CACT was a massive council, with thirty-five councillors, around one-third of them from the government and two-thirds from the rest of society. The new Council has had two periods in operation until the year 2019, which mostly coincides with two governmental conformations.

3. Methodology and results

3.1 Research Methodology

As previously introduced, this research considers research cases chosen following the polar cases sampling method – two-tailed for Yin (Yin, 2003) and diverse for Seawright and Gerring (Seawright & Gerring, 2008), which allows the researcher to 'observe contrasting patterns in the data' leading to 'very clear pattern recognition of the central constructs, relationships, and logic of the focal phenomenon' (Eisenhardt & Graebner, 2007). For this purpose, and based on the criteria developed in previous research (Cevallos & Merino, forthcoming), the cases of the Chilean and Spanish Council were selected. These councils belong to different clusters in the forenamed study (the Chilean is rated as a strong council –iNPC=10 – with transformative potential, and the Spanish an agile council – iNPC=4 – with consultant potential), but also due to historical reasons considering that these countries share some institutional and cultural settings. However, for this research a different Spanish council from the predominantly used on the RESGOV database will be considered, the Advisory Council for Science, Technology and Innovation (CACTI) due to a better alignment with the policy domains of STI than those discussed in the OECD study. After reviewing the legal conformation of this council's structure, it sheds light that could also be identified as an agile council (iNPC=4). Therefore, the parallel of the structural characteristics of the councils is summarised in Table 2 and deepening in the coordinative capacity in Table 3. Both tables lead to a significant differentiation in the structures of these councils.

Table 6. Comparison of the councils' structure

Chilean Council of Innovation for Development (CNIC)				
Executive Capacity	**Council's Role**	Joint Planning	Coordination	Advice
	Executive's Role	Involvement of the Top Level	Involvement of the Ministries Level	Involvement of the Upper Management Level
Coordinative Capacity	**Composition**	Government Officials	Outstanding Personalities	Representatives of Society (Stakeholders)
	Resources	Funding for external capacities	Funding for internal capacities	Funding for logistics

Spanish Advisory Council for Science, Technology and Innovation (CACTI)				
Executive Capacity	**Council's Role**	Joint Planning	Coordination	Advice
	Executive's Role	Involvement of the Top Level	Involvement of the Ministries Level	Involvement of the Upper Management Level
Coordinative Capacity	**Composition**	Government Officials	Outstanding Personalities	Representatives of Society (Stakeholders)
	Resources	Funding for external capacities	Funding for internal capacities	Funding for logistics

Source: Authors

Table 7. Comparison of the councils' features of coordinative capacity

Composition	CNID (CHILE)	CACTI (SPAIN)
Government Officials	4 councillors Ministers of Finance, Economy, Education, and Agriculture, or their representatives.	Nil
Outstanding Personalities	14 councillors One of them is appointed president of the council by the government with partial dedication.	10 councillors One of them is elected president of the council by the councillors.
Representatives of Society (Stakeholders)	2 councillors One vice-president for research from the universities and one expert in vocational training from the professional institutes, both in consultation with the Ministry of Economy.	4 councillors Two representatives of the central business confederations and two of the main unions.
Guests	3 councillors The chairpersons of the agencies for research, for innovation, and the Innovation Division of the Ministry of Economics.	Nil
TOTAL	23 councillors	14 councillors
Resources	Funding for institutionalisation, studies and logistics provided by an exclusive secretariat and budget.	Funding for logistics provided by a ministerial office.

Source: Authors, based on Chilean and Spanish normative frameworks as of year 2019.

Data Collection and Analysis

The methodology followed in this research for data collection consisted of interviews conducted in Santiago (Chile) and Madrid (Spain) , with current and former councillors, authorities, and staff of the councils between August 2018 and August 2019. The interviews were semi-structured, addressing topics such as: nomination process, dedication to the council, operation of the council, council's strengths and weaknesses, resources, relations with other governmental bodies, among other topics. The interviews were digitally recorded, and anonymity was guaranteed for the interviewee unless special arrangements were made for publicity, e.g., former President of the Republic of Chile, Mr. Ricardo Lagos Escobar. Regarding the councillors, ten from CNIC and five from CACTI were interviewed. The councillors' interviews were analysed following the structure already mentioned, and quotes of these interviews are displayed for every dimension to complement the analysis. The reason to focus on the testimonies of the councillors is twofold: firstly, they are in the best position regarding the councils since they know the reality of their operation, and secondly, they are also embedded in communities that are related to the decisions and discussions regarding the councils' outputs and outcomes.

3.2 Results

From the methodology above, the following results emerge. These results are structured following the same dimensions of analysis used for the councils.

3.2.1 Policy Domain

For both cases, even when the policy domain of innovation is within the scope of the councils, it remains the most unattainable of the subjects. The councillors discourses reflect that the council is prone to the discussion of the issues in the domains of science and technology, but innovation remains auxiliary; most of the time supposing that innovation processes will happen spontaneously by the operation and interests of the companies. Therefore, while the councils do their best for the action on the policy domain of innovation, some councillors recognise that it is a forced task.

'From my perspective, it is a mistake to mix science, technology and innovation. For a fundamental reason: innovation is made by companies, so the audiences are different (…), and if you go deep into this, the timings are different (…), the financing is different (…). The only thing that binds innovation with science and technology is that they are sources of progress, innovation mainly economic progress and science and technology progress in knowledge and to provide innovation with everything that needs. Therefore it seems to be an error that dates back to the year 1996'. Spanish Councillor N°4

3.2.2 Executive Capacity

The observed evidence points towards unmatched expectations along with higher inputs of executive capacities. Thus, even when the Chilean case seemed better aligned due to its structural definition, the operation of this design did not match the expectations of its mandate. On the other hand, the Spanish case seems less concerned about the operation of the council regarding their executive capacity, since their limits and mandate are not often challenged.

Council's Role

Regarding the role played by the councils, the experiences that emerged from the councillors' testimonies suggest that their operation either matched or failed to comply with their expectations. For the case with higher structural inputs, Chilean CNIC, concepts like 'missed opportunity' arise, often linked with a diagnosis of deficiencies in the definition of 'rituals' regarding the operation of the council. CACTI's experience is less criticised, in a context of lower expectations from the councillors given the mandate of the Law.

'…A problem at this time is that the Council does not act on its initiative, it acts on demand of the recommendations that the Government asks it to issue to evaluate or to accommodate its policies, and also according to the demands of information requested by the Council (of Science, Technology and Innovation Policy) '. Spanish Councillor N°3

Executive's Role

The role exercised by the executive is again par or below expectations. For the Chilean case, the function of the ministries is assessed as shallow, even declining to participate in many of the meetings and giving representation of the ministers to third parties; and for the agencies – acknowledged their different role in the council – an excess of independence. For the Spanish side, this was the lowest feature regarding the structural inputs, so was not an issue of concern. An unexpected element in the analysis was the role of the president of the council, who in both cases seemed to have a critical role in connecting the operation of the council with the governmental authorities. In the Chilean case, the president has an essential role in the agenda-setting process for the council, between the council and its secretariat, and with the governmental authorities, while in the Spanish council has a role of communication with the government primarily.

'…In the original design there were going to be meetings with the President of the Republic, and also a Council of Ministers that had to coordinate. It never worked, so the problem was that this (council, CNIC) has a certain role regarding the fostering of public deliberation, but the formal channel to the execution was lost (…) all of this should go into enhancing the alignment, but that alignment only works if there is political will'. Chilean Councillor N°3

3.2.3 Coordinative Capacity

The testimonies gathered suggest that this dimension complies in its operation with the original design, independently of the levels that every council has. The composition is regarded as a critical axis of the work of the council while having the appropriate support in resources is also a growing expectation to achieve higher levels of performance.

Composition

The composition of the councils is commonly assessed as positive in regard to embracing the diversity of actors in the discussion for the future of STI policy for each country. However, some harsh judgements regarding the interests of the actors could be observed from the least to the most traditional communities (because of their organisation or resources) e.g. innovators and entrepreneurs to the science community. However, it did not seem that the explicit representation was an issue, but rather the background of the councillors. The capacity in which the councillors

were nominated, on an individual nomination or as representative of a collective, did not emerge as a negative issue but rather as a specific input of information that nurtured the discussions of the councils. Moreover, even when the Spanish council did not consider government officials in their composition, it was highlighted that a position not considered in the law, a Deputy Director of the Ministry of Industries, acted as a secretary of the council and a facilitator with the government that surpassed preconceptions, obtaining higher involvement from the authorities in time.

'The strength of the Council is that the members of the councils (…) are prominent members of the research, business development and innovation communities. Let's say that they are proven people with a curriculum that is powerful enough and well known enough for their opinions to be weighted opinions, that is why it is an advisory council, in such a way that we say that has the authority in the sense that they know what they are discussing. It is evident and recognized that all have a broad background in research, development and innovation'. Spanish Councillor N°1

Resources

Despite the configuration of the support given by the governments to their councils, there is an urgent need regarding the relationship with the resources for supporting their work. Ranging from a secretariat to a think-tank in Chile or from logistic support to at least a small dedicated office in Spain; in both cases having a higher level of independence is highlighted as a feature to achieve higher levels of performance.

'I think that the Council without the Secretariat is worthless; it does not work. There has to be a technical team to do the routine work, elaborate information, nurture the Council (…) There has to be people with a profile related to mid to long-term strategical thinking, which is the role of an Innovation Council, and I believe that there are currently people with that profile and high-level, but not all of them, not all of them'. Chilean Councillor N°10

Summary

Following the structure of the research, the executive capacity of the councils seems to have greater room to improve than the coordinative capacity, enhancing the expected role of the councils. From a longitudinal perspective, the experiences of the councillors suggest the internal policy learning process of the organisations. In the Chilean case, due mainly to political reasons within the government, the discussion shifted from an orientation regarding the STI budget as the centre for the debate, to the future challenges and the society's involvement on these; and on the Spanish side, it moved from a council that was only considered to be informed about the governmental decisions on STI policy to a more active role in the discussion of these subjects. According to the testimonies gathered, these shifts had to do with the change of governments – in the Chilean experience also with the leadership styles of the council's presidencies – and the active role of the council to enhance their participation. However, the overall strategic capacity of the councils seems nuanced in the long run, either by design – low executive capacity as in Spain – or operation – low long-term binding through presidential terms as in Chile – and despite the contextual characteristics of the political regimes of Chile and Spain.

'The rules of the game – the responsibilities and attributions that we have as councillors – the responsibilities, obligations, rituals that the Council itself has of what it should be, and has to do, and how the conversations are organized, and the commitments are generated, and the distillates of that work, I think they are still in a very arbitrary field (…) Over time, that 'high expectations', that we were going to generate a series of critical strategic guidelines, was acquiring a certain color and smell of disenchantment'. Chilean Councillor N°5

Despite this particular comparison of cases, further research seems needed to understand the real implications of the councils, and whether they are conceived as a means or as an end by the governments, with the broader view of the potential decoupling between our original argumentation regarding their restricted or entrepreneurial role and their relationship with the overall economic model of the countries.

4. Conclusions and discussion

'One size does not fit all' seems the new mantra when discussing science, technology and innovation policy and the results of this research are on the same track. From the research design it was expected to devise the differences between the two models of councils presented. For the evidence gathered in this research, it is confirmed that there is significant heterogeneity not only in the structure but also in the operation of the councils due to their official and even to their unofficial and social characteristics. These considerations should be borne in mind by scholars and policy advisers while acting prescriptively. However, some commonalities also emerge, specifically regarding the policy domain of focus of the council and its approach, the need for an upgrade of resources, the intertemporal approach, and the high esteem on the composition of the councils, among others.

For the discussion about the policy domain, the gathered evidence suggests that this definition requires more advanced levels of policy learning, since a relevant share of the councillors appears more comfortable with the discussions based on the domains of science and technology, while the policy domain of innovation is still harder to grasp. This idea shares some commonalities with the observation of Edquist, in which an innovation council should be separate from a science and technology council, since these are policy domains with different communities and aims (Edquist, 2018). This process may be connected with the concept of bounded rationalities suggested by Kuhlmann et al. (Kuhlmann et al., 2010), experiences that could be enhanced by the fostering of actors' evolutionary paths (Dutrénit, et al., 2018) which at least in this evidence seems to be useful.

Regarding the existence of relevant shifts within councils for every government change - defined as dynamic inconsistency - still poses a challenge for long-term strategies that have not been significantly nuanced by the existing mechanisms - e.g. maintaining a policy of staggered renovation of councillors for every CNIC's term (CNIC, 2007) - but leaving space for a long-term coordination by commitment and trust (Nooteboom, 2000). From the last two points, the issue of independence emerges as one of the findings of this work. Apparently, there is a transversal will of the councils of having more independence from the current government in defining their products and outcomes,

and also that these agreements can ensure their intertemporal autonomy and have the chance to be honoured despite the political shifts.

