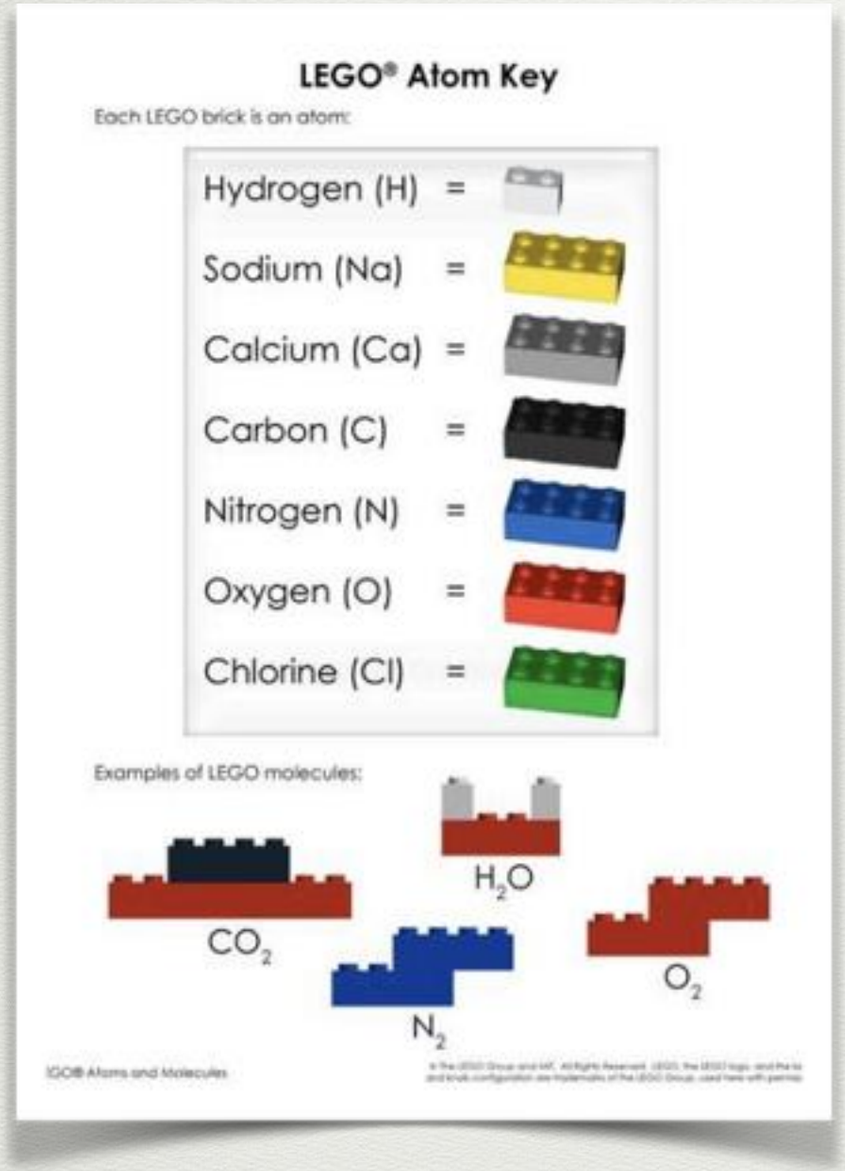
CARTOGRAFÍA DEL CONOCIMIENTO EN CHILE

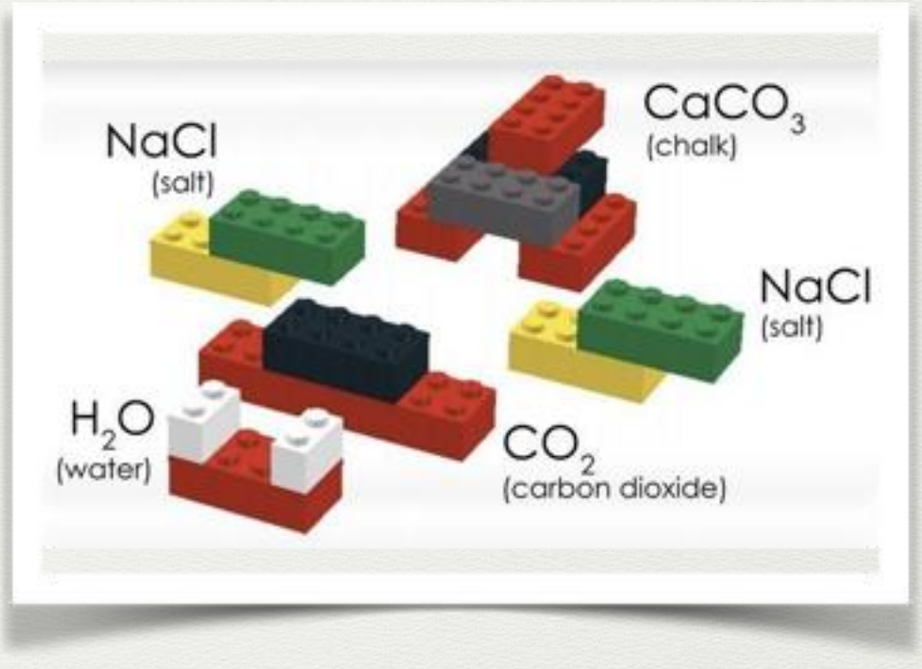
LA IMPORTANCIA DE LOS VÍNCULOS EN LA PRODUCCIÓN CIENTÍFICA

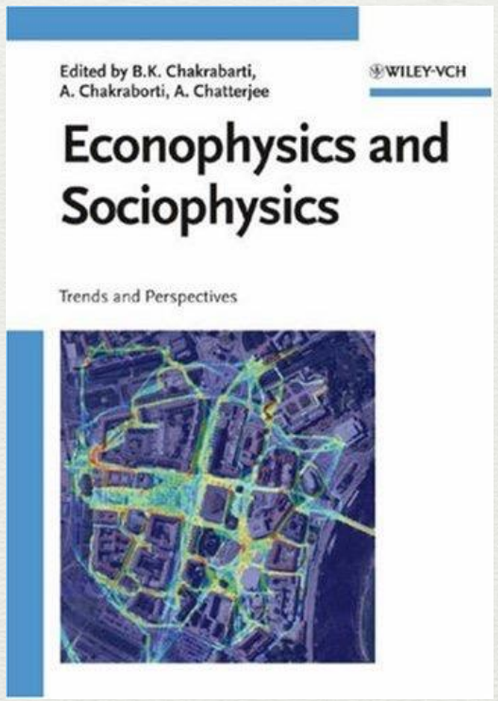
Juan Pablo Cárdenas, Fabiola Cabrera, Graciela Moguillansky, Gastón Olivares

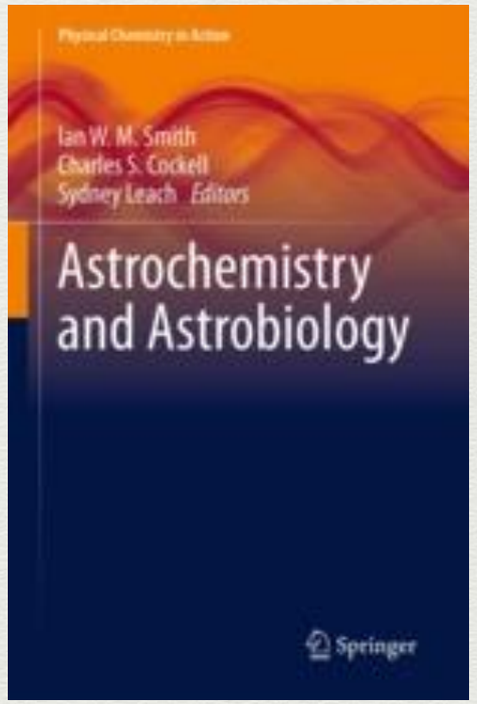
Relación entre disciplinas científicas

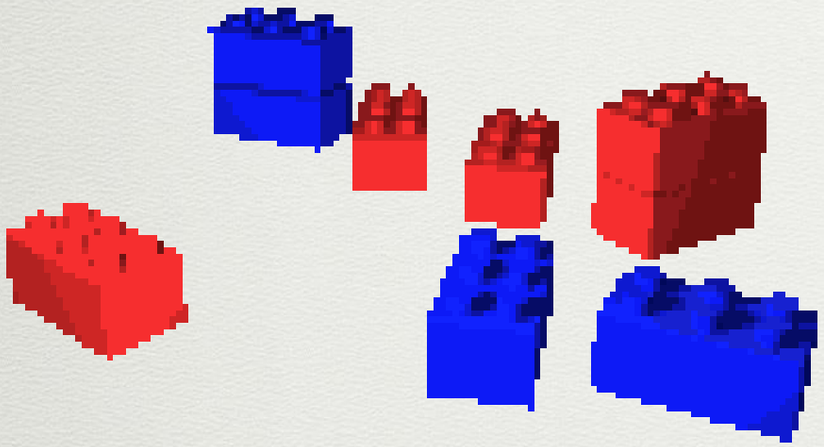
- El conocimiento científico se vincula por complemento para responder preguntas.


LEGO® Atom Key
Each LEGO brick is an atom:
Hydrogen (H) =
Sodium (Na) =
Calcium (Ca) =
Carbon (C) =
Nitrogen (N) =
Oxygen (O) =
Chlorine (Cl) =
Examples of LEGO molecules:
H_2O
CO_2
N_2
O_2
LEGO® Atoms and Molecules


NaCl
(salt)
$CaCO_3$
(chalk)
NaCl
(salt)
H_2O
(water)
CO_2
(carbon dioxide)


Edited by B.K. Chakrabarti,
A. Chakraborti, A. Chatterjee
WILEY-VCH
Econophysics and Sociophysics
Trends and Perspectives


Physical Chemistry in Action
Ian W. M. Smith
Charles S. Cockell
Sydney Leach Editors
Astrochemistry and Astrobiology
Springer