Nevertheless, essential differences could also be highlighted. As it can be distilled from the forecited work of Braun, it is easier for a government to comply with material considerations, mostly represented in the coordinative capacity in terms of resources and composition, than to resign to the exercise of their power and will as the executive capacity requires. This phenomenon is aligned with the founded evidence regarding greater gaps in operation with greater structural capacities, and the lower achievement obtained from the executive capacity in comparison with the coordinative capacity for the studied subjects. Moreover, the coordination tasks –that due to the defined structure were evident in the Chilean case and less clear in the Spanish case – seemed more straightforward to handle with the rest of the societal actors than within the government, either between different ministries or most notably from the council to the agencies. As expected, the capacity of the councils to address their coordination and strategic challenges is nuanced either explicitly by their design – structure – or implicitly by their implementation – operation.

The evidence and analysis collected for this research opens several avenues for future work. For instance, each studied dimension revealed a rich set of information that could lead to relevant findings, for the underpinning theory and the implementation of public policy: e.g. the boundaries of the action of the councils (the specifics of their field of activity), the relationship of independence or dependence with the government, a more general theory for councils definition, among others. Specifically relevant due to their policy implications is the need to make explicit the mechanisms and tasks commanded to the councils and its president, to serve as a guide but also to manage expectations regarding the council's outcomes and outputs.

5. References

Benavente, J. M., Bravo, C., Goya, D., & Zahler, A. (2016). Collaboration in clusters and technology consortia: The case of Chile. In E. Fernández Arias, C. F. Sabel, E. H. Stein & A. Trejos (Eds.), Two to tango: Public-private collaboration for productive development policies (pp. 189-236). Washington, DC: Inter-American Development Bank (IDB).

Benavente, J. M., & Price, J. J. (2014). Evolution of the public institutions of science, technology, and innovation in chile. In G. Crespi, & G. Dutrénit (Eds.), Science, technology and innovation policies for development (pp. 45-62) Springer. Retrieved from http://www.econis.eu/PPNSET?PPN=884371069

Borowiecki, M., & Paunov, C. (2018). How is research policy across the OECD organised? ().OECD Publishing. doi:10.1787/235c9806-en Retrieved from http://dx.doi.org/10.1787/235c9806-en

Borrás, S. (2012). Three tensions in the governance of science and technology. In D. Levi-Faur (Ed.), The oxford handbook of governance (pp. 429-440) Oxford University Press. doi:10.1093/oxfordhb/9780199560530.013.0030 Retrieved from http://oxfordhandbooks.com/view/10.1093/oxfordhb/9780199560530.001.0001/oxfordhb-9780199560530-e-30

Borrás, S., & Edler, J. (2014). Introduction: On governance, systems and change. In S. Borrás, & J. Edler (Eds.), The governance of socio-technical systems: Explaining change (pp. 1-22) Edward Elgar Publishing. doi:10.4337/9781784710194.00010 Retrieved from http://www.elgaronline.com/view/9781784710187.00010.xml

Boston, J. (1992). Country report : The problems of policy coordination : The new zealand experience. Governance, 5(1), 88-103. Retrieved from https://natlib-primo.hosted.exlibrisgroup.com/primo-explore/search?query=any,contains,991360503602837&tab=innz&search_scope=INNZ&vid=NLNZ&offset=0

Braun, D. (2008). Organising the political coordination of knowledge and innovation policies. Science and Public Policy, 35(4), 227-239. doi:10.3152/030234208X287056

Braun, D., & Guston, D. H. (2003). Principal-agent theory and research policy: An introduction. Science and Public Policy, 30(5), 302-308. doi:10.3152/147154303781780290

Breznitz, D., Ornston, D., & Samford, S. (2018). Mission critical: The ends, means, and design of innovation agencies. Industrial and Corporate Change, 27(5), 883-896. doi:10.1093/icc/dty027

Chaminade, C., Lundvall, B., & Haneef, S. (2018). Advanced introduction to national innovation systems Retrieved from http://lup.lub.lu.se/record/ee76fc4a-c7e8-4638-8f3d-0e1d2ec5746f

CNIC. (2007). Hacia una estrategia nacional de innovación, volumen 1. (). Santiago de Chile:

CNID. (2017). Ciencias, tecnologías e innovación para un nuevo pacto de desarrollo sostenible e inclusivo. (). Retrieved from http://www.cnid.cl/wp-content/uploads/2017/05/CTI-para-un-nuevo-pacto-de-desarrollo-CNID-2a-edicion.pdf

Cueto Pérez, M. (2012). Incidencia de la nueva ley de la ciencia en el régimen jurídico de las universidades. Revista de Administración Pública, núm 187. Madrid: CEPC - Centro de Estudios Políticos y Constitucionales. Retrieved from https://ebookcentral.proquest.com/lib/[SITE_ID]/detail.action?docID=3222780

de la Mothe, J. (2004). The institutional governance of technology, society, and innovation. Technology in Society, 26(2), 523-536. doi:10.1016/j.techsoc.2004.01.009

Díez Bueso, L. (2013). La gobernanza del sistema español de ciencia, tecnología e innovación. Revista De Bioética Y Derecho, (28), 20-32. doi:10.4321/S1886-58872013000200003

Dutrénit, G., Natera, J. M., Puchet Anyul, M., Vera-Cruz, A. O., & Torres, A. (2018). Dialogue processes on STI policy-making in latin america and the caribbean: Dimensions and conditions. Science and Public Policy, 45(3), 293-308. doi:10.1093/scipol/scx044

Edler, J., & Fagerberg, J. (2017). Innovation policy: What, why, and how. Oxford Review of Economic Policy, 33(1), 2-23. doi:10.1093/oxrep/grx001

Edquist, C. (2005). Systems of innovation, perspectives and challenges. In J. Fagerberg, D. Mowery & R. Nelson (Eds.), The Oxford handbook of innovation (). New York: Oxford University Press.

Edquist, C. (2018). Towards a holistic innovation policy: Can the swedish national innovation council (NIC) be a role model? Research Policy, doi:10.1016/j.respol.2018.10.008

Edquist, C., & Johnson, B. (2015). Institutions and organizations in systems of innovation. In C. Edquist (Ed.), Systems of innovation; technologies, institutions and organizations (pp. 41-63)

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. Academy of Management Journal, 50(1), 25-32. doi:10.5465/amj.2007.24160888

Escobar, B., & Valenzuela, A. (2015). Autoridades para la promoción de innovación: ¿cuán efectivos son los diferentes modelos nacionales?. Santiago, Chile: CIEPLAN.

Fagerberg, J. (2017). Innovation policy: Rationales, lessons and challenges. Journal of Economic Surveys, 31(2), 497-512. doi:10.1111/joes.12164

Flanagan, K., & Uyarra, E. (2016). Four dangers in innovation policy studies - and how to avoid them. Industry and Innovation, 23(2), 177-188. doi:10.1080/13662716.2016.1146126

Foxley, A., Saez, R. E., & Valenzuela, A. (2015). Outcome report on the first meeting of the global forum of national advisory councils on science, technology and innovation. (). Santiago, Chile:

Galli, R., & Teubal, M. (2005). Paradigm shifts in national innovation systems. In C. Edquist (Ed.), Systems of innovation; technologies, institutions and organizations (pp. 342-370)

Jefatura del Estado. Ley 14/2011, de 1 de junio, de la ciencia, la tecnología y la innovación, (2011).

Kuhlmann, S., & Rip, A. (2018). Next-generation innovation policy and grand challenges. Science and Public Policy, 45(4), 448-454. doi:10.1093/scipol/scy011

Kuhlmann, S., Shapira, P., & Smits, R. (2010). Introduction. A systemic perspective: The innovation policy dance. In R. Smits, S. Kuhlmann & P. Shapira (Eds.), Theory and practice of innovation policy (). Cheltenham, UK ; Northhampton, MA, USA: Edward Elgar.

Lundvall, B. (2007). National innovation systems-analytical concept and development tool. Industry and Innovation, 14(1), 95-119. doi:10.1080/13662710601130863

Lundvall, B. (2016). National systems of innovation: Towards a theory of innovation and interactive learning. In B. Lundvall (Ed.), The learning economy and the economics of hope () Anthem Press. Retrieved from http://www.jstor.org/stable/j.ctt1hj9zjd.9

Lundvall, B., & Borrás, S. (2005). Science, technology and innovation policy. In J. Fagerberg, D. Mowery & R. Nelson (Eds.), The oxford handbook of innovation (). New York: Oxford University Press.

Magro, E., Navarro, M., & Zabala-Iturriagagoitia, J. M. (2014). Coordination-Mix: The hidden face of STI policy. Review of Policy Research, 31(5), 367-389. doi:10.1111/ropr.12090

Mazzucato, M. (2018a). Mission-oriented innovation policies: Challenges and opportunities. Industrial and Corporate Change, 27(5), 803-815. doi:10.1093/icc/dty034

Mazzucato, M. (2018b). Mission-oriented research & innovation in the European Union. (). Brussels: doi:10.2777/360325

Ministerio de Hacienda de la República de Chile. Decreto N°1408 : CREA COMISION ASESORA PRESIDENCIAL CONSEJO DE INNOVACION PARA LA COMPETITIVIDAD, (2005). Retrieved from https://www.leychile.cl/Navegar?idNorma=245508&tipoVersion=0

Nooteboom, B. (2000). Institutions and forms of co-ordination in innovation systems. Organization Studies, 21(5), 915-939. doi:10.1177/0170840600215004

North, D. C. (1994). Economic performance through time. The American Economic Review, 84(3), 359-368. Retrieved from http://www.econis.eu/PPNSET?PPN=260449245

OECD. (2005a). Governance of innovation systems. volume 1. synthesis report. Paris and washington, D.C.: Author, 2005, pp. 117 (pp. 117)

OECD. (2005b). OECD economic surveys: Chile 2005. (). Paris: Paris: OECD Publishing. doi:10.1787/eco_surveys-chl-2005-en

OECD. (2009). Chile's national innovation council for competitiveness. ().

OECD. (2012). OECD science, technology and industry outlook 2012. (). FR: OECD Publishing. Retrieved from https://ebookcentral.proquest.com/lib/[SITE_ID]/detail.action?docID=1057622

OECD. (2018). OECD science, technology and innovation outlook 2018. (). Paris: OECD Publishing. doi:10.1787/sti_in_outlook-2018-en Retrieved from http://dx.doi.org/10.1787/sti_in_outlook-2018-en

Painter, M. (1981). Central agencies and the coordination principle. Australian Journal of Public Administration, 40(4), 265. Retrieved from https://search.proquest.com/docview/1309392610

Pelkonen, A. (2006). The problem of integrated innovation policy: Analyzing the governing role of the science and technology policy council of Finland. Science and Public Policy, 33(9), 669-680. doi:10.3152/147154306781778623

Peters, G. Concepts and theories of horizontal policy management. Paper presented at the X Congreso Internacional Del CLAD Sobre La Reforma Del Estado Y De La Administración Publica,

Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. Research Policy, 47(9), 1554-1567. doi:10.1016/j.respol.2018.08.011

Schwaag-Serger, S., Wise, E., & Arnold, E. (2015). National research and innovation councils as an instrument of innovation governance. (). Retrieved from http://lup.lub.lu.se/record/358845c4-356c-4b46-a5a2-c6cfdfd81a5f

Seawright, J., & Gerring, J. (2008). Case selection techniques in case study research: A menu of qualitative and quantitative options. Political Research Quarterly, 61(2), 294-308. doi:10.1177/1065912907313077

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. Research Policy, 42(9), 1568-1580. doi:10.1016/j.respol.2013.05.008

Yin, R. K. (2003). Case study research: Design and methods. Beverly Hills etc.: Beverly Hills etc. Sage Publications.

Annex 1. Information about the interviewed councillors

Councillor	Council	Country	Date and Place of Interview
Councillor N°1	CNIC	Chile	07 Aug 2018; Santiago, Chile
Councillor N°2	CNIC	Chile	13 Aug 2018; Santiago, Chile
Councillor N°3	CNIC	Chile	17 Aug 2018; Santiago, Chile
Councillor N°4	CNIC	Chile	21 Aug 2018; Santiago, Chile
Councillor N°5	CNIC	Chile	22 Aug 2018; Santiago, Chile
Councillor N°6	CNIC	Chile	21 Dec 2018; Santiago, Chile
Councillor N°7	CNIC	Chile	26 Dec 2018; Santiago, Chile
Councillor N°8	CNIC	Chile	26 Dec 2018; Santiago, Chile
Councillor N°9	CNIC	Chile	27 Dec 2018; Santiago, Chile
Councillor N°10	CNIC	Chile	05 Jul 2019; Santiago, Chile
Councillor N°1	CACTI	Spain	10 Oct 2018; Madrid, Spain
Councillor N°2	CACTI	Spain	26 Feb 2019; Madrid, Spain
Councillor N°3	CACTI	Spain	15 Mar 2019; Madrid, Spain
Councillor N°4	CACTI	Spain	08 Apr 2019; Madrid, Spain
Councillor N°5	CACTI	Spain	24 Apr 2019; Madrid, Spain

Annex 2. Practical advice for the design and implementation of a national policy council for science, technology and innovation

1. Define a clear focus of activity for the council in order to address its domain effectively.

2. Define explicitly and in advance, the processes, functions, outputs and outcomes expected from the council and its councillors.