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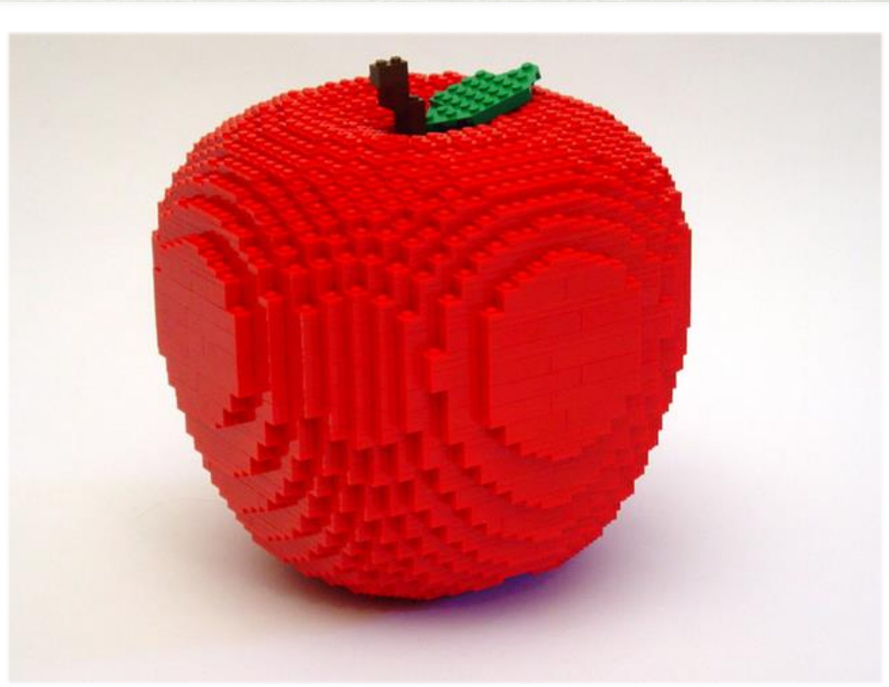
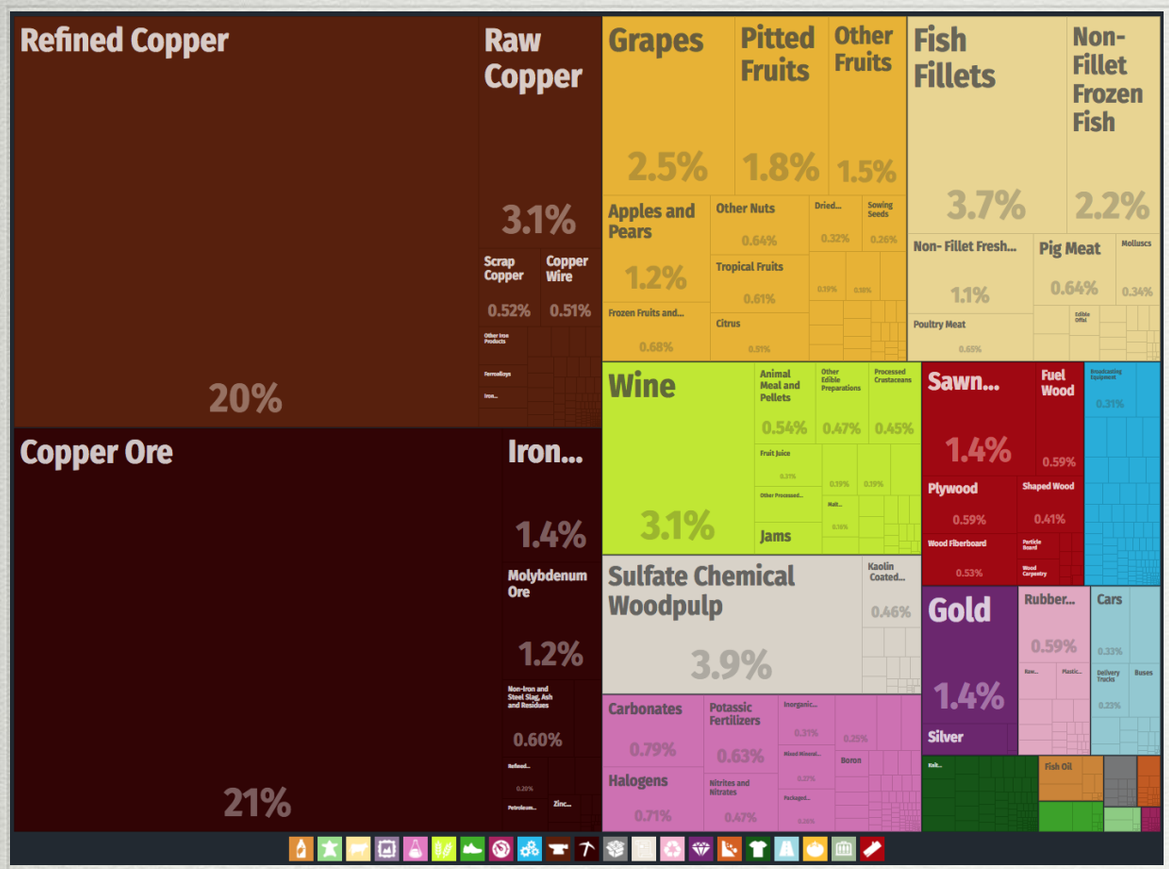


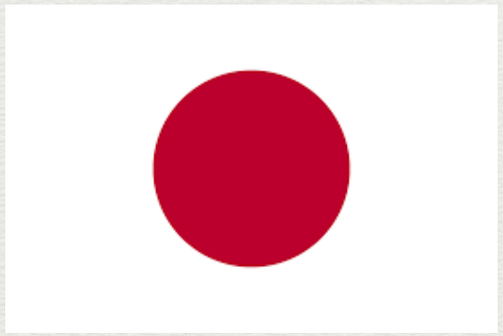
Complejidad Económica

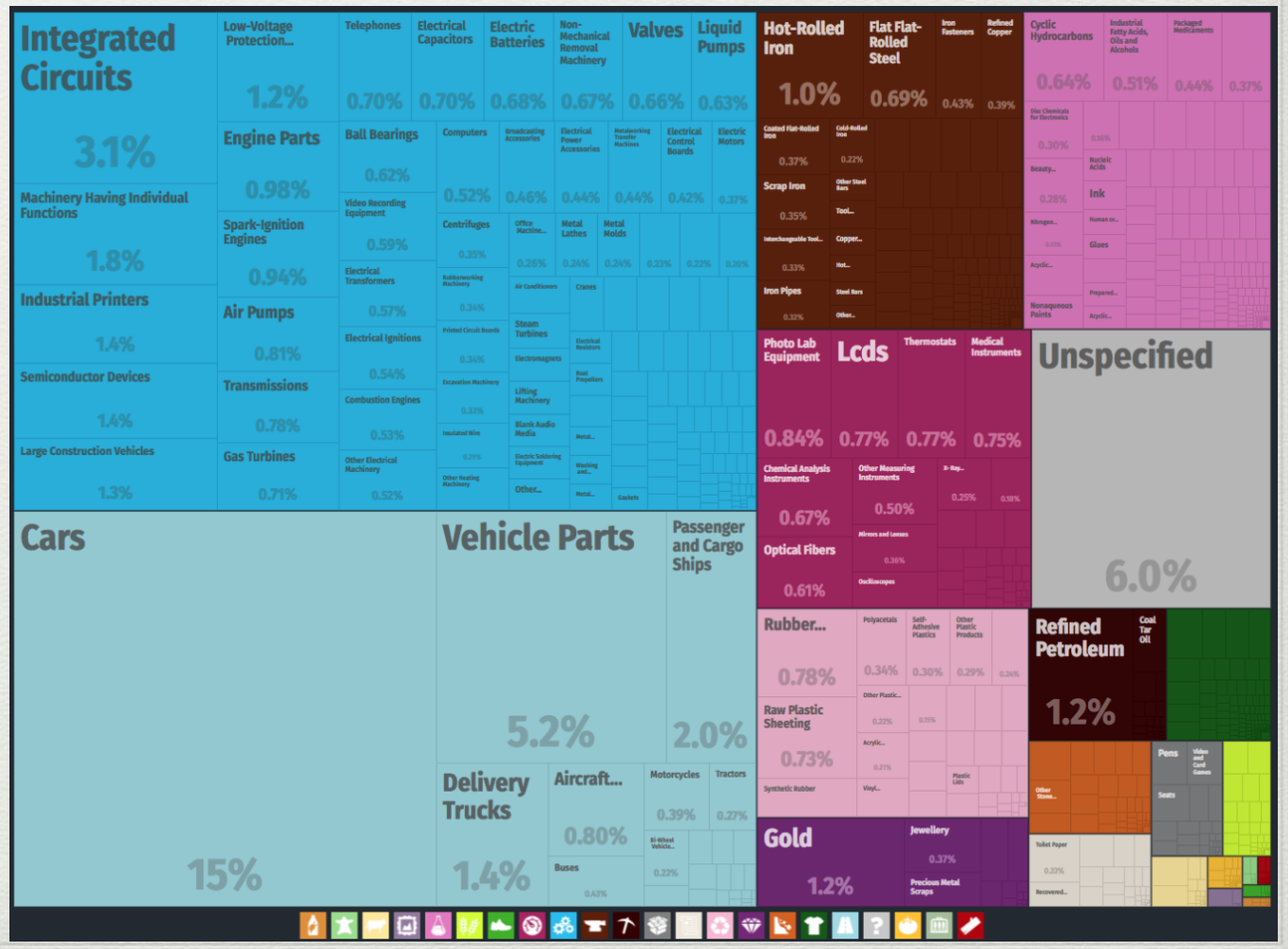
	País	2011	2012	2013	2014	2015	2016	
1	Japón	2.31329	2.32408	2.37352	2.31842	2.34767	2.61516	
2	Corea del Sur	1.70696	1.64658	1.82762	1.90646	1.97403	2.37378	
3	Suiza	1.95964	2.01041	2.05181	1.99456	2.12416	2.33787	
4	Singapur	1.68651	1.70347	1.71717	1.71171	1.72081	2.25069	
5	Alemania	1.9408	1.87347	1.84608	1.81367	1.91906	1.89207	
6	Hong Kong	0.801652	1.09895	1.26313	1.35236	1.35536	1.47134	
7	República Checa	1.69489	1.68896	1.53381	1.52129	1.56023	1.42049	
8	Estados Unidos	1.49138	1.45359	1.43702	1.30167	1.32592	1.3899	
9	Reino Unido	1.54878	1.49378	1.45544	1.40296	1.34514	1.36113	

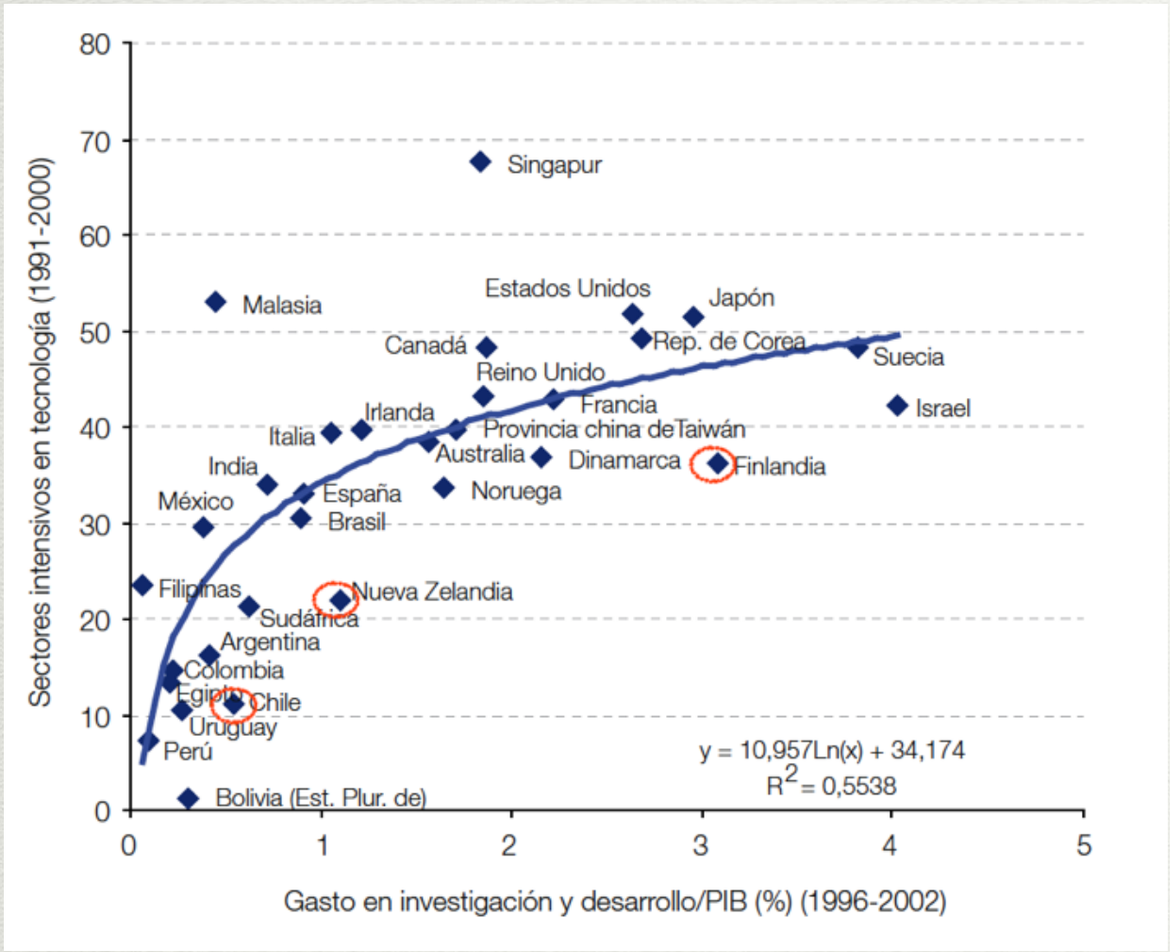
⋮

67	Albania	0.272749	-0.472586	-0.684933	-0.542079	-0.650885	-0.871937	
68	Argentina	-0.063178	-0.148047	-0.496513	-0.502072	-0.528185	-0.882143	
69	Chile	-0.328124	-0.333627	-0.499261	-0.532363	-0.592885	-0.899662	
70	Marruecos	-0.509268	-0.535805	-0.774475	-0.559651	-0.747625	-0.944238	