3. Define explicitly and in advance, the processes of communication between the council and the government.

4. Define explicitly and in advance, the processes that the government will follow to evaluate and eventually implement the proposals of the council.

5. Define explicitly and in advance, the scope of action of the council, in terms of its boundaries in interacting with other organisations.

6. Provide the council with the independence needed in order to be isolated from a potential influx of interests, especially from the government.

7. Provide the council with the appropriate resources to match the outcomes and outputs expected, specifically human resources and information.

8. Designate a president for the council with proven social and political skills and technical knowledge.

9. Designate councillors with various backgrounds, ideally with experience in different activities related to the purpose of the council, and in a manageable number.

10. Schedule activities and delivery dates for the outputs of the council well in advance, considering the best timing for these outputs to be evaluated and eventually implemented; while the meetings should be informative, reflexive and executive.

Manuscrito 3: Implementing Directionality in Research and Innovation, a tale of two councils and strategies.

Este tercer manuscrito se origina en la necesidad de dar una versión más específica de la gestión y operación de los CNP-CTI, en una temática de alto interés actual, el desarrollo de estrategias específicas de ciencia, tecnología e innovación. Este manuscrito fue postulado como un resumen extendido al Primer Congreso ESOCITE-LALICS[4], el que como resultado de la pandemia de la enfermedad COVID-19 fue suspendido sin fecha determinada de realización. Sin perjuicio de lo anterior, M3 continuó un proceso estándar de publicación, el que se puede resumir en el siguiente registro (se ha mantenido en este proceso por más de seis meses):

Actividad	Fecha
Envío a Technological Forecast and Social Change	16 08 2020

Este documento se basa tanto en la clasificación previamente realizada en M1 respecto a la estructura de los CNP-CTI, como en la profundización de M2 sobre la relación entre estructura y agencia de dos consejos extremos de acuerdo a la distribución previamente definida en M1; para ilustrar las opciones de implementación resultantes de las interacciones entre estructuras y operación para la definición de estrategias específicas de CTI.

[4] Capítulo de la región latinoamericana de la asociación Globelics.

Implementing Directionality in Research and Innovation, a tale of two councils and strategies.

Rodrigo A. CEVALLOS, Doctoral Researcher, Faculty of Economics and Management, Universidad Autónoma de Madrid, Madrid 28049, Spain, rodrigo.c@estudiante.uam.es

Carlos MERINO MORENO , Professor, Faculty of Economics and Management, Universidad Autónoma de Madrid, Madrid 28049, Spain, carlos.merino@uam.es

*Calle Francisco Tomás y Valiente, 5, Módulo 8, Despacho 12, Madrid 28049, Spain.

Abstract

The normative turn of science, technology and innovation policy, in the context of the rise of the transformative change framework, has positioned the issue of directionality as a widespread discussion for every government's debate about their science, technology and innovation strategy. However, despite this interest, little research has been done on how governments operatively face these discussions in the different levels of implementation. To contribute in addressing this gap, this research showcases the experience of two extreme case studies of National Policy Council for Science, Technology and Innovation, and their role in developing specific strategies, specifically in their selection and design processes; to describe the processes related to directionality and the relation with the policy options derived from their definitions and their relationships with the academic literature. The collected evidence suggests the relevance of both the councils' mandate and resources to comply with their expected role. Moreover, some evidence points towards the relationship between councils and councillors towards directionality as an issue that deserves more scholarly attention.

Keywords: Directionality; STI strategy; National Policy Councils; Innovation Policy; Research Policy.

1. Introduction

Organizations commonly aim to fulfill long term objectives through the definition of strategies, sticking to the path defined on it, and after a few years, assessing their advances and refreshing them. These strategies are a customary step in the definitions for positioning of medium to large companies and non-governmental organizations. However, experiences with different outcomes have shown us that – for many reasons, ranging from ideological to practical – it is not evident that countries and their successive governments should have and follow a strategy for their development. However, one of the fields emerging more clearly in the past century to be steered by a strategy was industrial policy (Borrás & Edquist, 2019). According to Andreoni and Chang, this domain has seen a revival in the past decades and is currently mainstreaming, reaching its fourth wave (Andreoni & Chang, 2019). In this context, the directionality – understood in this field as the ability to identify strategically oriented areas of opportunity for progress, while positioning, devising and acting in their achievement – of the innovation systems seems to emerge as part of the third wave of industrial policy, which highlights as new characteristics the relevance of internal competition and cooperation, the institutions for the implementation of policies, and the learning processes for producers (Andreoni & Chang, 2019).

Nowadays, the discussion on directionality has been joined by the positions on the domains of Science, Technology and Innovation (STI) Policy; however, when thinking about these three ideal types of policy domains, the definitions have not affected them necessarily in the same proportion. Science policy has demonstrated a mostly neutral approach regarding specific areas or sectors, as it can be distilled from the work of Lundvall and Borrás, technology policy has experienced a highly directed basis, and finally, innovation policy had shared different realities between countries and times (Lundvall & Borrás, 2005). These definitions put a new burden on the capacity of governments to call for a broad exercise of governance to enhance their strategic, inspiring and coordination roles (Boon & Edler, 2018). In particular, for the case of specific strategies, this process is reinforced addressing rationales that according to Laranja and colleagues could be defined as systemic and evolutionary; due to the role of policy-makers as organizers rather than planners, with a specific approach on networks and sectors (Laranja, Uyarra, & Flanagan, 2008).

The relevance of studying the specific STI strategies that countries develop and steer to foster progress is on the roots of the National Innovation Systems approach. As pointed out by Acs et al., since knowledge is a fundamental resource embedded in the institutions of a given country, and that these institutions and systems are inherited and evolve with them (Acs, Audretsch, Lehmann, & Licht, 2017), these new strategies provide fresh guidelines for the system and the development of its components. In the definition of the STI strategies, National Policy Councils (NPCs) for Science, Technology and Innovation (STI) are becoming one of the common responses that governments are implementing to achieve better levels of societal coordination and governance for STI policy. The strategical definition commonly has to address prioritizing among different lines of work, either by their nature, objectives, instruments, or outcomes. One of these definitions, regarding a non-neutral approach towards an object or subject, is commonly named as 'directionality'. Following this notion, the science, technology and innovation strategies for specific areas, sectors or regions are

becoming a mandatory policy instrument for countries and territories in a context of increased attention to directionality, such as the efforts in defining Missions (Mazzucato, 2018), or Grand Challenges (Kuhlmann & Rip, 2018), or addressing the dimensions of Responsible (Research and) Innovation (Stilgoe, Owen, & Macnaghten, 2013), and in some cases also identifying their potentials and developing strategies for smart specialisation (Capello & Kroll, 2016) among other decisions; challenging the current trends about the governance of socio-technical systems and the role(s) of the state (Borrás & Edler, 2020).

However, there is academic consensus regarding this governance as an understudied subject (Borrás & Edler, 2014; Edler & Fagerberg, 2017); meanwhile – despite some individual efforts – the role of Councils within this governance does not appear to gain scholar momentum yet. In this context, despite the increasing interest on NPCs, there is little evidence on how these organizations relate within their national innovation systems, and how the councils shape (or are shaped) by the national strategies for STI definition. The definition of strategic priorities is commonly highlighted as one of the more common tasks of an NPC for STI; for instance, 74% of the OECD countries with councils (Borowiecki & Paunov, 2018). However, coincidently with the highly prescriptive nature of the innovation studies field (Flanagan & Uyarra, 2016), and as recognized by Breznitz et al., in STI policy the description of the modus-operandi, the implementation stage of these processes, typically falls short (Breznitz, Ornston, & Samford, 2018); even when the definitions surrounding the abovementioned topics challenge the different levels of STI policy and their coordination profoundly (Lindner et al., 2016).

In the depicted context, this article aims to shed light on how a specific type of organization for STI –National Policy Councils – conduct one of their canonical tasks, to provide advice for STI strategies; facing from an inductive perspective – as is customary in this academic field (Martin, 2012) – a few of the challenges for the Innovation Studies field, regarding the directionality of innovation (Martin, 2016). The specific objectives of this document are:

- To illustrate the role of two different types of National Policy Advisory Councils for STI in the strategy-making process for research and innovation areas derived from a strategical selectivity process.

- To compare the policy options derived from the governance process in which the NPCs participate, stressing the relevance of the organizational design of the NPCs for their role in the strategy-making process.

An exploratory and descriptive comparative case study between two NPCs for STI was conducted to fulfill the abovementioned research aims. The chosen cases were Chile and Spain for the participation of their councils in the definition of their specific STI strategies for Risk Disaster Resilience and Artificial Intelligence, respectively; and the methodological strategies included interviews with the councillors of both councils and the revision of secondary data.

The remainder of the documents continues as follows: Section 2 addresses the theoretical background that underpins this research, Section 3 showcases the methodological strategies

followed and presents in more detail the case studies research objects, Section 4 presents the results of the research, and finally, Section 5 concludes with the final thoughts and reflections on the subject.

2. Definitions and Theory

In this section, we present the theoretical frameworks that underpin this research. These frameworks are divided between the object approach of the National Innovation Systems and NPCs for STI in the first subsection (2.1) and the intra-disciplinary approach of the study of strategy and their focus in science, technology and innovation in the second subsection (2.2).

2.1 National Innovation Systems and the National Policy Councils for Science, Technology and Innovation.

The complexity that the National Innovation Systems entails, derived from the number of actors and interconnections (Edquist, 2005), implies a need for coordination; and the common objectives for science, technology and innovation require a long term consensuated strategy to approach to their potential. Moreover, governments and innovation policy are increasingly concerned on how to address societal challenges and no longer exclusively economic goals (Fagerberg, 2017). Following this, the canonical organization of National Policy Councils for Science, Technology and Innovation has been often presented as means for more coordination in innovation policy (Edler & Fagerberg, 2017; Foxley, Saez, & Valenzuela, 2015), particularly for the objective of setting long term direction and - therefore - coordination (Fagerberg & Hutschenreiter, 2020).

However, the approximation about the organizations for STI policy requires a more in-depth understanding. Previous works have established the foundations of the modern research on types of organizations for STI; on an operational level Lepori and Reale provided a classification of the research agencies according to their position to the state, their task distribution and their organizational forms (Lepori & Reale, 2019), while Breznitz et al. performed similar work on the innovation agencies and the scope and nature of the innovation fostered by them (Breznitz et al., 2018). On the strategical level, Cevallos and Merino-Moreno proposed an empirical map and a classification based on the structural characteristics of NPCs for STI, built on some of the characteristics highlighted in previous classifications (OECD, 2009; OECD, 2018; Schwaag-Serger, Wise, & Arnold, 2015), while addressing the black-boxed and unproblematic approach commonly developed towards NPCs (Cevallos & Merino-Moreno, forthcoming). On the other hand, qualitative approaches have been discussed for case studies based on the experience of the Science and Technology Policy Council (STPC) – former Finland's council – (Pelkonen, 2006), Sweden's National Innovation Council (NIC) (Edquist, 2018), partially Finland's and Sweden's councils (Fagerberg & Hutschenreiter, 2020), and also a comparative case study between the councils of Chile and Spain (Cevallos & Merino-Moreno, forthcoming).

2.2. Strategy and Directionality

As is mentioned in the introduction, the NPCs commonly participate in the definition of STI strategies for their countries. The objectives of an STI strategy have been defined by an international policy cooperation organization such as the OECD a few years ago:

'First, they articulate the government's vision regarding the contribution of STI to their country's social and economic development. Second, they set priorities for public investment in STI and identify the focus of government reforms (e.g., funding of university research, evaluation systems). They also mobilize STI actors around specific goals (…) Third, the elaboration of these strategies can engage stakeholders (the research community, funding agencies, business, civil society, regional and local governments) in broad consultations that will help building a common vision of the future and facilitate coordination within the innovation system. ' (OECD, 2014, p.90)

These strategies may have different scopes of action, such as the geographic level (supranational-national-regional-local), the economic level (overall, industries-based, technologies-based) or the impact level (overall, scientific, technological, economic, social), sources (supply-oriented, demand-oriented, or both), timings (based on past experiences or future expectations), among other features. As mentioned as the second characteristic by the OECD, the STI strategies come to prioritize some activities over others, either explicitly or implicitly, and this non-neutral approach has been labeled 'directionality'. Directionality has been regarded by scholars of the field like Mariana Mazzucato, as one of the two main characteristics of innovation policy, affirming that 'Innovation has not only a rate but also a direction' (Mazzucato, 2018) that allows governments to develop innovation-led growth (Mazzucato, 2015) – 'smarter', 'inclusive' and 'sustainable' – and at the same time has been syndicated as one of the potential failures that drive the most recent frame for innovation policy, Transformative Change, by Weber and Rohracher (Weber & Rohracher, 2012).