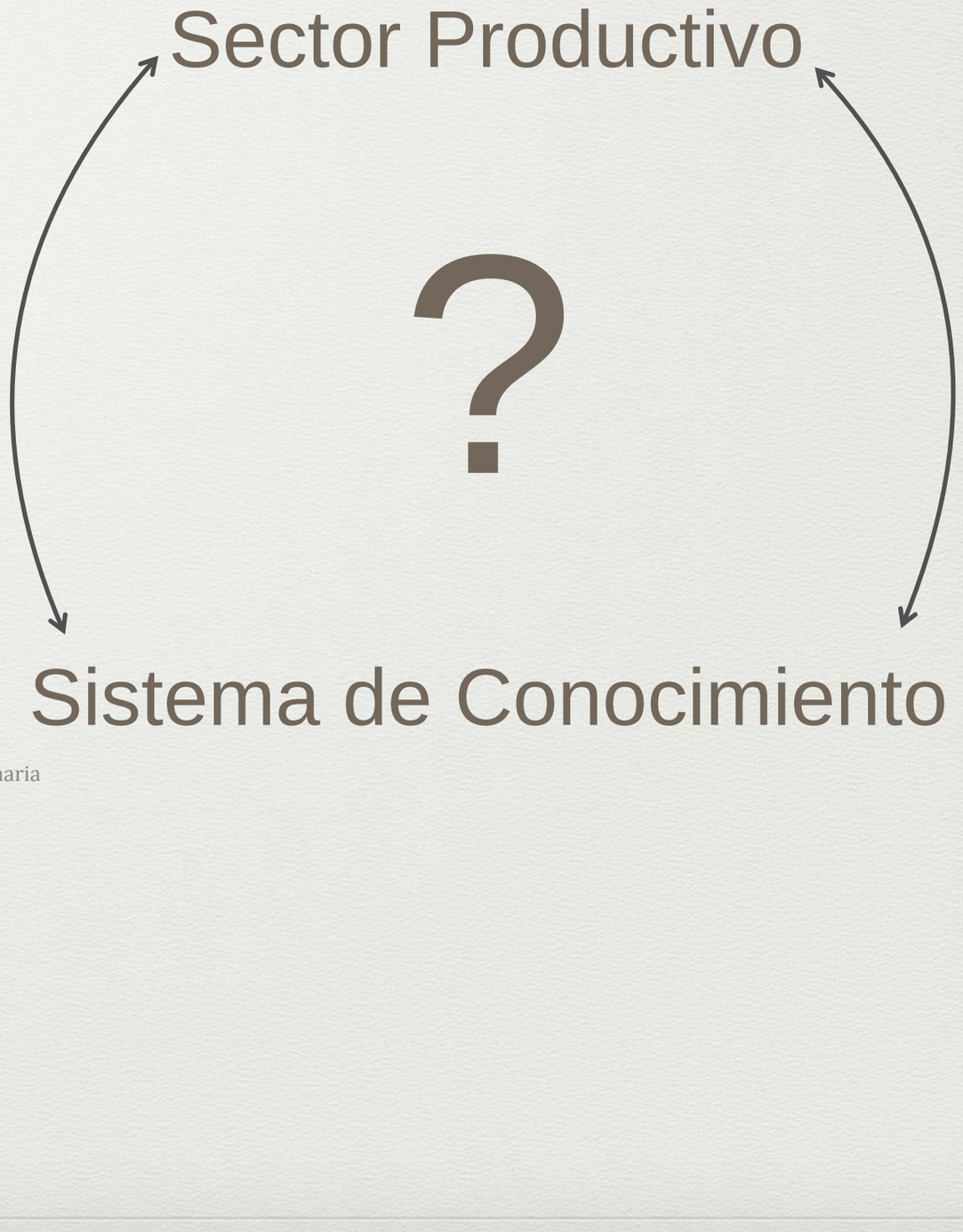

Refined Copper
20%
Raw Copper
3.1%
Scrap Copper
0.52%
Copper Wire
0.51%
Copper Ore
21%
Iron...
1.4%
Molybdenum Ore
1.2%
0.60%
Grapes
2.5%
Pitted Fruits
1.8%
Other Fruits
1.5%
Apples and Pears
1.2%
Other Nuts
0.64%
Tropical Fruits
0.61%
Frozen Fruits and...
0.68%
Citrus
0.51%
Fish Fillets
3.7%
Non-Fillet Frozen Fish
2.2%
Non- Fillet Fresh...
1.1%
Pig Meat
0.64%
Molluscs
0.34%
Poultry Meat
0.65%
Wine
3.1%
Animal Meal and Pellets
0.54%
Other Edible Preparations
0.47%
Processed Crustaceans
0.45%
Jams
Sawn...
1.4%
Fuel Wood
0.59%
Plywood
0.59%
Shaped Wood
0.41%
Wood Fiberboard
0.53%
Sulfate Chemical Woodpulp
3.9%
Kaolin Coated...
0.46%
Gold
1.4%
Silver
Rubber...
0.59%
Cars
0.33%
Delivery Trucks
0.23%
Buses
Carbonates
0.79%
Potassic Fertilizers
0.63%
Halogens
0.71%
Nitrites and Nitrates
0.47%
Boron
0.25%
Fish Oil