In this sense, directionality has often been linked with the notion of collective-priorities by Schot and Steinmuller in their revision of the frames for innovation policy, 'The transformative change frame takes the question of direction as a starting point and requires a process for setting collective priorities' (Schot & Steinmueller, 2018) p.1562 and also by Chaminade et al. 'Directionality refers to the need to articulate collective priorities and the direction of change.' (Chaminade, Lundvall, & Haneef, 2018, p. 93). This definition of the collective priorities may be either on the selection process for the areas to be addressed by specific STI strategies, or in the definition of the aims and expected outputs of these strategies. Furthermore, the relationships and definitions of the concept 'directionality' are broad enough to aim for multiple target dimensions of interest, such as priorities between areas, sectors, levels, processes, populations, or organizations, among others.

As presented by Daimer et al., in the context of the normative turn of the challenge-driven innovation activities should be characterized for features such as socio-technical, systemic, transition-oriented, experimental, glocal, transdisciplinary and participatory, in order to fulfill the new requirements of these orientations (Daimer, Hufnagl, & Warnke, 2012). In this scenario, the connections between NPCs for STI – as a device to implement governance for STI – and STI strategies are multiple, since as highlighted by Borowiechi and Paunov, from the evidence of the RESGOV database the 74 percent of the OECD countries considered in the survey that have a council, answer positively to the question regarding the participation of the council developing national strategic priorities. Furthermore, in this subset of countries, these documents may have a specific focus to address the current issues of directionality:

'Science, technology, and innovation (STI) strategies or plans are in place in most countries (33 of 35, 94%). These commonly define STI strategies to address major societal challenges (30 of 33, 91%). Key themes include sustainable growth, health, and efficient transportation systems. STI strategies and plans also define specific scientific research, technologies or economic fields of national priority (31 of 33, 94%). In 23 of 32 countries (72%), STI strategies address specific sub-national priorities for specific federal states or regions, reflecting for EU member states and partner countries Smart Specialisation strategies.' (Borowiecki & Paunov, 2018, p. 6)

3. Methodology and Case Selection

In this section, the first subsection will illustrate the methodology followed for this research, and the next two subsections will present each of the cases selected NPCs and their role in a case of development of the specific STI strategy.

3.1. Methodology

This methodology coincides with Yin's -following COSMOS Corporation- vision of a research design about an organization and data collection source from individuals (how the organization works) and the organization (organization outcomes) (Yin, 2003). The case selection process follows a polar types criteria (Eisenhardt & Graebner, 2007), also known as two-tailed (Yin, 2003) or diverse (Seawright & Gerring, 2008), by using the differences among the subjects to identify their features. This criterion is based on the empirical results obtained from the iNPC index (Cevallos & Merino Moreno, forthcoming), selecting one strong council – high level of potential according to their structural capacities – and one agile council – low level of potential due to their structural capacities – complying with the extreme versions of this type of organizations for STI.

The selected councils are the National Council of Innovation for Development (CNID) of the Republic of Chile (subsection 3.1) as a representative of a potential transformative council, and the Advisory Council for Science, Technology and Innovation (CACTI) of the Kingdom of Spain (subsection 3.2) as a representative of a potential agile council, for a comparison of these councils their information is synoptically consolidated in Table 2. Furthermore, the STI strategies selected are different in terms of the concerning area but also in their scope of action, local in Chile for an initially endemic challenge that has the potential to position internationally the country, and global in the case of Spain for a widespread opportunity that is being tackled by several countries around the globe.

These strategies selection process followed a selection based on their representativeness for the STI Strategy for Natural Disasters Resilience (NDR) of Chile, and also for the uniqueness of the STI Strategy for Artificial Intelligence (AI) of Spain. For comparison purposes, while it would have been ideal to review the same strategy for both countries, due to the timing, idiosyncratic nature of this definition and the value embedded in the comparison of these two extreme types of councils, different sectoral strategies were considered. This information is summarized in Table 1.

Table 8. Comparison of the Structure of CNID and CACTI

Chilean Council of Innovation for Development (CNID)				
Executive Capacity	**Council´s Role**	Joint Planning	Coordination	Advice
	Executive´s Role	Involvement of the Top Level	Involvement of the Ministries Level	Involvement of the Upper Management Level
Coordinative Capacity	**Composition**	Government Officials (4) Ministers of Finance, Economy, Education, and Agriculture, or their representatives.	Outstanding Personalities (14) One of them is appointed President of the Council by the government with partial dedication.	Representatives of Society (Stakeholders) (2) One vice-president for research from the universities and one expert in vocational training from the Vocational Schools, both in consultation with the Ministry of Economy.
	Resources	Funding for Institutionalization	Funding for Studies	Funding for Logistics

Spanish Advisory Council for Science, Technology and Innovation (CACTI)				
Executive Capacity	**Council´s Role**	Joint Planning	Coordination	Advice
	Executive´s Role	Involvement of the Top Level	Involvement of the Ministries Level	Involvement of the Upper Management Level
Coordinative Capacity	**Composition**	Government Officials	Outstanding Personalities (10) One of them is elected President of the Council by the councilors	Representatives of Society (Stakeholders) (4) Two representatives of the central business confederations and two of the main Unions.
	Resources	Funding for Institutionalization	Funding for Studies	Funding for Logistics

Source: Authors

Table 9. Cases of Study

Country	Chile	Spain
Type of Council	Strong	Agile
Council	National Council of Innovation for Development (CNID)	Advisory Council for Science, Technology and Innovation (CACTI)
STI Strategy	Natural Disasters Resilience	Artificial Intelligence
STI Activities	Specific activities	
Scope	National	
Problem	Supply, Demand and Interactions	
Source	Top-Down	
Aims	Proposal of a new policy	
Position	Open	
Power	Symmetric relationships	
Temporality	Limited period	

Source: Authors, partly following the scheme proposed by Dutrénit *et al.* (Dutrenit, Natera, Puchet, Torres, & Vera-Cruz, 2017) for dialogue processes about STI.

The data collection methodology used to gather the information presented comprises primary data obtained in individual semi-structured recorded interviews of councillors of CNID and CACTI (more information on Annex 1) regarding the general operation of NPCs and directionality, and in some cases addressing the role of the NPC on the specific strategy explicitly. These interviews were conducted between the years 2018 and 2019, and were complemented by secondary data reviewed from relevant documentation – i.e., laws, decrees, and reports – regarding each of the councils. The interviews consisted of ten councillors of CNID and five of CACTI, and were performed in Santiago de Chile and Madrid . The choice regarding the councillors as a primary source is based on the information they have due to their twofold characteristics, being part of the organization and familiar with its internal operation and also having a background and being part of a community sensitive to the Council's outcomes and products. These insights make the councillors the ideal sources for the aims of this research, illustrating the role of the NPCs in the process of a specific strategy and comparing the policy options derived from different organizational settings.

3.2. The Chilean Council of Innovation for Development and the STI Strategy for Natural Disasters Resilience

The Chilean Council of Innovation for Development (CNID), formerly Innovation for Competitiveness (CNIC) until 2014, was established in the year 2005 by Presidential Decree as an Advisory Council for the Chilean Presidency (Ministerio de Hacienda de la República de Chile, 2005). Since then, it has

had five clearly defined stages with their compositions and mandates. The first stage lasted only for a few months and set the organizational and conceptual basis for the Council starting in March of the year 2006 with the newly elected government. In this first complete presidential term, the Council had two stages (2006-2008 and 2008-2010) crossed by the definition of a National Strategy for STI and strategical selectivity.

The next phase (2010-2014) coincided with a government of a different political orientation, and it was a time of revisionism and future thinking. The final stage of CNID spans between the years 2014 and 2017, again in a different coalition government –the one that established CNIC-, when it became a Council for Development rather than Competitiveness, with the purpose of explicitly considered social innovation for the nation's welfare. In the year 2018, a new governmental institutionalization for STI was approved, again under the government of a different coalition than the previous, leaving the Council partially on hold until the new organizations are deployed in the year 2020.

CNID has a mandate over the policy domains of science, technology and innovation; trying to encompass the efforts on these. The Executive Power is involved at the highest level in leading the Council, not by participating in the discussions rather than by defining the overarching goals and expected advisory from the Council. The presidency scheduled a few meetings with the whole Council in the presidential term and a fluid connection with the President of the Council –appointed and trusted by the government on its capacities and political vision-. The Council's role is to advise the Presidency, and its aims are divided among specific products – such as reports on relevant issues – and the creation of a social tissue that goes beyond the government and the Council related to the themes of interest. CNID is composed by ministries, outstanding personalities – from the fields of science, technology, innovation, education, and social-oriented NGOs- , representatives of stakeholders, and finally – as guests – the chairpersons of the governmental agencies. This composition of the Council is supported by a Secretariat with funding to provide administrative and professional support, and also to command a few external studies per year.

Since its new conformation in the year 2014, CNID received the mandate of the Presidency to discuss a new regime for STI broadly. Among the definitions of the strategical agenda, the Commission highlighted the need to 'Concentrate efforts in prioritized areas', and suggested that three areas were prioritized during that presidential term (Comision Presidencial Ciencia para el Desarrollo, 2015). This was a shift compared to the recent years' policy, since a 2017 study on the Chilean national investment on STI, it was highlighted that for the previous ten years span the government spending had a neutral approach for 70 percent average, with the remainder mainly associated to sectoral focus in detriment of a strategical one (Balbontín, Roeschmann, & Zahler, 2018). For analytical purposes, in the remainder of this document, we will focus only on the Resilience for Natural Disasters proposal due to its uniqueness and the relevance of the field for the country, which has highlighted its position on the subject as a Natural Laboratory (NL) (Guridi, Pertuze, & Pfotenhauer, 2020).

3.3. The Spanish Advisory Council for Science, Technology and Innovation and the STI Strategy for Artificial Intelligence

The Spanish Advisory Council for Science and Technology (CACT) was established according to the Law for the Promotion and General Coordination of the Scientific and Technical Research (Jefatura del Estado, 1986). In this law, the Spanish State acknowledged – almost thirty-five years ago – the relevance of the bond with the stakeholders for science and technology, specifically from the private sector and scientific communities, towards a socially desirable development of their activities. Regarding the composition of CACT, as specified in the law it will be chaired first by the Minister of Industry and Energy and the by the Minister of Science and Technology, and as defined by successive modifications in Royal Decrees , councilors from research organizations –public and private-, innovative enterprises, business confederations, unions, and government officials. The current Spanish Advisory Council for Science, Technology and Innovation was considered in the Law for Science, Technology and Innovation promulgated in 2011 (Jefatura del Estado, 2011). This law crystallized the position of the Council, with the possibility to intervene in the strategical process of STI and act as a bridge for the society to influence these policy domains (Díez Bueso, 2013).

CACTI has been mandated to coordinate the policy domains of science, technology and innovation. The governments' role is at a low commitment level, acting similarly as a counterpart for the Council by giving it inputs and receiving their outputs. The hierarchy within the Council is defined by the conforming councilors, who elect a President – who is in charge of the coordination with the Executive – and a Vice-president to surrogate the President. The aims of the Council concern mainly to execute their advisory role on specific products, such as the National Plan for Research and Innovation, the National STI Strategy, specific calls, among other policies and instruments. The official composition of the Council lacks governmental representatives and guests, by considering exclusively outstanding personalities and stakeholders' representatives of business and unions. The Council does not have administrative and professional support but has the resources of the Ministry in case of need since, in practice, a government official act as secretary of the council.

The Spanish STI strategy designed for the 2013-2020 period stressed the importance of being aligned with the European efforts in STI, specifically by supporting the objectives of the Horizon 2020 Strategy, the Innovation Union, the European Research Area, and the Framework Program Horizon 2020 (Ministerio de Economia y Competitividad del Gobierno de España,). This Strategy defined as one of its objectives the 'STI support towards the societal challenges', outlining eight grand challenges that encompass research and innovation and intersectoral and multidisciplinary collaboration to receive societal returns in the medium and long term (Ibíd). Coincidently, Artificial Intelligence has also been on the sight of the European Commission, highlighting it as one of the most strategic technologies of the century, and recognizing the need for a coordinated approach among European nations to face the challenges that it entails (European Commission, 2018).

4. Results

Following the qualitative methodology supported for the literature for this type of research and explained in the previous section, the results will be presented in three analytical pillars, each a subsection, that first aims to shed light on the ideological positions of the councillors regarding directionality, which is a relevant input for the next two subsections which are more directly related to the objectives of this document: first to illustrate the process of defining the strategies and then to compare their design processes. Finally, one subsection will summarize the topics in an overall view.