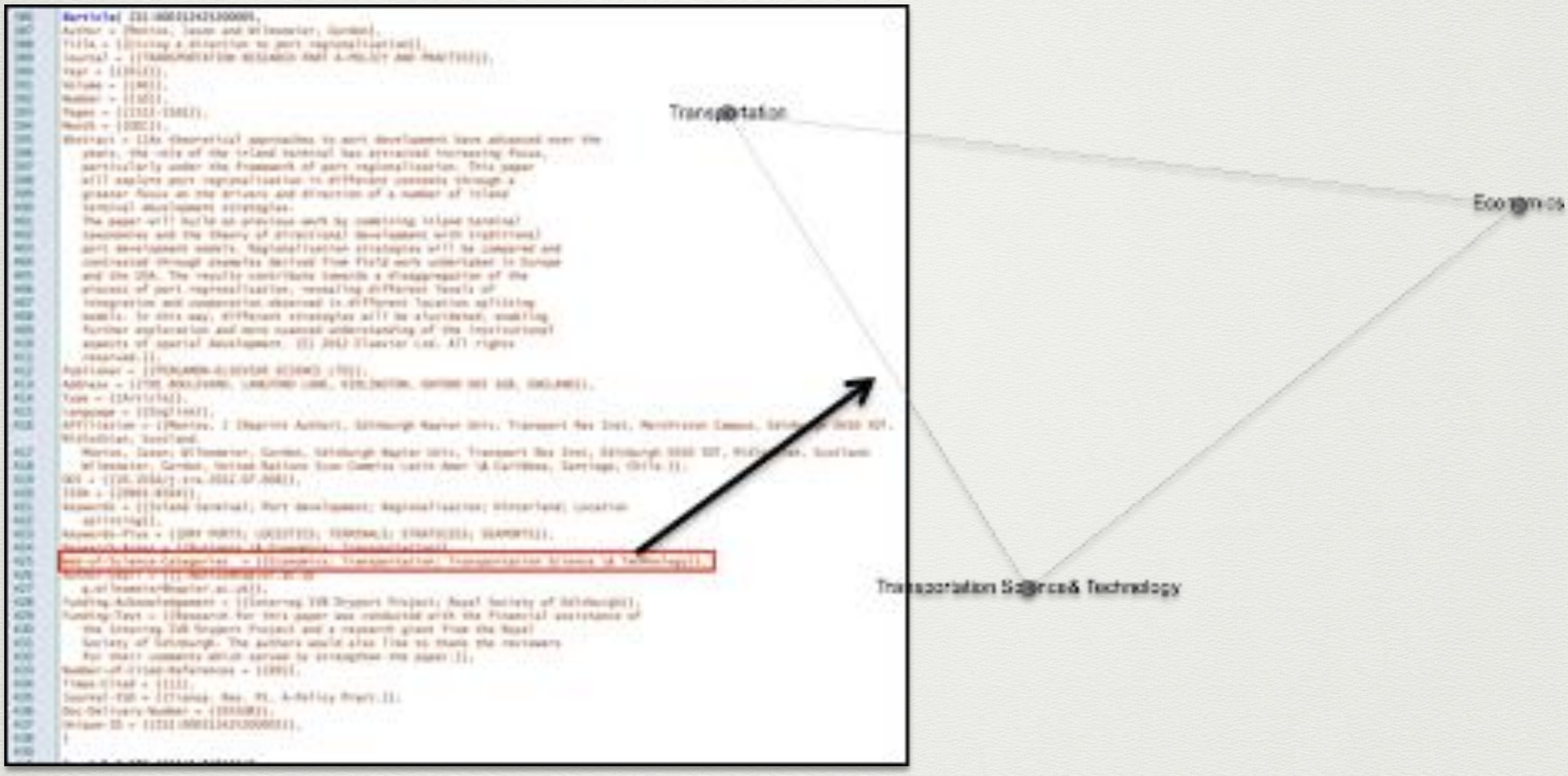

Integrated Circuits
3.1%
Machinery Having Individual Functions
1.8%
Industrial Printers
1.4%
Semiconductor Devices
1.4%
Large Construction Vehicles
1.3%
Low-Voltage Protection...
1.2%
Engine Parts
0.98%
Spark-Ignition Engines
0.94%
Air Pumps
0.81%
Transmissions
0.78%
Gas Turbines
0.71%
Telephones
0.70%
Electrical Capacitors
0.70%
Electric Batteries
0.68%
Non-Mechanical Removal Machinery
0.67%
Valves
0.66%
Liquid Pumps
0.63%
Ball Bearings
0.62%
Video Recording Equipment
0.59%
Electrical Transformers
0.57%
Electrical Ignitions
0.54%
Combustion Engines
0.53%
Other Electrical Machinery
0.52%
Computers
0.52%
Broadcasting Accessories
0.46%
Electrical Power Accessories
0.44%
Metalworking Transfer Machines
0.44%
Electrical Control Boards
0.42%
Electric Motors
0.37%
Centrifuges
0.35%
Office Machine...
0.26%
Metal Lathes
0.24%
Metal Molds
0.24%
0.23%
0.22%
0.20%
Air Conditioners
Cranes
Steam Turbines
Electromagnets
Lifting Machinery
Blank Audio Media
Electric Soldering Equipment
Other...
Electrical Resistors
Boat Propellers
Metal...
Washing and...
Metal...
Gaskets
Hot-Rolled Iron
1.0%
Flat Flat-Rolled Steel
0.69%
Iron Fasteners
0.43%
Refined Copper
0.39%
Coated Flat-Rolled Iron
0.37%
Cold-Rolled Iron
0.22%
Scrap Iron
0.35%
Other Steel Bars
Tool...
Interchangeable Tool...
0.33%
Copper...
Hot...
Iron Pipes
0.32%
Steel Bars
Other...
Cyclic Hydrocarbons
0.64%
Industrial Fatty Acids, Oils and Alcohols
0.51%
Packaged Medicaments
0.44%
0.37%
Disc Chemicals for Electronics
0.30%
Nucleic Acids
Beauty...
0.28%
Ink
Kilnges...
0.23%
Humas or...
Glues
Acyclic...
Prepared...
Nonaqueous Paints
Acyclic...
Photo Lab Equipment
0.84%
Lcds
0.77%
Thermostats
0.77%
Medical Instruments
0.75%
Chemical Analysis Instruments
0.67%
Other Measuring Instruments
0.50%
X- Ray...
0.25%
0.18%
Optical Fibers
0.61%
Mirrors and Lenses
0.36%
Oscilloscopes
Unspecified
6.0%
Cars
15%
Vehicle Parts
5.2%
Passenger and Cargo Ships
2.0%
Delivery Trucks
1.4%
Aircraft...
0.80%
Buses
0.43%
Motorcycles
0.39%
Tractors
0.27%
Bi-Wheel Vehicle...
0.22%
Rubber...
0.78%
Polyacetals
0.34%
Self-Adhesive Plastics
0.30%
Other Plastic Products
0.29%
0.24%
Raw Plastic Sheeting
0.73%
Other Plastic...
0.22%
Acrylic...
0.21%
Plastic Lids
0.33%
Synthetic Rubber
Vinyl...
Refined Petroleum
1.2%
Coal Tar Oil
Other Stone...
Pens
Video and Card Games
Seats
Toilet Paper
0.22%
Recovered...
Gold
1.2%
Jewellery
0.37%
Precious Metal Scraps



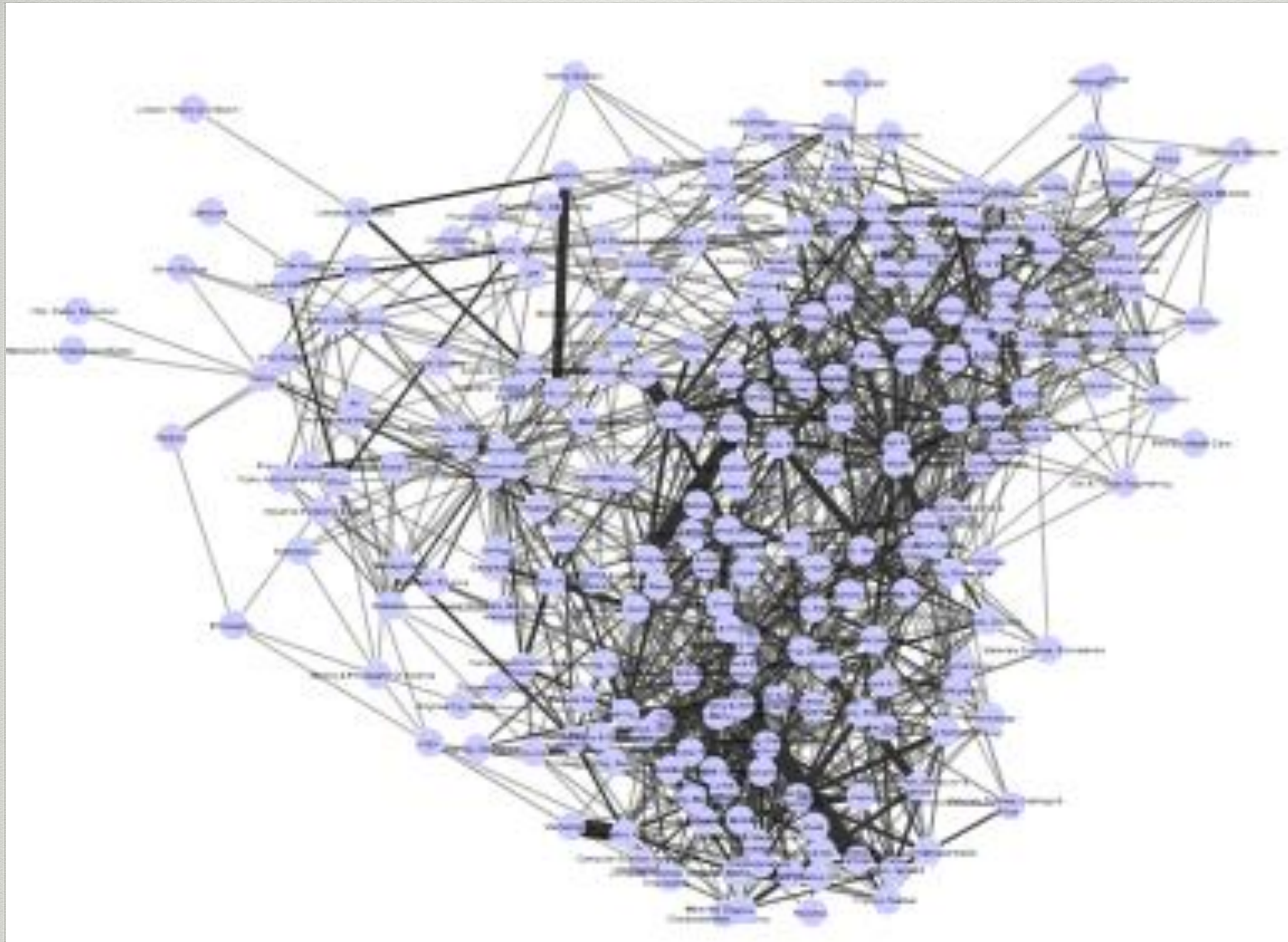
Los sectores considerados como intensivos en tecnología son: productos fabricados de metal, maquinaria, maquinaria eléctrica, equipo de transporte, equipo técnico y profesional (CEPAL, 2010).

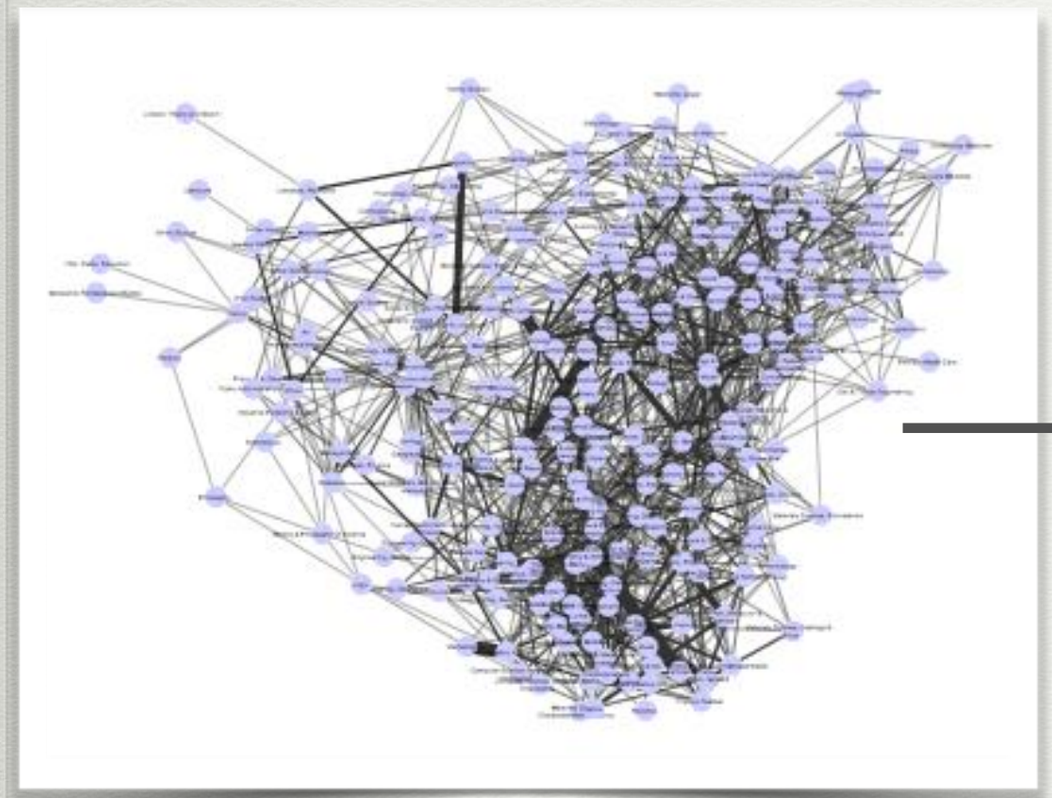


Metodología



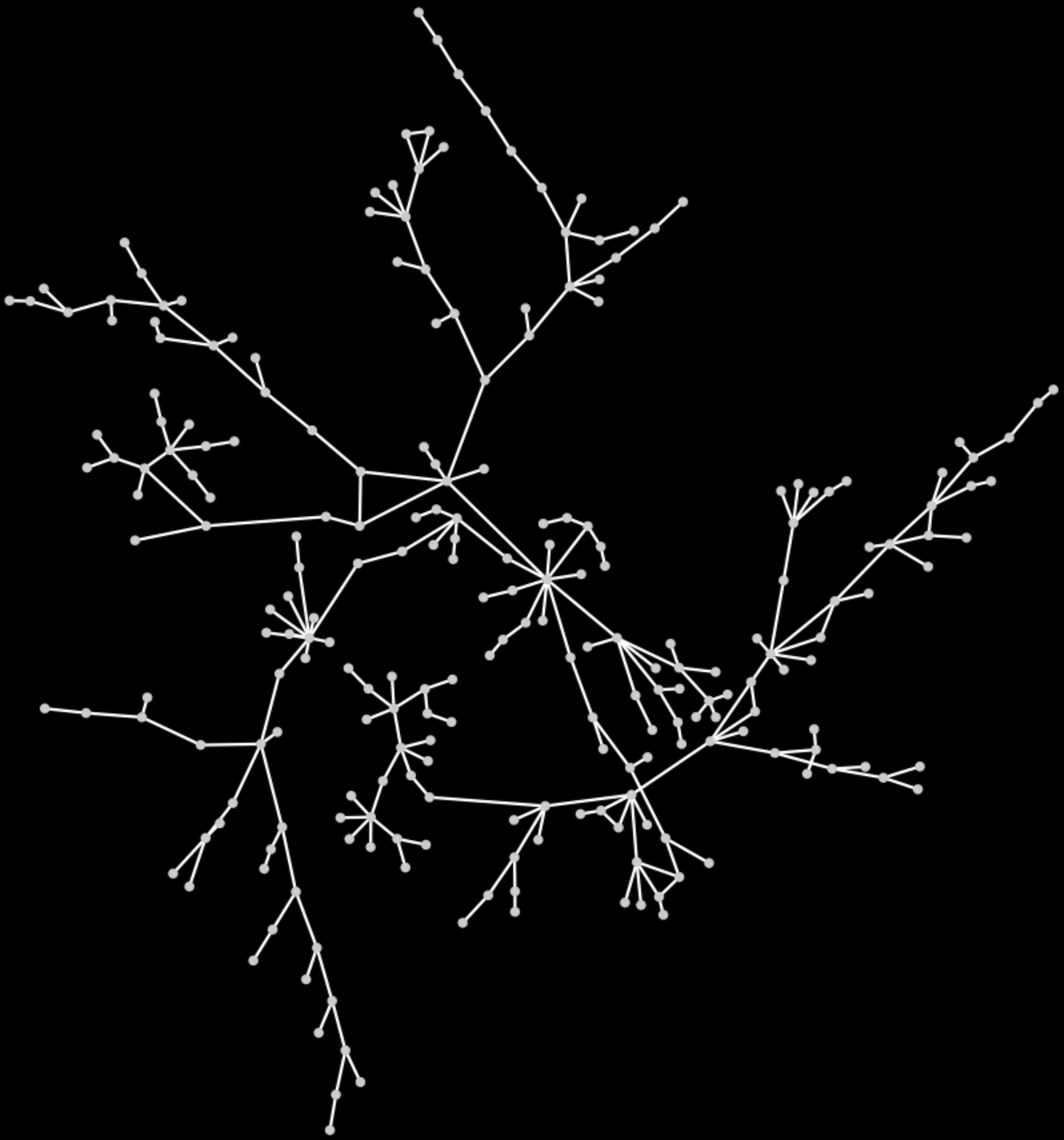
Base de datos ISI-WoS (2004-2014)
48.667 artículos con al menos 1 autor afiliado a alguna institución Chilena