Councillors' positions on directionality

A first analysis, to frame the object of study, was to getting acquainted with the councillors' positions on their ideological definitions regarding directionality. While a more specific research could be developed just on this subject, a first difference emerges on the approaches to directionality, remaining still political for the Chilean councillors and more pragmatic logic of compliance-and-profiting for the Spanish councillors.

'I believe that the philosophy of having as a base that a Council will be able to determine which are 'the five most important things to do' is a wrong approach and leads to entrenchment'.

Chilean Councillor N°5

'We had a discussion in the context of the report about the State's Plan (for STI). Indeed one of the guidelines is to identify strategic lines, but we did not consider it as a priority within the Council'.

Spanish Councillor N°1

From the previous quotes, the Chilean councillor illustrates the position of some of the councillors that were not convinced about the role that a Council should have regarding the directionality among areas, meanwhile the Spanish councillor presents a new scenario, it is not necessarily choosing among sectors what matters – considering the role of the Council – but maybe among other levels of interest. In the next quotes, for the case of Chile, the feature of directionality emerges as a possibility with the existence of the Council but in a dilettante approach. At the same time, for Spain it appears to be strongly related to the supra-order of the European Commission regarding the STI matters and its political and economic influx and incentives.

'Before the existence of the Council, prior to 2004, in the public discussion the possibility to propose strategical areas was vetoed, it had no chance (…) despite some particular projects, when it was raised to some degree of public discussion you encountered really strong reactions. (…) Basically it (the Council) came to legitimize one governmental choice about those areas, (…) the logic was, well, how the citizens defines this area prioritization'.

Chilean Councillor N°3

'What is sought (in Spain) is to bring as much as possible of what Europe is willing to put in more quantity, therefore their elections are always telling us they are mediated by what Europe has said'.

Spanish Councillor N°5

Council's role on the selection process of the strategy

Regarding the selection process, for the Chilean case, to comply with the suggestion made by the Commission on the year 2015 – mentioned in the previous section – the Presidency mandated CNID to propose agendas regarding two highly sensitive issues for Chile: the Resilience for Natural Disasters and the Sustainability of Hydric Resources. On the other hand, the Minister of Economics attended one of the meetings of the Council to ask for a proposal regarding Ports and Tourism. Furthermore, the Council was asked by the Ministry of Mining to continue with the proposal developed by social organizations and business confederations regarding mining. On the other hand, for the case of Spain, following the roadmap defined by the European Commission to establish a new common platform – i.e. the European AI Alliance – as a member country was requested to develop its national strategy for Artificial Intelligence before the month of July of the year 2018.

'Once the report about science and development was handled to the President, in that exact same act she acknowledges that there are two big issues that concern us as a country, and we are interested in what science and technology have to say on the subject. The themes of Hydric Resources and of Natural Disasters'.

Chilean Councillor N°10

'The Ministry has the commitment, I believe for June or July (2019), to present Europe a strategy for Artificial Intelligence for the country as a state member of the Union. (…) A first document was written and they asked for CACTI's opinion, I do not know if others's opinion were asked'.

Spanish Councillor N°4

Council's role on the design process of the strategy

Chilean CNID broadly convened the society in a new commission to develop a National Strategy of STI for Resilience for Natural Disasters (CREDEN). This strategy could be initially labeled as defensive since Chile is the OCDE country most exposed to natural disasters and one of the most affected nations in casualties and loss of material resources, but their purposes are to use this exposure as a source for innovation (Comisión Nacional para la Resiliencia frente a Desastres de Origen Natural, (CREDEN), 2016). The commission divided in a central committee and four subcommittees, the initiative was championed by a councilor of CNID, worked for several months, and delivered a final report at the end of the year 2016. The document comprised the strategic, policy and instruments for the implementation of the defined efforts, as well as the definition of the required budget to implement the strategy.

'The commission about natural disasters (…) had an ample discussion, because it is a really particular subject to Chile. (…) In this case, what was heavily employed were the science involved in this regard; because for a big part of the (previous conformations of) Innovation Councils the science part was mainly scientific about natural sciences or engineering, but that I remember the social sciences were not that present (…) however they leaded the discussion regarding natural disasters, there were

many scientist from that background, and also governmental offices (…) it was multi-scientific, multi-technic'.

Chilean Councillor N°7

The Spanish STI Strategy for Artificial Intelligence was developed by a working group appointed by the General Secretariat of Science Policy Coordination of the Ministry of Science, Innovation and Universities; and outlined the strategical priorities on the subject to be implemented with specific instruments to be defined in the STI annual plans (Secretaría General de Coordinación de Política Científica del Ministerio de Ciencia, Innovación y Universidades del Gobierno de España & Grupo de Trabajo en Inteligencia Artificial, (GTIA), 2019). According to the report, the comments provided by CACTI were considered in developing the document for this strategy. The resources were syndicated as the main restriction to have a higher degree of involvement on the process.

'As a councillor, (…) I contribute with this, but who has to do the charts is not me, because it has to do with some minimal conditions (…) It does not exist, each one collaborates according to their personal inputs (…) we contribute with personal experience but without a structure it is really difficult to work. Because you are assessing artificial intelligence documents and, if you do not give me a few days, then I do not have any clue'.

Spanish Councillor N°3

'If I have a doubt related to artificial intelligence, given that I am not an specialist, I have plenty of resources to ask experts (…) about their vision. The same thing happens with the rest of the councillors'.

Spanish Councillor N°2

'We could not ellaborate a document about artificial intelligence because truth to be told, only three or four members of the Council had the capacities and time to make an opinion. (…) It is right that the Ministry did this because we would not have the capacity since we do not have a Secretariat or anything to catch all that people'.

Spanish Councillor N°4

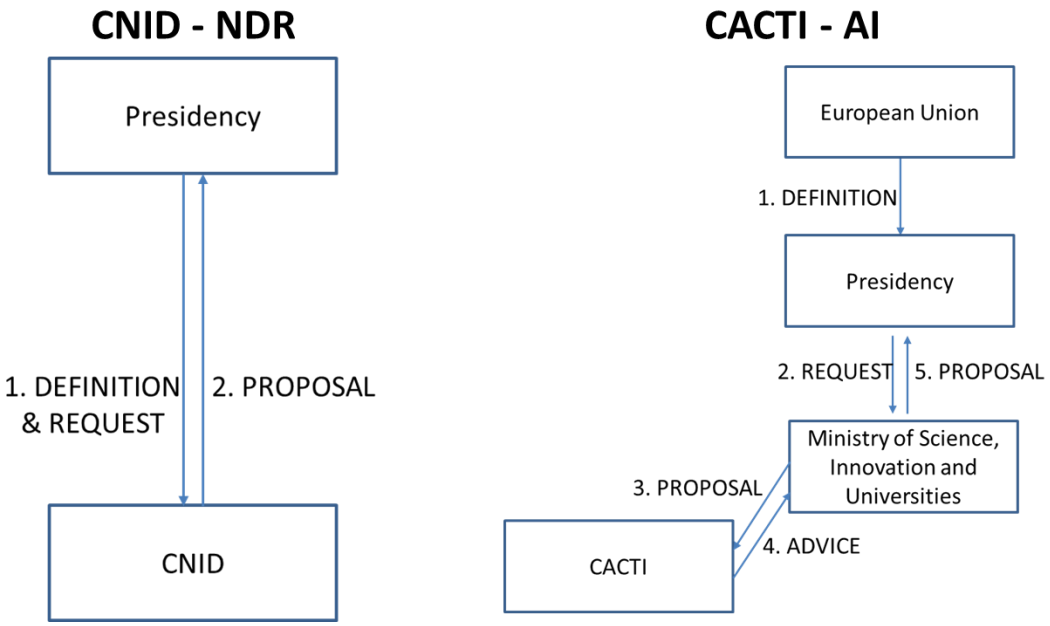
Summary

According to the testimonies gathered, the ex-ante position for the councillors regarding directionality was not a consensus. The reasons regarding the partial refusal to select areas for their strategical development mainly had to do with the uncertainty involved in this forecasting exercise, and the need for higher resources – broadly understood – to develop such decisions. However, if directionality was a mandate to the Council or, even better, was partially or fully defined in other governmental bodies, and therefore their participation was an ex-post position, the councillors were in place to support the predefined aims; in other words it seems that the councillors preferred to

enhance definitions rather than taking them in this context. This suggests that the issues of responsibility and resources are highly connected with the capacities of the councils to comfortably work on the area of directionality.

For the cases of interest, the process of participation of the councils on the directionality efforts could be illustrated according to 1. From this figure, the depicted process for the Spanish Council appears more complex than the process of the Chilean Council. In the same fashion, the processes developed by the Chilean Council seems deeper – championing the process – than the processes of the Spanish Council – exercising their advisory role – given that in the latter, the Ministry complements some of the activities developed by the Council, specifically regarding the relationship with the communities of stakeholders. Summarizing, while in Chile the mandate of the specific strategy came directly from the Presidency, in Spain the mandate was first supranational and then the Presidency identified the best institutional way to address it. Furthermore, for the Chilean case the design of the strategy was broadly developed by the council; while in Spain the Ministry had to perform that task, and after that a consultation process involved the council.

Figure 1. Comparison of CNID and CACTI mandate of STI strategy



The roles played by each of the councils seem also strongly related to the expectations of their design, regarding their executive and coordinative capacity, and specifically about the resources involved, which may seem enough for some councillors or insufficient for others, questioning which is an appropriate level of resources for the definition of strategies that are aimed to shape the future of a country in a given direction. However, these demands suggest whether the actions developed

by these councils are enough for the requirements of current times to STI policy, and which is their formal scope of action.

5. Final Reflections

Following the rationale of increasing demands for STI policy depicted in the introduction of this document, the obtained results unpack the issue of the process and the actual role of the governments – complementary to the theoretical approach depicted by Boon and Edler (Boon & Edler, 2018) – and the stakeholders. Despite the fact that National Policy Councils seem to be aligned with the notion of the involvement of communities in the definitions regarding the directionality of efforts in STI policy, it does not seem evident that every configuration of NPCs will be suitable for developing this task complying with the mandates. On the other hand, leaving this process as duties of the exclusive responsibility of the governmental departments jeopardize the expected role of the stakeholder in the definition process, making it potentially partisan and, therefore, either a shortsighted or dilettante effort.

Expectedly by design, both the resources and the councils' role were syndicated as the main reasons for the difference in the involvement of both councils studied. However, this difference points the attention to the reality of the prescriptive nature of STI policy scholarship highlighted by Flanagan & Uyarra. In this context, the directionality issues characteristic of the framework of transformational change should also consider the specific features of the councils mandated to develop certain tasks. Furthermore, the implications of these decisions remain an issue since the raison d'etre of the councils seems strongly related to their strategical capacities and, therefore with the directionality – broadly speaking – that these organizations can imprint in the discussions regarding the STI Policy. This approach questions the links between the councils and the normative turn, regarding how they relate: do councils foster and enhance the discussions about normativity and directionality, are the councils instrumental to the already made definitions regarding these subjects, or is there a continuum in which every country has to fix their position.

The nature of these discussions is also affected by the overall STI configuration of organizations and their relations, following the studies of Lepori & Reale and Breznitz et al. on the operational level, Cevallos & Merino-Moreno on the strategical level, and having in mind the potential configurations of the political level as well – which ministry or ministries will be in charge of the STI policy domain(s) -, the puzzle of organizations for STI policy. This notion implicates the organizational and institutional setting and how the different types for each of these organizations and relationships configure a harder challenge to tackle the abovementioned demands, or positively, a multiplicity of potential answers due to the different configurations of organizations and their types.

In the process of this research, several avenues found in order to be complemented by future studies. The ideological approach to directionality seems to deserve more scholar attention, despite the gained momentum in the policy-making arena. The definitions surrounding directionality remains a moving object, regarding the definitions and the roles that different actors have to play in this process. Finally, the assessment of directionality definitions seems to be still scarce, while

having much evidence on the will to make it happen and succeed on it, more research on the past results of these instances – and intermediate assessments for the ongoing projects – would be necessary to address directionality and therefore partially support the framework of transformational change.

6. References

Acs, Z., Audretsch, D., Lehmann, E., & Licht, G. (2017). National systems of innovation. The Journal of Technology Transfer, 42(5), 997-1008. doi:10.1007/s10961-016-9481-8

Andreoni, A., & Chang, H. (2019). The political economy of industrial policy: Structural interdependencies, policy alignment and conflict management. Structural Change and Economic Dynamics, 48, 136-150. doi:10.1016/j.strueco.2018.10.007

Balbontín, R., Roeschmann, J. A., & Zahler, A. (2018). Ciencia, tecnología e innovación en chile: Un análisis presupuestario. ().

Benavente, J. M., Bravo, C., Goya, D., & Zahler, A. (2017). Collaboration in clusters and technology consortia: The case of chile. In E. Fernández-Arias, C. F. Sabel, E. H. Stein & A. Trejos (Eds.), Two to tango: Public-private collaboration for productive development policies (). Washington, DC: Inter-American Development Bank (IDB). Retrieved from https://www.econstor.eu/handle/10419/173904

Boon, W., & Edler, J. (2018). Demand, challenges, and innovation : Making sense of new trends in innovation policy. Science and Public Policy, 45(4), 435-447. doi:10.1093/scipol/scy014

Borowiecki, M., & Paunov, C. (2018). How is research policy across the OECD organised? ().OECD Publishing. doi:10.1787/235c9806-en Retrieved from http://dx.doi.org/10.1787/235c9806-en

Borrás, S., & Edler, J. (2014). Introduction: On governance, systems and change. In S. Borrás, & J. Edler (Eds.), The governance of socio-technical systems: Explaining change (pp. 1-22) Edward Elgar Publishing. doi:10.4337/9781784710194.00010 Retrieved from http://www.elgaronline.com/view/9781784710187.00010.xml

Borrás, S., & Edler, J. (2020). The roles of the state in the governance of socio-technical systems' transformation. Research Policy, 49(5), 103971. doi:10.1016/j.respol.2020.103971

Borrás, S., & Edquist, C. (2019). Holistic innovation policy (First edition ed.). Oxford: Oxford University Press. doi:10.1093/oso/9780198809807.001.0001 Retrieved from https://doi.org/10.1093/oso/9780198809807.001.0001

Breznitz, D., Ornston, D., & Samford, S. (2018). Mission critical: The ends, means, and design of innovation agencies. Industrial and Corporate Change, 27(5), 883-896. doi:10.1093/icc/dty027

Capello, R., & Kroll, H. (2016). From theory to practice in smart specialization strategy: Emerging limits and possible future trajectories. European Planning Studies, 24(8), 1393-1406. doi:10.1080/09654313.2016.1156058

Chaminade, C., Lundvall, B., & Haneef, S. (2018). Advanced introduction to national innovation systems Retrieved from http://lup.lub.lu.se/record/ee76fc4a-c7e8-4638-8f3d-0e1d2ec5746f

Comisión Nacional para la Resiliencia frente a Desastres de Origen Natural, (CREDEN). (2016). Hacia un chile resiliente frente a desastres: Una oportunidad. (). Santiago de Chile:

Comision Presidencial Ciencia para el Desarrollo. (2015). Un sueño compartido para el futuro de chile. ().

Daimer, S., Hufnagl, M., & Warnke, P. (2012). Challenge-oriented policy-making and innovation systems theory. Innovation System Revisited, , 217-234. Retrieved from http://www.econis.eu/PPNSET?PPN=737674237

Díez Bueso, L. (2013). La gobernanza del sistema español de ciencia, tecnología e innovación. Revista De Bioética Y Derecho, (28), 20-32. doi:10.4321/S1886-58872013000200003

Dutrenit, G., Natera, J. M., Puchet, M., Torres, A., & Vera-Cruz, A. O. (2017). Dimensiones y atributos relevantes de los procesos de diálogo entre comunidades para el diseño de políticas públicas de CTI. In G. Dutrénit, & J. M. Natera (Eds.), Procesos de diálogo para la formulación de políticas de CTI en América Latina y España (pp. 37-72) Argentina. Retrieved from http://biblioteca.clacso.edu.ar/gsdl/collect/clacso/index/assoc/D13468.dir/Procesos_de_dialogo_para_la_formulacion_de_politicas_de_CTI.pdf

Edler, J., & Fagerberg, J. (2017). Innovation policy: What, why, and how. Oxford Review of Economic Policy, 33(1), 2-23. doi:10.1093/oxrep/grx001

Edquist, C. (2005). Systems of innovation, perspectives and challenges. In J. Fagerberg, D. Mowery & R. Nelson (Eds.), The oxford handbook of innovation (). New York: Oxford University Press.

Edquist, C. (2018). Towards a holistic innovation policy: Can the swedish national innovation council (NIC) be a role model? Research Policy, doi:10.1016/j.respol.2018.10.008

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. Academy of Management Journal, 50(1), 25-32. doi:10.5465/amj.2007.24160888

European Commission. (2018). Artificial intelligence for europe. (). Brussels, Belgium: Retrieved from https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=51625

Fagerberg, J. (2017). Innovation policy: Rationales, lessons and challenges. Journal of Economic Surveys, 31(2), 497-512. doi:10.1111/joes.12164

Fagerberg, J., & Hutschenreiter, G. (2020). Coping with societal challenges: Lessons for innovation policy governance. Journal of Industry, Competition and Trade, 20(2), 279-305. doi:10.1007/s10842-019-00332-1

Fernandez-Arias, E., & Stein, E. (2014). Un tema tabú: La selección de sectores prioritarios para la transformación productiva. In G. Crespi, E. Fernandez-Arias & E. Stein (Eds.), Cómo repensar el desarrollo productivo?: Políticas e instituciones sólidas para la transformación económica () Inter-American Development Bank (IDB).

Flanagan, K., & Uyarra, E. (2016). Four dangers in innovation policy studies - and how to avoid them. Industry and Innovation, 23(2), 177-188. doi:10.1080/13662716.2016.1146126

Flink, T., & Kaldewey, D. (2018). The new production of legitimacy: STI policy discourses beyond the contract metaphor. Research Policy, 47(1), 14-22. doi:10.1016/j.respol.2017.09.008

Foxley, A., Saez, R. E., & Valenzuela, A. (2015). Outcome report on the first meeting of the global forum of national advisory councils on science, technology and innovation. (). Santiago, Chile:

Guridi, J. A., Pertuze, J. A., & Pfotenhauer, S. M. (2020). Natural laboratories as policy instruments for technological learning and institutional capacity building: The case of chile's astronomy cluster. Research Policy, 49(2), 103899. doi:10.1016/j.respol.2019.103899

Ley 13/1986, de 14 de abril, de Fomento y Coordinación General de la Investigación Científica y Técnica. (1986).

Ley 14/2011, de 1 de junio, de la ciencia, la tecnología y la innovación, (2011).

Kuhlmann, S., & Rip, A. (2018). Next-generation innovation policy and grand challenges. Science and Public Policy, 45(4), 448-454. doi:10.1093/scipol/scy011

Laranja, M., Uyarra, E., & Flanagan, K. (2008). Policies for science, technology and innovation: Translating rationales into regional policies in a multi-level setting. Research Policy, 37(5), 823-835. doi:10.1016/j.respol.2008.03.006

Lepori, B., & Reale, E. (2019). The changing governance of research systems. agencification and organizational differentiation in research funding organizations. In D. Simon, S. Kuhlmann, J. Stamm & W. Canzler (Eds.), Handbook on science and public policy (). Norhampton: Edward Elgar.

Lindner, R., Daimer, S., Beckert, B., Heyen, N., Koehler, J., Teufel, B., . . . Wydra, S. (2016). Addressing directionality: Orientation failure and the systems of innovation heuristic. towards reflexive governance. Fraunhofer ISI Discussion Papers Innovation Systems and Policy Analysis, 52 Retrieved from https://www.econstor.eu/handle/10419/145315

Lundvall, B., & Borrás, S. (2005). Science, technology and innovation policy. In J. Fagerberg, D. Mowery & R. Nelson (Eds.), The oxford handbook of innovation (). New York: Oxford University Press.

Magro, E., Navarro, M., & Zabala-Iturriagagoitia, J. M. (2014). Coordination-Mix: The hidden face of STI policy. Review of Policy Research, 31(5), 367-389. doi:10.1111/ropr.12090

Martin, B. R. (2012). The evolution of science policy and innovation studies. Research Policy, 41(7), 1219-1239. doi:10.1016/j.respol.2012.03.012

Martin, B. R. (2016). Twenty challenges for innovation studies. Science and Public Policy, 43(3), 432-450. doi:10.1093/scipol/scv077

Mazzucato, M. (2015). The entrepreneurial state (Rev. ed. ed.). GB: Anthem Press. Retrieved from https://ebookcentral.proquest.com/lib/[SITE_ID]/detail.action?docID=4107798

Mazzucato, M. (2018). Mission-oriented innovation policies: Challenges and opportunities. Industrial and Corporate Change, 27(5), 803-815. doi:10.1093/icc/dty034

Ministerio de Economia y Competitividad del Gobierno de España.Estrategia española de ciencia y tecnologia y de innovacion 2013-2020. ().

Decreto N°1408 :CREA COMISION ASESORA PRESIDENCIAL CONSEJO DE INNOVACION PARA LA COMPETITIVIDAD, (2005). Retrieved from https://www.leychile.cl/Navegar?idNorma=245508&tipoVersion=0

OECD. (2009). Chile's national innovation council for competitiveness. ().

OECD. (2014). OECD science, technology and industry outlook 2014. (). Paris: Paris : OECD Publishing.

OECD. (2018). OECD science, technology and innovation outlook 2018. (). Paris: OECD Publishing. doi:10.1787/sti_in_outlook-2018-en Retrieved from http://dx.doi.org/10.1787/sti_in_outlook-2018-en

Pelkonen, A. (2006). The problem of integrated innovation policy: Analyzing the governing role of the science and technology policy council of finland. Science and Public Policy, 33(9), 669-680. doi:10.3152/147154306781778623

Porter, M. E. (1998). Clusters and the new economics of competition. Harvard Business Review, 76(6), 77-90. Retrieved from http://parlinfo.aph.gov.au/parlInfo/search/summary/summary.w3p;query=Id:%22library/jrnart/1LP56%22

Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. Research Policy, 47(9), 1554-1567. doi:10.1016/j.respol.2018.08.011

Schwaag-Serger, S., Wise, E., & Arnold, E. (2015). National research and innovation councils as an instrument of innovation governance. (). Retrieved from http://lup.lub.lu.se/record/358845c4-356c-4b46-a5a2-c6cfdfd81a5f

Seawright, J., & Gerring, J. (2008). Case selection techniques in case study research: A menu of qualitative and quantitative options. Political Research Quarterly, 61(2), 294-308. doi:10.1177/1065912907313077

Secretaría General de Coordinación de Política Científica del Ministerio de Ciencia, Innovación y Universidades del Gobierno de España, & Grupo de Trabajo en Inteligencia Artificial, (GTIA). (2019). Estrategia española de I+D+i en inteligencia artificial. ().Secretaría General Técnica del Ministerio de Ciencia, Innovación y Universidades del Gobierno de España.

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. Research Policy, 42(9), 1568-1580. doi:10.1016/j.respol.2013.05.008

Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change. Research Policy, 41(6), 1037-1047. doi:10.1016/j.respol.2011.10.015

Yin, R. K. (2003). Case study research: Design and methods. Beverly Hills etc.: Beverly Hills etc. Sage Publications.

Annex 1. More information about the interviewed councillors

Councillor	Council	Country	Date and Place of Interview
Councillor N°1	CNIC/CNID	Chile	07 Aug 2018; Santiago, Chile
Councillor N°2	CNIC/CNID	Chile	13 Aug 2018; Santiago, Chile
Councillor N°3	CNIC/CNID	Chile	17 Aug 2018; Santiago, Chile
Councillor N°4	CNIC/CNID	Chile	21 Aug 2018; Santiago, Chile
Councillor N°5	CNIC/CNID	Chile	22 Aug 2018; Santiago, Chile
Councillor N°6	CNIC/CNID	Chile	21 Dec 2018; Santiago, Chile
Councillor N°7	CNIC/CNID	Chile	26 Dec 2018; Santiago, Chile
Councillor N°8	CNIC/CNID	Chile	26 Dec 2018; Santiago, Chile
Councillor N°9	CNIC/CNID	Chile	27 Dec 2018; Santiago, Chile
Councillor N°10	CNIC/CNID	Chile	05 Jul 2019; Santiago, Chile
Councillor N°1	CACTI	Spain	10 Oct 2018; Madrid, Spain
Councillor N°2	CACTI	Spain	26 Feb 2019; Madrid, Spain
Councillor N°3	CACTI	Spain	15 Mar 2019; Madrid, Spain
Councillor N°4	CACTI	Spain	08 Apr 2019; Madrid, Spain
Councillor N°5	CACTI	Spain	24 Apr 2019; Madrid, Spain

Annex 2. Evidence of directionality on national STI strategies or plans for OECD countries

2.6. Does the national STI strategy or plan address any of the following priorities? Specify if another more dedicated strategy (e.g. a specific plan) covers these topics?[5]	Number of positive answers	Percentage of the respondants
a) Specific themes and/or societal challenges (e.g. Industry 4.0; 'green innovation'; health; environment; demographic change and wellbeing; efficient energy; climate action)	30	86%
a_2) Demographic change (i.e. ageing populations, etc.)	14	40%
a_3) Digital economy (e.g. big data, digitalisation, industry 4.0)	25	71%
a_4) Green economy (e.g. natural resources, energy, environment, climate change)	27	77%
a_5) Health (e.g. Bioeconomy, life science)	28	80%
a_6) Mobility (e.g. transport, smart integrated transport systems, e-mobility)	16	46%
a_7) Smart cities (e.g. sustainable urban systems urban development)	16	46%
b) Specific scientific research, technologies and economic fields (e.g. ICT; nanotechnologies; biotechnology)	31	89%
b_2) Agriculture and agricultural technologies	18	51%
b_3) Energy and energy technologies (e.g. energy storage, environmental technologies)	27	77%
b_4) Health and life sciences (e.g. biotechnology, medical technologies)	29	83%
b_5) ICT (e.g. big data, digital platforms, data privacy)	29	83%
b_6) Nanotechnology and advanced manufacturing (e.g. robotics, autonomous systems)	24	69%
c) Specific regions (e.g. smart specialisation strategies)	23	66%
d) Supranational or transnational objectives set by transnational institutions (for instance related to European Horizon 2020)	20	57%