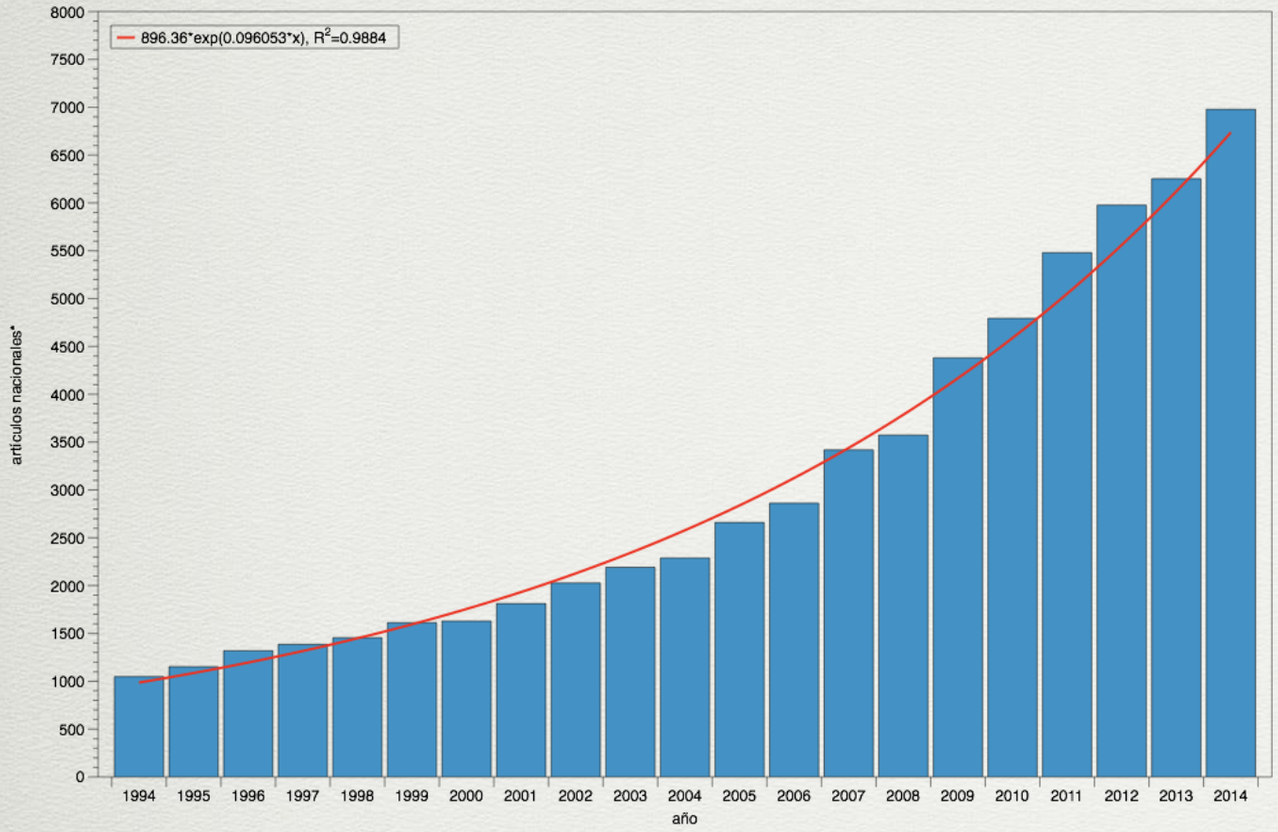




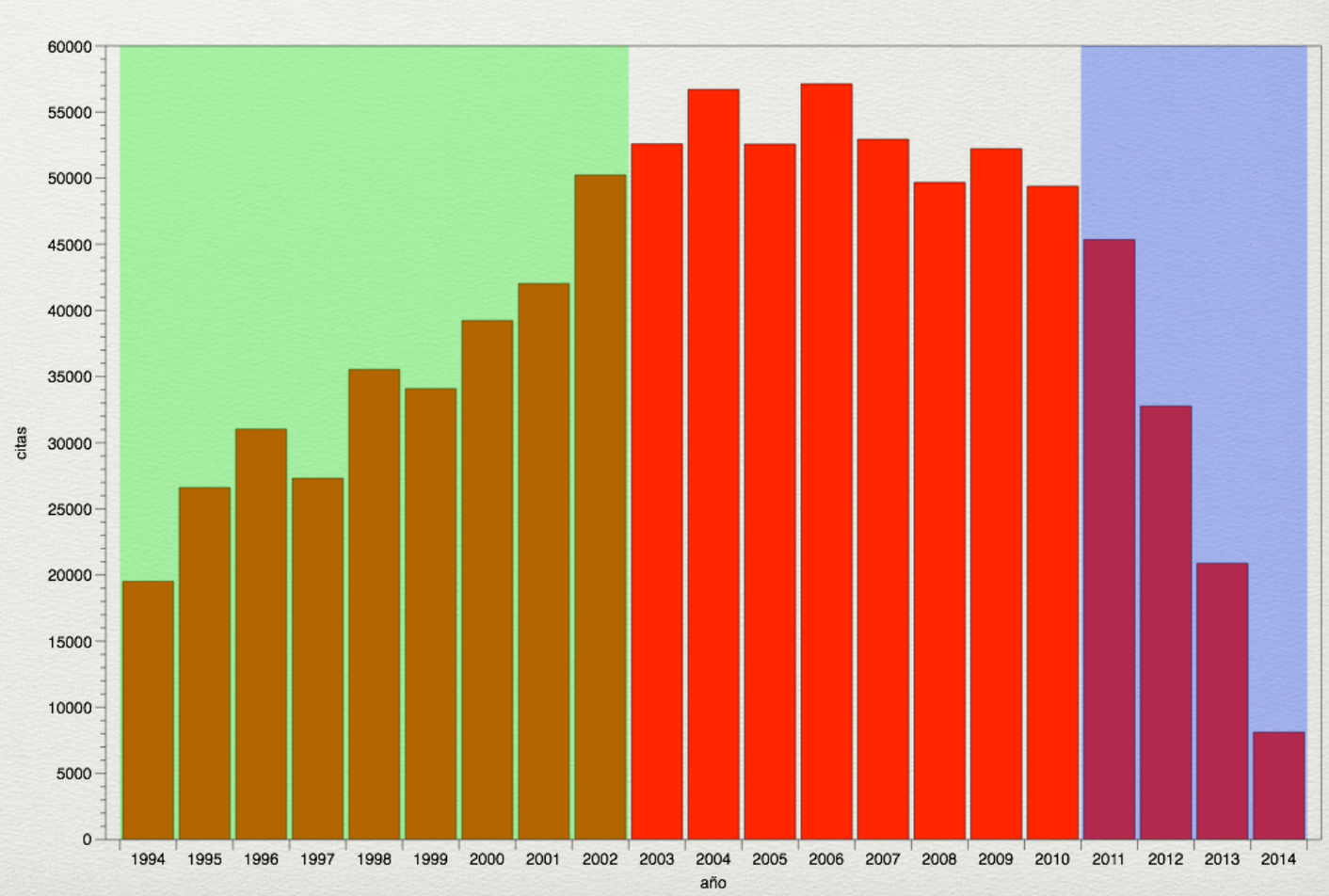
MST

Cartografía
Conocimiento

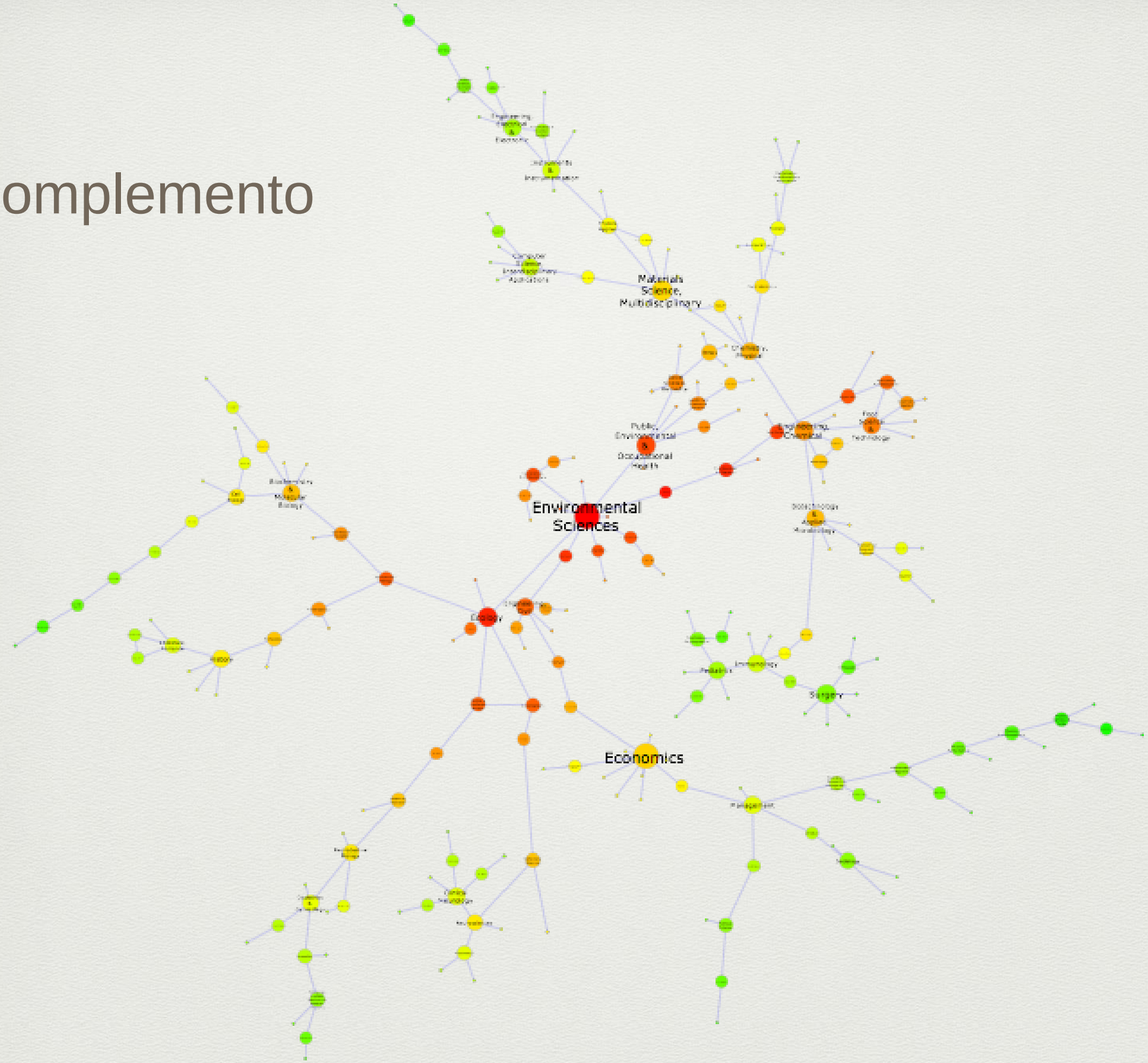




Producción e Impacto



Complemento

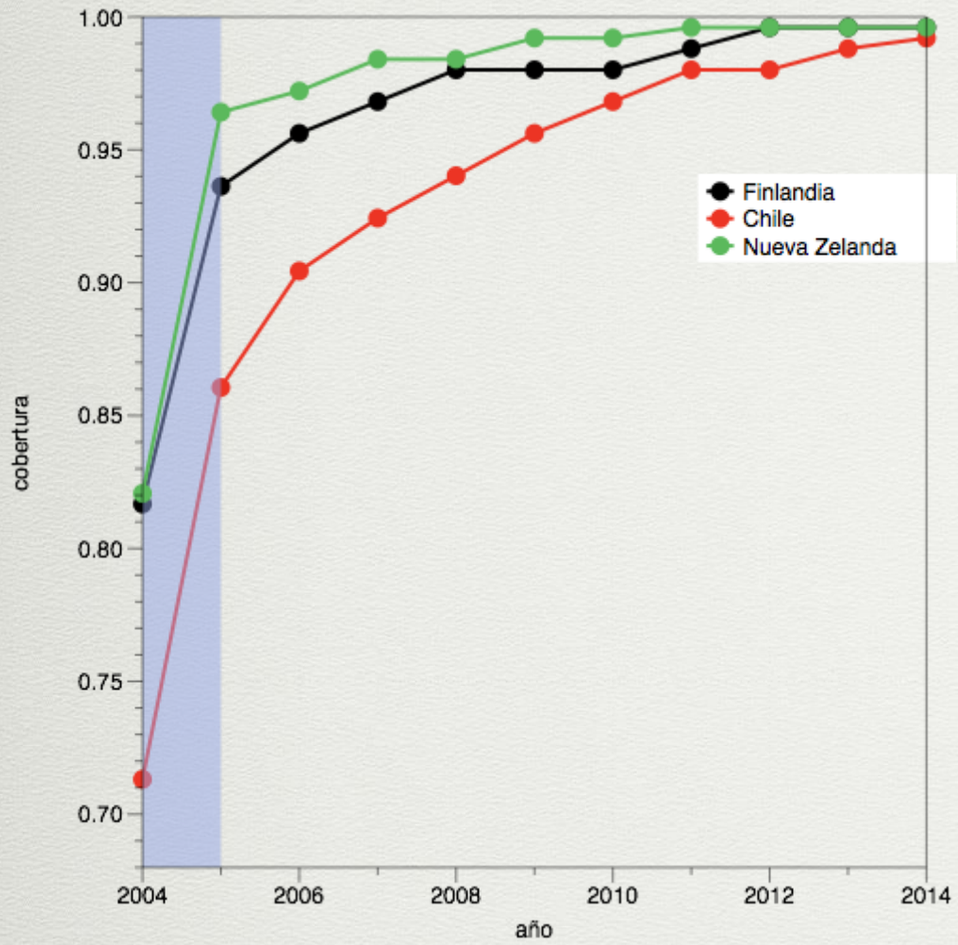


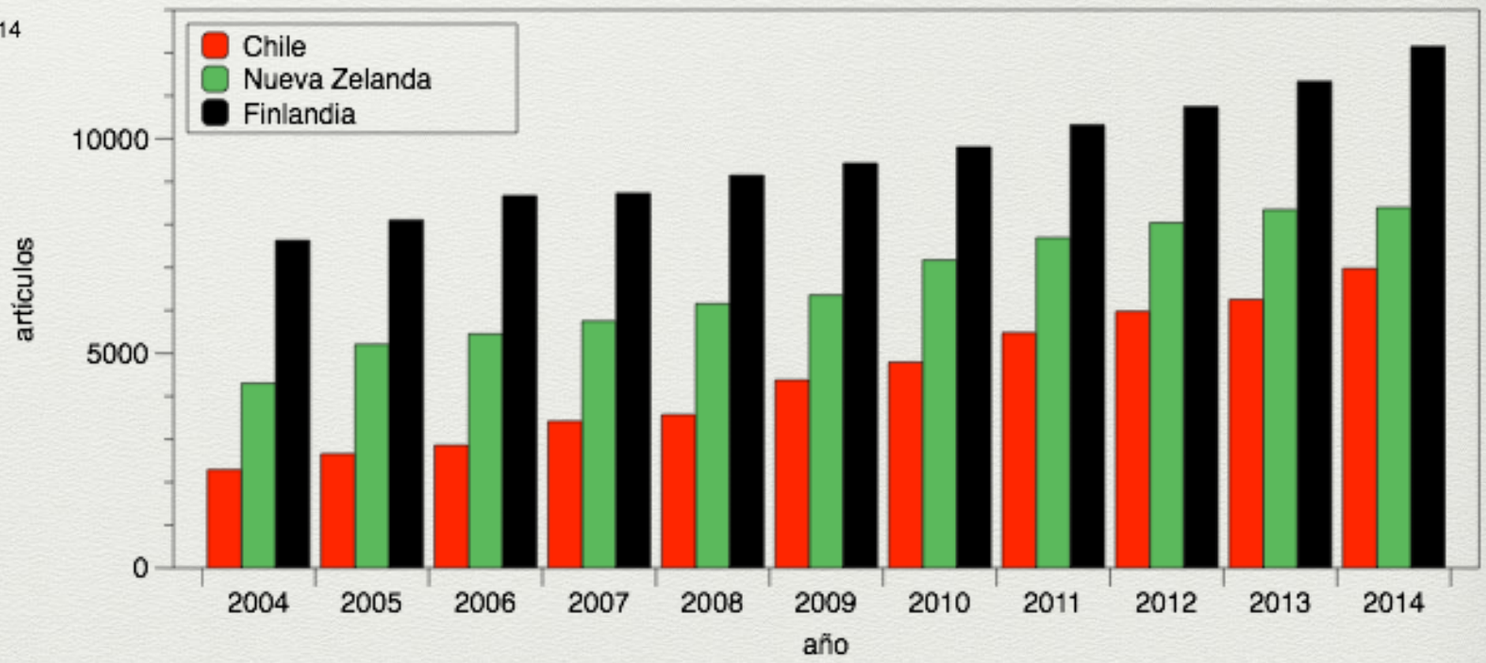
Producción e Impacto

Proporción de “chilenos”

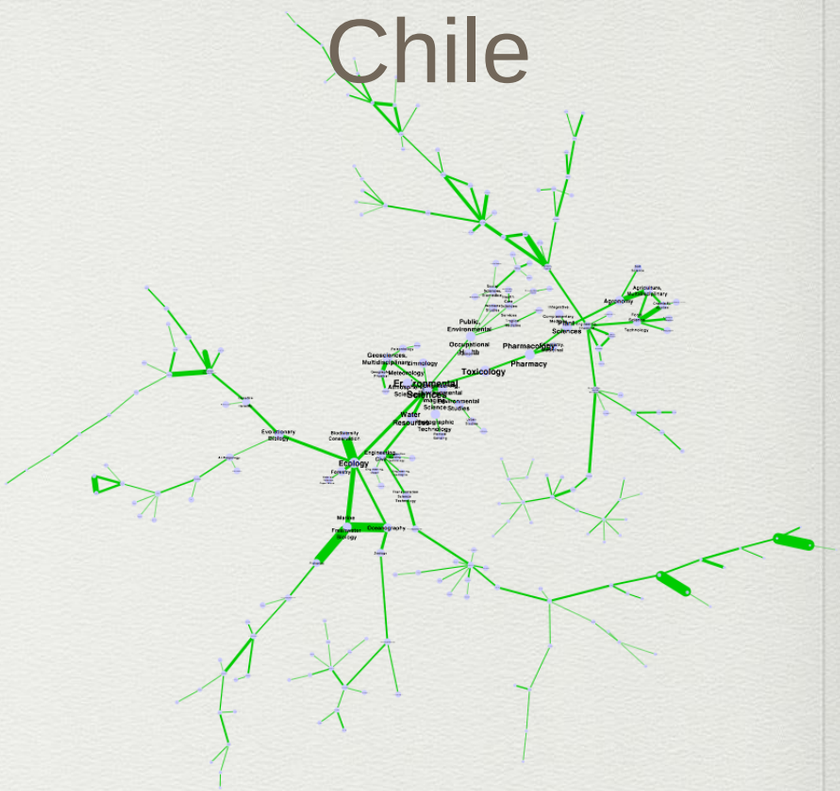
Recursos Naturales

El núcleo del conocimiento Chileno está en disciplinas tales como las **Ciencias Medio Ambientales, Ecología, Biodiversidad y Conservación**, junto a **Ciencias del Mar y de la Tierra**. Destacan también algunas disciplinas **Agrícolas** y algunas **Médicas** relacionadas a sus productos, ciencias de la **Ingeniería, ciencias Químicas, y otras vinculadas a la Minería**.

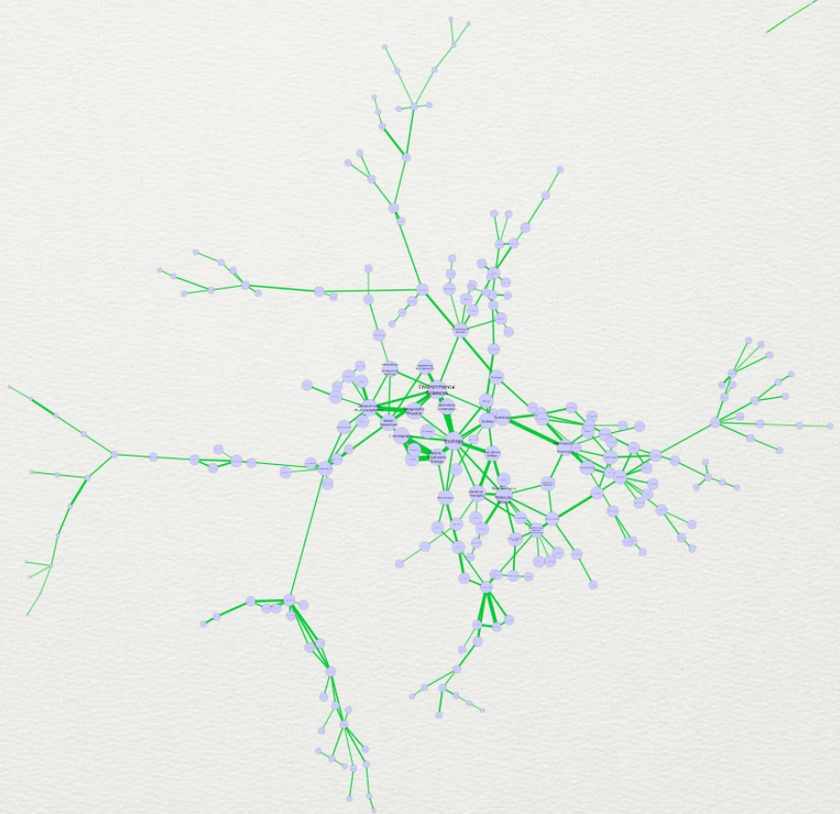

1.00
0.95
0.90
0.85
0.80
0.75
0.70
cobertura
2004
2006
2008
2010
2012
2014
año
Finlandia
Chile
Nueva Zelanda