Source: OECD RESGOV DATABASE

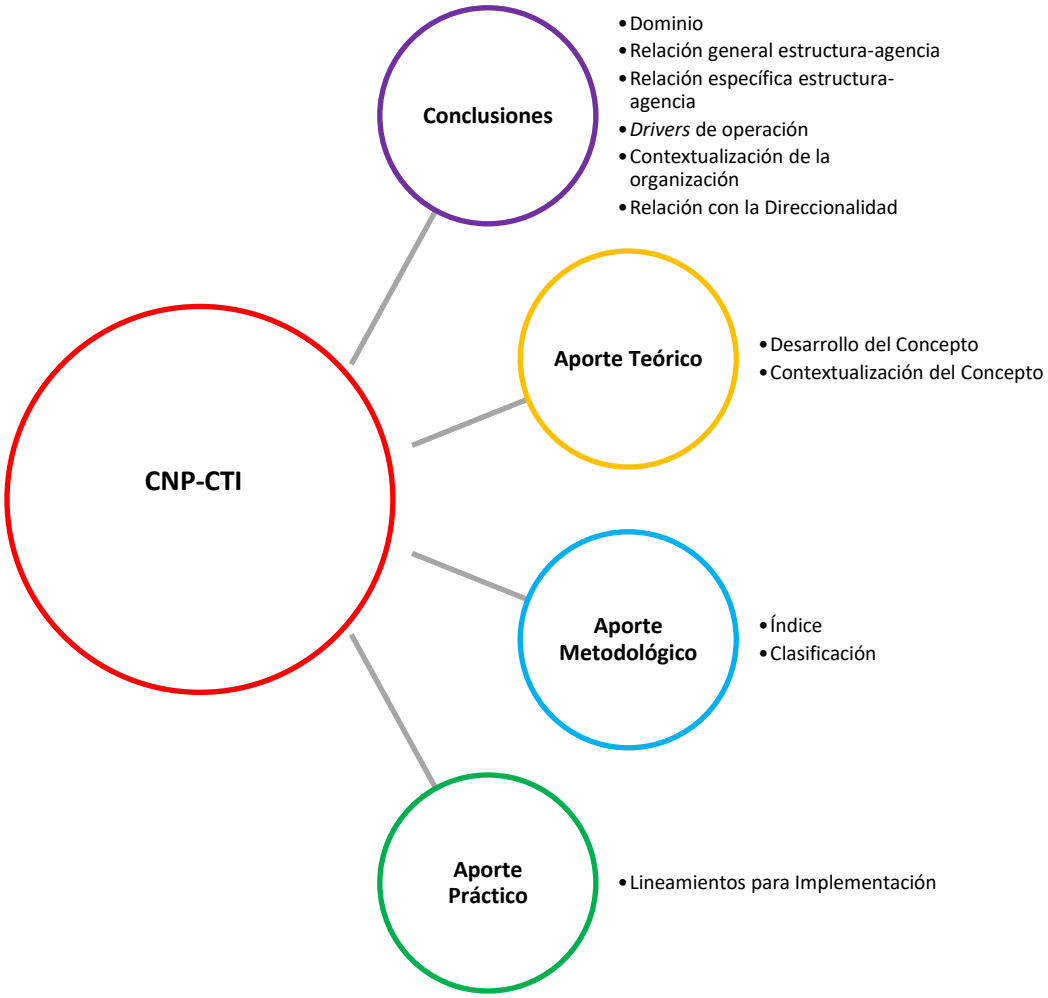
[5] Part of the answers to the question 2.6 of the REGOV questionnaire: '2.6. Does the national STI strategy or plan address any of the following priorities? Specify if another more dedicated strategy (e.g. a specific plan) covers these topics? Please refer to the main STI strategy. If additional strategies address the following issues, please provide further information on them.
a) Societal challenges
a_1) Which priorities
b) Scientific research, technologies, and economic fields
b_1) Which priorities
c) Regions
c_1) Which priorities and regions
d) Supranational or transnational objectives
d_1) Which priorities
e) Quantitative targets for monitoring and evaluation

CONCLUSIONES

En esta tesis se configura una nueva capa de conocimiento respecto al funcionamiento de los CNP-CTI, desarrollando una problematización inicial del objeto de investigación en M1, que presenta un instrumento y su respectiva clasificación tentativa, entregando una perspectiva novedosa desde la estructura de estas organizaciones, que es complementada en M2 con la relación entre la estructura y agencia, para sus condiciones generales de operación, y en M3 para la implementación de una de sus tareas principales; concluyendo la revisión de los distintos campos de acción del objeto de interés.

Entre los aportes específicos obtenidos desde el desarrollo de los objetivos de esta tesis doctoral al acervo académico de la literatura del campo de la política científica y los estudios de innovación, con énfasis en el rol de las organizaciones, específicamente de los Consejos Nacionales de Política Científica, Tecnológica y de Innovación, y de carácter más general que los observados en los manuscritos, se pueden ilustrar en la siguiente figura y resumir en los puntos a continuación:

Figura 1. Principales Conclusiones y Aportes de la Tesis Doctoral



- Los resultados de la investigación refrendan la tensión existente respecto a la política científica, tecnológica y de innovación; en relación a si componen un único y amplio **dominio de política**, o bien corresponden a dominios distintos pero que cultivan un cierto nivel de superposición. Esta discusión se relaciona también con lo relativo a las definiciones amplias y acotadas de innovación, pero a la vez las supera. Las implicancias de lo anterior desafían la convención existente en las organizaciones de muchos países, respecto al desarrollo de CNP-CTI que finalmente terminan sirviendo principalmente sólo a una de las potenciales dimensiones de política del consejo. Lo anterior implica una complejidad en el ámbito de los objetivos del meta-instrumento de los CNP, pero a la vez podría tensionar las relaciones entre las comunidades que participan de estos CNP en relación a los resultados relativos que vayan obteniendo de sus gestiones, afectando el aporte de coordinación y estratégico de largo plazo de estas organizaciones y sus países.

- Como parte de la investigación, el "enfrentamiento" entre las estructuras de los CNP-CTI abordados desde los casos de estudio con la vivencia de sus consejeros como parte de la implementación de su gestión, permite capturar cómo el **diseño** de estas estructuras termina

relacionándose o no a su operación, y de la misma forma los **factores ambientales** permiten - o no - facilitar la consecución de los objetivos de estas organizaciones, y de esta forma de los países que las implementan. El impacto teórico de lo anterior fluye entre el campo de la teoría de las organizaciones y el campo principal que enmarca esta tesis, estableciendo tensiones que van más allá del ámbito estrictamente académico de los campos considerados.

- La investigación logra describir distintos tipos de gestión general y específica de CNP-CTI y cómo estos se relacionan con la estructura definida para estas organizaciones por los gobiernos, estableciendo algunas de las tensiones que en la práctica se observan para el trabajo coordinado - al interior del aparato gubernamental y con la sociedad en general - que se espera se profundice en estas organizaciones, así como los **catalizadores de su diseño** que parecen afectar su desempeño. Lo anterior, sin perjuicio de que el desempeño de los CNP-CTI sea una materia de difícil evaluación, dados sus componentes blandos y prospectivos.

- Como resultado de la investigación, se logran reafirmar observaciones y análisis previos sobre las características y dimensiones estructurales de los CNP, pero a la vez se profundiza en cómo estas afectan específicamente el desarrollo de cierto tipo de tareas y el ***pool* de recursos necesarios** para conseguir determinados objetivos. Estos recursos pueden responder a distintos niveles, tanto ejecutivos como coordinativos, con fines relacionales u operativos, pero terminan afectando el desarrollo de las misiones determinadas para los CNP.

- En la investigación sobre la gestión de los CNP, tras el estudio de los CNP-CTI y realizar las correspondientes entrevistas a sus consejeros se pudo observar la relación que existe entre los consejos y la toma de decisiones en función de la direccionalidad, lo que parece abrir un espacio para un estudio en mayor profundidad respecto a los roles de los CNP - si se trata sólo de "dispositivos de acuerdos" orientados a la coordinación y aporte estratégico o si cumplen un **rol afirmativo** en función de la direccionalidad - y cómo estos se condicen con la direccionalidad - que al encontrarse en un ámbito de acción muy coincidente al del "giro normativo" dan mayor actualidad e interés a este potencial.

- La investigación también nota la emergencia de cierto tipo de tensiones entre el rol de los consejeros y el mandato de los CNP-CTI, lo que releva la capacidad de los consejos de resolver internamente las diferencias – esperables – en el desarrollo de sus misiones, y en qué condiciones estas resoluciones afectan o no el resultado esperado de su gestión. Lo anterior fue particularmente evidente en el **análisis de la direccionalidad**, en el que factores ideológicos y prácticos pueden determinar la toma de decisiones en una dirección inesperada sólo en base a la presencia – o no – de aproximaciones específicas que contemplen recursos o *leverage* ejecutivo.

Además de lo anteriormente señalado, en esta investigación se presentan aportaciones teóricas, metodológicas y prácticas particulares, que emergen como resultado del proceso de investigación, como las siguientes:

- En base a las distintas realidades de CNP, esta investigación establece un nivel de profundidad mayor respecto a su realidad como una organización "monolítica", sino más precisamente se trata de **una familia de organizaciones con distintas características** y de la misma forma distintos rangos de alcance. Esto cuestiona las definiciones prescriptivas, muy habituales en este campo académico como se señaló en la introducción, de la organización como un medio para distintos fines relacionados a la coordinación y al aporte estratégico, forzando en adelante un segundo nivel de profundidad en este tipo de acciones.

- Durante el desarrollo de la investigación, en diálogo con la literatura reciente de organizaciones para la CTI reseñada en la introducción, se incorpora la noción del ***puzle de organizaciones*** resultante de los distintos tipos de clasificaciones que se han desarrollado en los últimos años sobre este objeto de investigación. Este trabajo añade un nuevo nivel en este proceso, el nivel estratégico, lo que incorpora junto al nivel operativo de agencias de investigación e innovación la posibilidad de establecer como condición de análisis estos *puzles* para el desarrollo de la CTI en distintos países. Este análisis permite considerar los distintos tipos de arreglos organizacionales – los *puzles* – como distintas opciones que aglomeran un menú de organizaciones para CTI, estableciendo la posibilidad de incorporar mayor complejidad en el análisis teórico y aplicado del desarrollo de la CTI; al nivel de casos de estudio, comparación de casos transversales y análisis longitudinales.

- Entre los resultados metodológicos más evidentes de la investigación se encuentra el esquema de clasificación de los CNP-CTI. Este esquema permite tratar las distintas dimensiones estructurales de cada consejo, realizando primero una clasificación cuantitativa en función de la **creación de un índice**, el iNPC, resultante de un sistema de puntuación de las características estructurales de los consejos, de acuerdo a sus categorías. Posteriormente, permite analizar los puntajes obtenidos entre distintas dimensiones, para alcanzar una **clasificación cualitativa de los consejos** en cuanto a su potencial. La diferenciación explícita sugiere que las rutas que llevan a la homogeneización de este tipo de organizaciones se encuentran – de existir – aún lejanas. Debido a lo anterior, la herramienta heurística desarrollada provee una **base analítica** para el desarrollo de investigaciones futuras, permitiendo situar, comparar y caracterizar los consejos de interés en una realidad que entrega más información que lo realizado previamente por la literatura académica del campo.

- Además de las aportaciones al ámbito académico, en base a las experiencias recogidas en el transcurso de la investigación, se presenta también un aporte práctico (contenido en uno de los anexos de M2), en el que se sugiere un **set de lineamientos** para la definición y operación de Consejos Nacionales de Política, en particular de CTI pero potencialmente aplicables a cualquier

otro dominio de política, que pueden ser de utilidad para gobiernos u otras organizaciones que estén interesados en la implementación de este tipo de organizaciones.