Chile
Nueva Zelanda
Finlandia
10000
5000
0
artículos
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
año

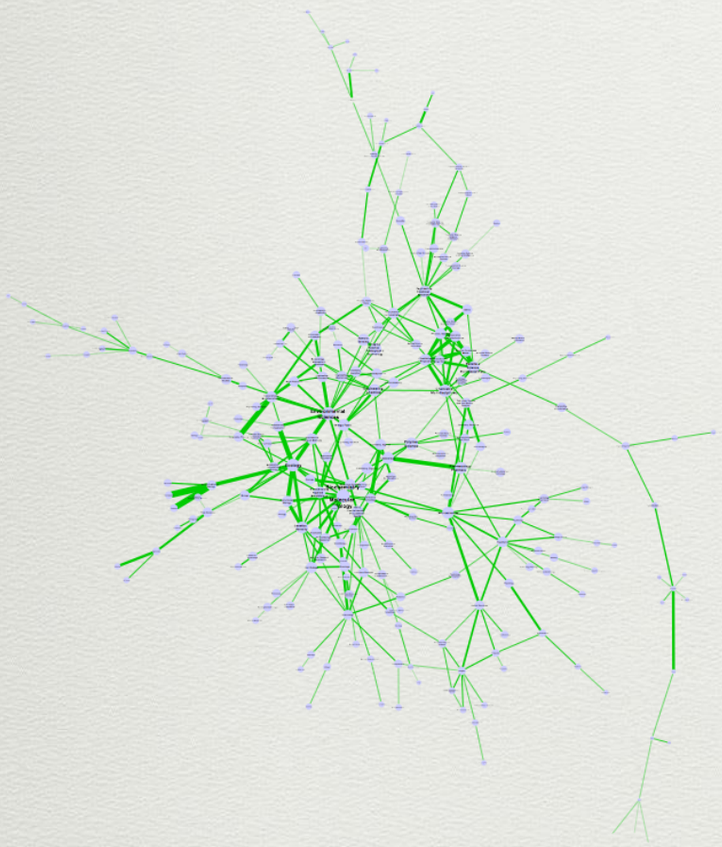
Chile



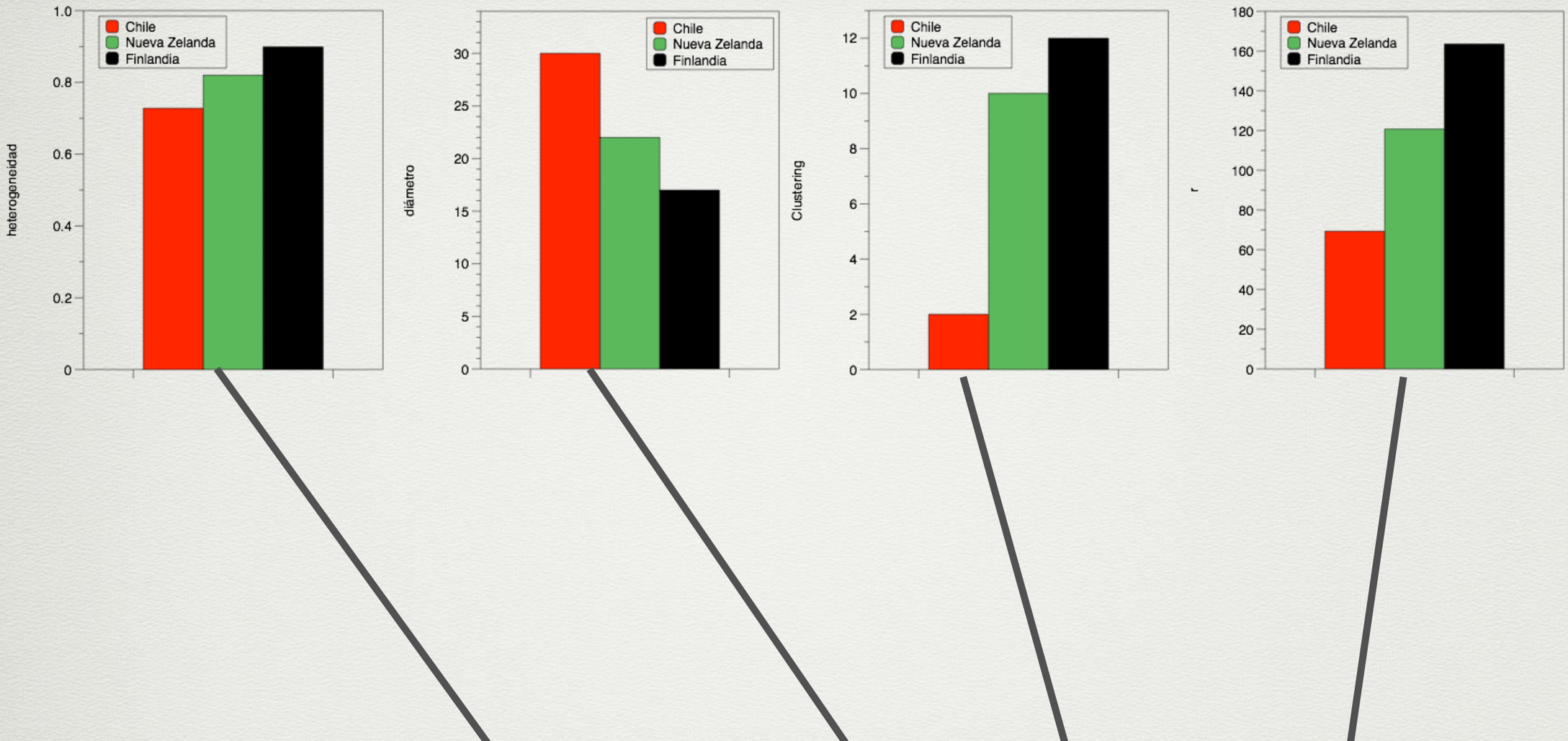
Nueva Zelanda



Finlandia

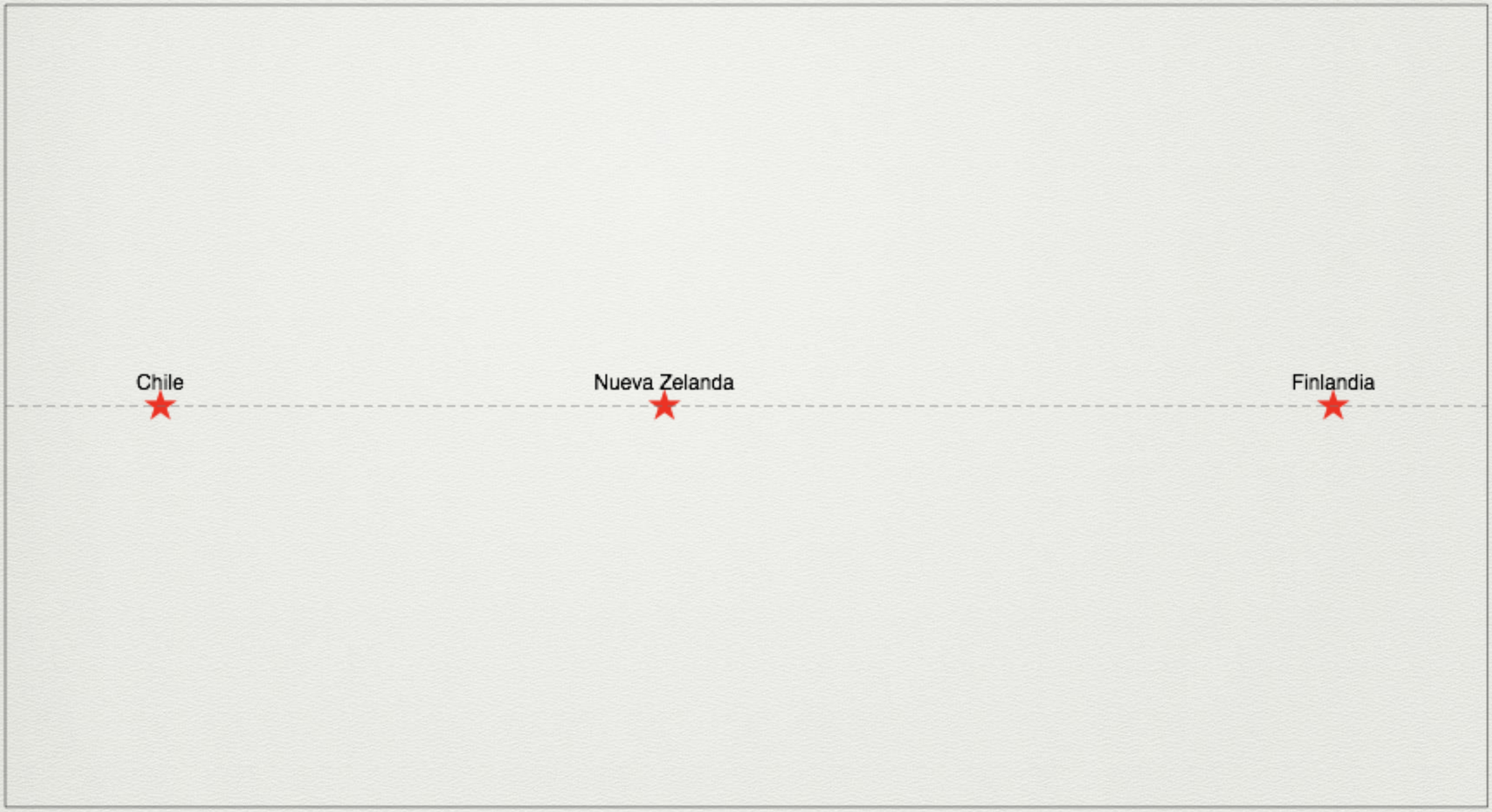


Complejidad = propiedades de red

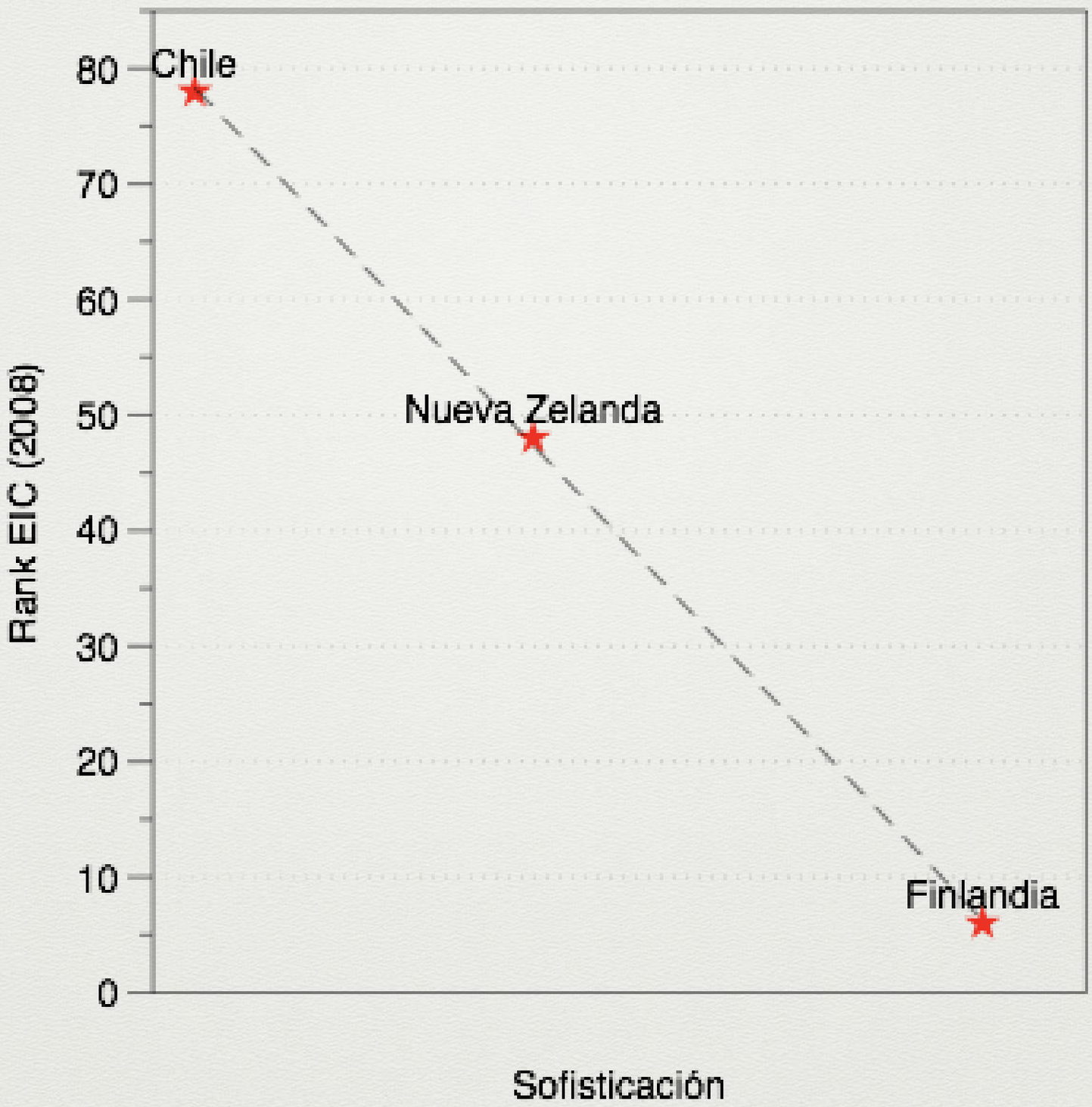


$$S = (H + ((1/d) \times C)) \times r$$