En consideración de los aportes anteriormente señalados, durante la investigación se han abierto una multiplicidad de interrogantes que llevan a nuevas avenidas de desarrollo futuro de esta temática, estas se encuentran a nivel exploratorio y descriptivo en el campo académico de la política científica y los estudios de innovación como:

(i) evaluar las tipologías ex-ante definidas para las organizaciones relacionadas a la CTI con las taxonomías obtenidas ex-post, contrastando la teoría con lo empírico.
(ii) analizar la relación entre los CNP-CTI y sus consejeros y comunidades (en especial respecto a la direccionalidad),
(iii) analizar las características de la Presidencia y la Secretaria de los CNP-CTI en términos de sus perfiles y relaciones respecto a resultados esperados,
(iv) analizar el rol entre consejeros equivalentes, el Presidente del Consejo y la Secretaria Ejecutiva respecto a cómo se relacionan, discuten, reaccionan frente a la evidencia y llegan a acuerdos,
(v) profundizar en el fenómeno de la transferencia de políticas de CTI del establecimiento de los CNP en distintos países (comenzando, con la información revisada hasta ahora, desde la experiencia finlandesa con el Science and Technology Policy Council y sus derivaciones),
(vi) el análisis longitudinal de casos de estudio de los CNP-CTI, el análisis comparado transversal de CNP-CTI con nuevas olas de información (como nuevas versiones de la encuesta RESGOV o equivalentes),
(vii) el análisis comparativo de los CNP orientados a la CTI con otros CNP orientados a otros dominios de política,
(viii) incorporar el nivel de análisis en todas las opciones anteriores de los puzzles de organizaciones para CTI;
(ix) finalmente, al nivel de análisis correlacionales y causales se abre la posibilidad de estudio de estas nuevas "variables" organizacionales (por sí solas y como "menú") en relación a distintas métricas de desarrollo de CTI de los países.

Es de esperar que los resultados de esta tesis doctoral (los que se presentan sinópticamente en el Anexo 2) sean un insumo valioso, pero a la vez una parte pequeña de un engranaje mayor, que permitan favorecer un avance conjunto entre las aproximaciones académicas y las políticas de innovación, para lograr nuevos niveles de desarrollo sostenible en el mediano plazo.

Anexo 1
Comunicaciones de Aceptación para Publicación de Manuscritos

M1:

Decision Letter (SPP-2019-172.R1)

From: hinze@dzhw.eu

To: rodrigo.c@estudiante.uam.es, rcevallos@uc.cl

CC:

Subject: Science and Public Policy - Decision on Manuscript ID SPP-2019-172.R1

Body: 18-May-2020

Dear Mr. Cevallos:

It is a pleasure to accept your manuscript titled "National Policy Councils for Science, Technology and Innovation: A scheme for structural definition and implementation" in its current form for publication in Science and Public Policy. The comments of the referee(s) who reviewed your manuscript are included at the foot of this letter.

Thank you for your fine contribution. On behalf of the Editors of Science and Public Policy, we look forward to your continued contributions to the Journal.

Sincerely,
Dr. Sybille Hinze
Editor, Science and Public Policy
hinze@dzhw.eu

Referee(s)' Comments to Author:

This new version of the document is connected to the literature and places its contribution.

Date Sent: 18-May-2020

Fuente: Editores, Revista Science and Public Policy.

M2:

Libro Governance of Science, Technology and Innovation in Latin America - RED GCTI

Luis Antonio Orozco Castro <luis.orozco@uexternado.edu.co> 9 de octubre de 2020 a las 16:59
Para: Nohora Ga|vis <icri,co|ombia@gmail.com>, |van Montenegro Trujillo <imontenegrotrujillo@gmail.com>, K|einsy Bonilla <k|einsy@gmail.com>, Diana Carolina Velasco Malaver <diana.velasco@uni|bague.edu.co>, "sa|im.cha|e|a@unaula.edu.co" <sa|im,cha|e|a@unau|a,edu,co>, LOURDES ELV|RA RODR|GUEZ GUZMAN <|e|virarodriguez@ucundinamarca,edu,co>, Juan Pablo Centeno Cachopo <juan.centeno@uexternado.edu.co>, Nicolás Garzón Rodriguez <nikholas.garzon@gmail.com>, Hector Hera|do Rojas Jimenez <hector,rojas@uexternado,edu,co>, |van Dario Hernandez Umana <ivan,hernandez@uni|bague,edu,co>, Jaime Humberto Sierra Gonzalez <jhsierra@javeriana.edu.co>, JHON ALEXANDER CASTILLO GARCES <a|exander,castillo,g@uniautonoma,edu,co>, Juan David Reina Rozo <jdreinar@unal.edu,co>, Luz Stella Pemberthy Gallo <pemberthyls@unicauca.edu.co>, Mario Pinzon Camargo <m.a.pinzoncamargo@utwente.nl>, PEDRO PABLO Burbano <innovayaco@gmail.com>, Rodrigo Cevallos <rodrigo,c@estudiante,uam,es>, Gustavo Enrique Va|divieso Cervera <gustavo.valdivieso@uexternado.edu.co>, Javier Hernando Garcia Estevez <jh.garcia@uniandes.edu.co>, Cristhian Ruiz <cr,cristhian@gmail.com>, "ribonilla@gmail.com" <ribonilla@gmail.com>, John A|irio Sanabria Tellez <john.sanabria@uexternado.edu.co>, Eliana Fernandez <fernandezelu@gmail.com>
CC: Hector Gonza|o Ordoñez Matamoros <gonza|o,ordonez@uexternado,edu,co>, "|sabe|bortagaray@gmail.com" <|sabe|bortagaray@gmail.com>, Javier Hernando Garcia Estevez <jh.garcia@uniandes.edu.co>, Jaime Humberto Sierra Gonza|ez <jhsierra@javeriana,edu,co>

Apreciados colegas y amigos,

Me complace anunciarles que la editorial Palgrave MacMillan aprobó nuestra propuesta. Felicitaciones a todos por el esfuerzo y gracias por creer en esta iniciativa. Como diría el gran Maestro José Luis Villaveces, un grupo existe por su producción, y en este caso nuestra Red de Gobernanza y Gestión de la Ciencia, la Tecnología y la Innovación Red GCTI tendrá un componente de existencia con esta publicación en una de las editoriales académicas más prestigiosas del mundo.

Luego de la negociación el libro queda dividido en dos volúmenes

Volume 1

Editors: Luis Antonio Orozco, Gonzalo Ordónez-Matamoros, Jaime Humberto Sierra González, Javier García-Estévez, and Isabel Bortagaray

Title: Governance of Science, Technology and Innovation in Latin America, Volume 1: Cases in Social Inclusion and Sustainable Development

Volume 2

Editors: Gonzalo Ordónez-Matamoros, Luis Antonio Orozco, Jaime Humberto Sierra González, Isabel Bortagaray, and Javier García-Estévez

Title: Governance of Science, Technology and Innovation in Latin America, Volume 2: Policy and Governance System Approaches

Series: Palgrave Studies in Democracy, Innovation, and Entrepreneurship for Growth

The book will be published by Palgrave Macmillan and will be distributed worldwide. It will also be included in Palgrave Macmillan's Business and Management package on SpringerLink, which has a global list of subscribing institutions.

La serie está indexada en SCOPUS!

Fuente: Editores, Libro Governance of Science, Technology and Innovation in Latin America.

Anexo 2:
Resumen de Aportes Tesis Doctoral

Aporte Teórico

- **Desarrollo del Concepto "Consejo Nacional de Política Científica, Tecnológica y de Innovación" (CNP-CTI)**, ampliando percepciones previas al respecto y contribuyendo en la especialización del término.

- **Contextualización del Concepto CNP-CTI**, permitiendo que esta organización sea considerada en su riqueza en el contexto del puzle de organizaciones de CTI, permitiendo relacionar estas distintas tipologías.

Aporte Metodológico

- **Creación del Índice iNPC**, permitiendo a futuras investigaciones comenzar desde una base analítica cuantitativa basada en las características estructurales del iNPC.

- **Clasificación de los CNP-CTI**, vinculando las ideas relativas al desarrollo de la política de CTI con las características estructurales de los CNP-CTI en una base analítica cualitativa.

Aporte Práctico

- **Lineamientos para Implementación de CNP-CTI**, estableciendo ciertos principios básicos para la operación de los CNP-CTI, basados en la evidencia recolectada, en pos de mejorar su operación.

Fuente: Autores.

BIBLIOGRAFÍA

Borowiecki, M., & Paunov, C. (2018). *How is research policy across the OECD organised?* ().OECD Publishing. doi:10.1787/235c9806-en Retrieved from http://dx.doi.org/10.1787/235c9806-en

Borrás, S., & Edler, J. (2014). Introduction: On governance, systems and change. In S. Borrás, & J. Edler (Eds.), *The governance of socio-technical systems: Explaining change* (pp. 1-22) Edward Elgar Publishing. doi:10.4337/9781784710194.00010 Retrieved from http://www.elgaronline.com/view/9781784710187.00010.xml

Borrás, S., & Edler, J. (2020). The roles of the state in the governance of socio-technical systems' transformation. *Research Policy, 49*(5), 103971. doi:10.1016/j.respol.2020.103971

Braun, D. (2008). Organising the political coordination of knowledge and innovation policies. *Science and Public Policy, 35*(4), 227-239. doi:10.3152/030234208X287056

Breznitz, D., Ornston, D., & Samford, S. (2018). Mission critical: The ends, means, and design of innovation agencies. *Industrial and Corporate Change, 27*(5), 883-896. doi:10.1093/icc/dty027

Center for International Affairs, Korea Institute of S&T Evaluation and Planning (KISTEP). (2016). *Summary: The 2nd meeting of the global forum of national advisory councils.* ().

Daimer, S., Hufnagl, M., & Warnke, P. (2012). Challenge-oriented policy-making and innovation systems theory. *Innovation System Revisited,* , 217-234. Retrieved from http://www.econis.eu/PPNSET?PPN=737674237

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review, 48*(6), 147. Retrieved from https://search.proquest.com/docview/1289882989

Edler, J., & Fagerberg, J. (2017). Innovation policy: What, why, and how. *Oxford Review of Economic Policy, 33*(1), 2-23. doi:10.1093/oxrep/grx001

Edquist, C. (2005). Systems of innovation, perspectives and challenges. In J. Fagerberg, D. Mowery & R. Nelson (Eds.), *The oxford handbook of innovation* (). New York: Oxford University Press.

Edquist, C. (2018). Towards a holistic innovation policy: Can the swedish national innovation council (NIC) be a role model? *Research Policy,* doi:10.1016/j.respol.2018.10.008

Escobar, B., & Valenzuela, A. (2015). *Autoridades para la promoción de innovación: ¿cuán efectivos son los diferentes modelos nacionales?*. Santiago, Chile: CIEPLAN.

Fagerberg, J., & Hutschenreiter, G. (2020). Coping with societal challenges: Lessons for innovation policy governance. *Journal of Industry, Competition and Trade, 20*(2), 279-305. doi:10.1007/s10842-019-00332-1

Flanagan, K., & Uyarra, E. (2016). Four dangers in innovation policy studies - and how to avoid them. *Industry and Innovation, 23*(2), 177-188. doi:10.1080/13662716.2016.1146126

Foxley, A., Saez, R. E., & Valenzuela, A. (2015). *Outcome report on the first meeting of the global forum of national advisory councils on science, technology and innovation.* (). Santiago, Chile:

Kuhlmann, S., & Rip, A. (2018). Next-generation innovation policy and grand challenges. *Science and Public Policy, 45*(4), 448-454. doi:10.1093/scipol/scy011

Lepori, B., & Reale, E. (2019). The changing governance of research systems. agencification and organizational differentiation in research funding organizations. In D. Simon, S. Kuhlmann, J. Stamm & W. Canzler (Eds.), *Handbook on science and public policy* (). Norhampton: Edward Elgar.

Mazzucato, M. (2018). Mission-oriented innovation policies: Challenges and opportunities. *Industrial and Corporate Change, 27*(5), 803-815. doi:10.1093/icc/dty034

OECD. (2009). *Chile's national innovation council for competitiveness.* ().

OECD. (2018). *Oecd database of governance of public research policy (resgov)*

Pelkonen, A. (2006). The problem of integrated innovation policy: Analyzing the governing role of the science and technology policy council of finland. *Science and Public Policy, 33*(9), 669-680. doi:10.3152/147154306781778623

Puranam, P. (2018). *The microstructure of organizations* (First edition ed.). Oxford: Oxford University Press. doi:10.1093/oso/9780199672363.001.0001 Retrieved from http://www.oxfordscholarship.com/view/10.1093/oso/9780199672363.001.0001/oso-9780199672363

Schwaag-Serger, S., Wise, E., & Arnold, E. (2015). *National research and innovation councils as an instrument of innovation governance.* (). Retrieved from http://lup.lub.lu.se/record/358845c4-356c-4b46-a5a2-c6cfdfd81a5f

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy, 42*(9), 1568-1580. doi:10.1016/j.respol.2013.05.008

The World Bank. (2008). *Chile: Toward a cohesive and well governed national innovation system.* ().Washington, DC. Retrieved from http://hdl.handle.net/10986/28202

Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change. *Research Policy, 41*(6), 1037-1047. doi:10.1016/j.respol.2011.10.015