Sofisticación del Sistema



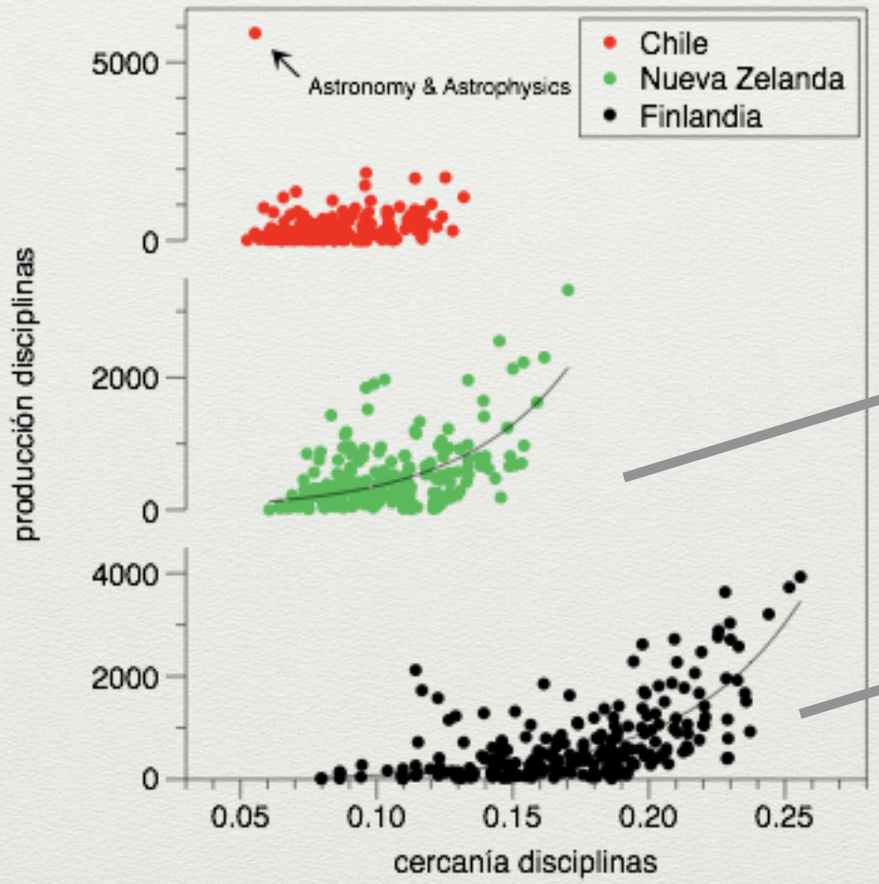
- ⟵ Sofisticación del Sistema de Conocimiento ⟶ +


Chile
Nueva Zelanda
Finlandia
80
70
60
50
40
30
20
10
0
Rank EIC (2008)
Sofisticación

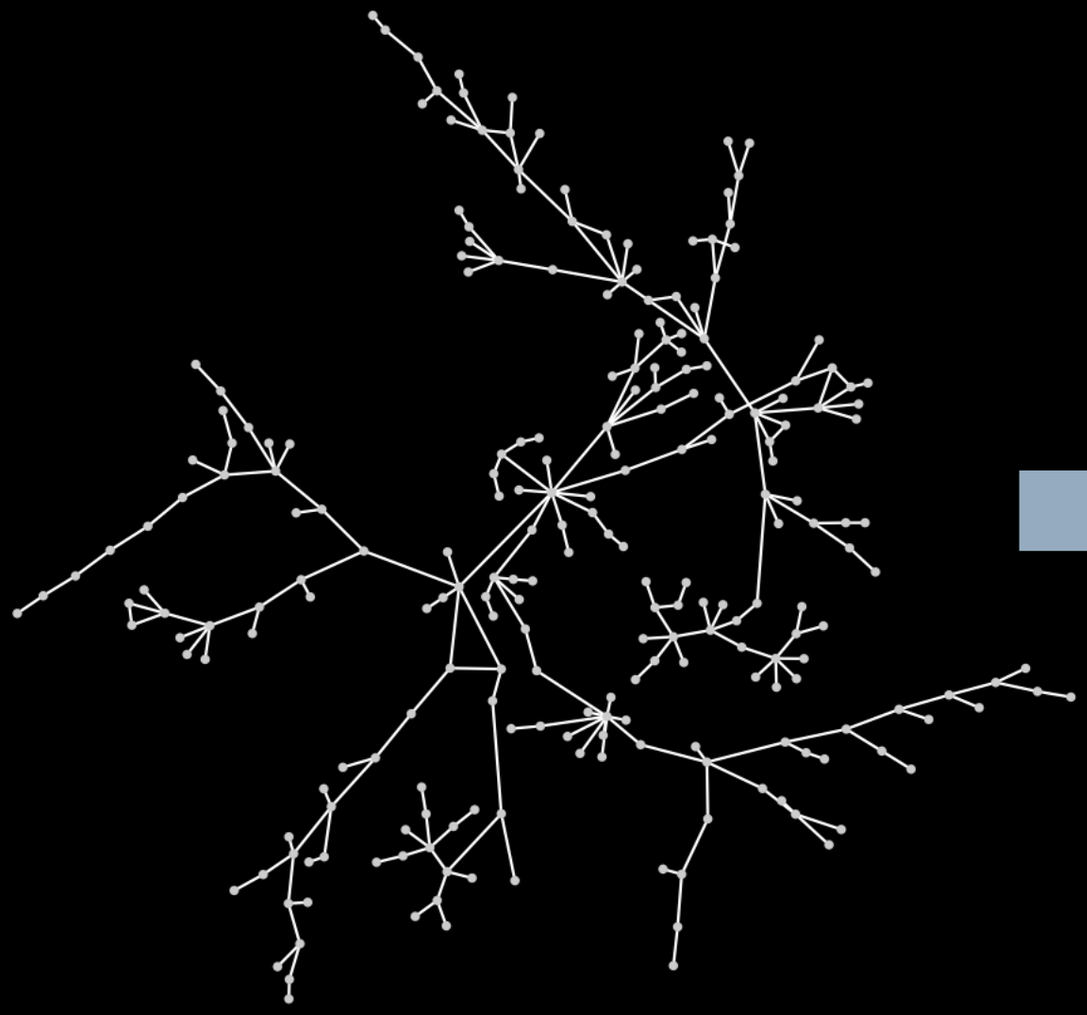
Finlandia

Nueva Zelanda

Chile



El núcleo del conocimiento es también muy productivo

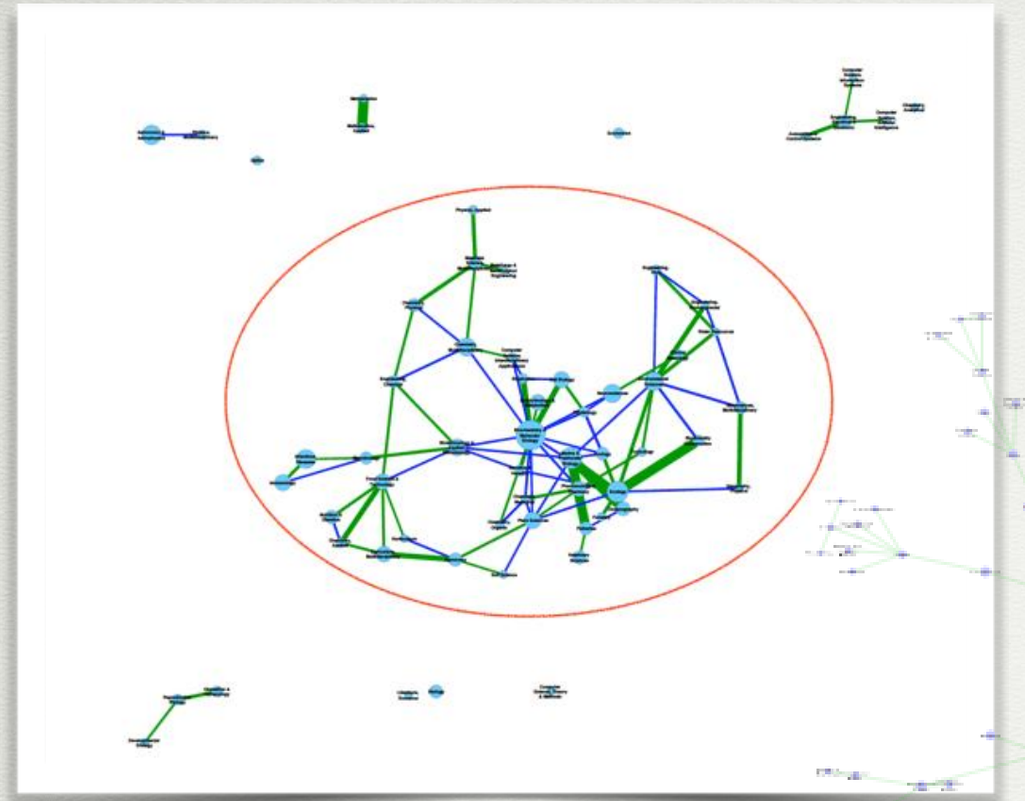


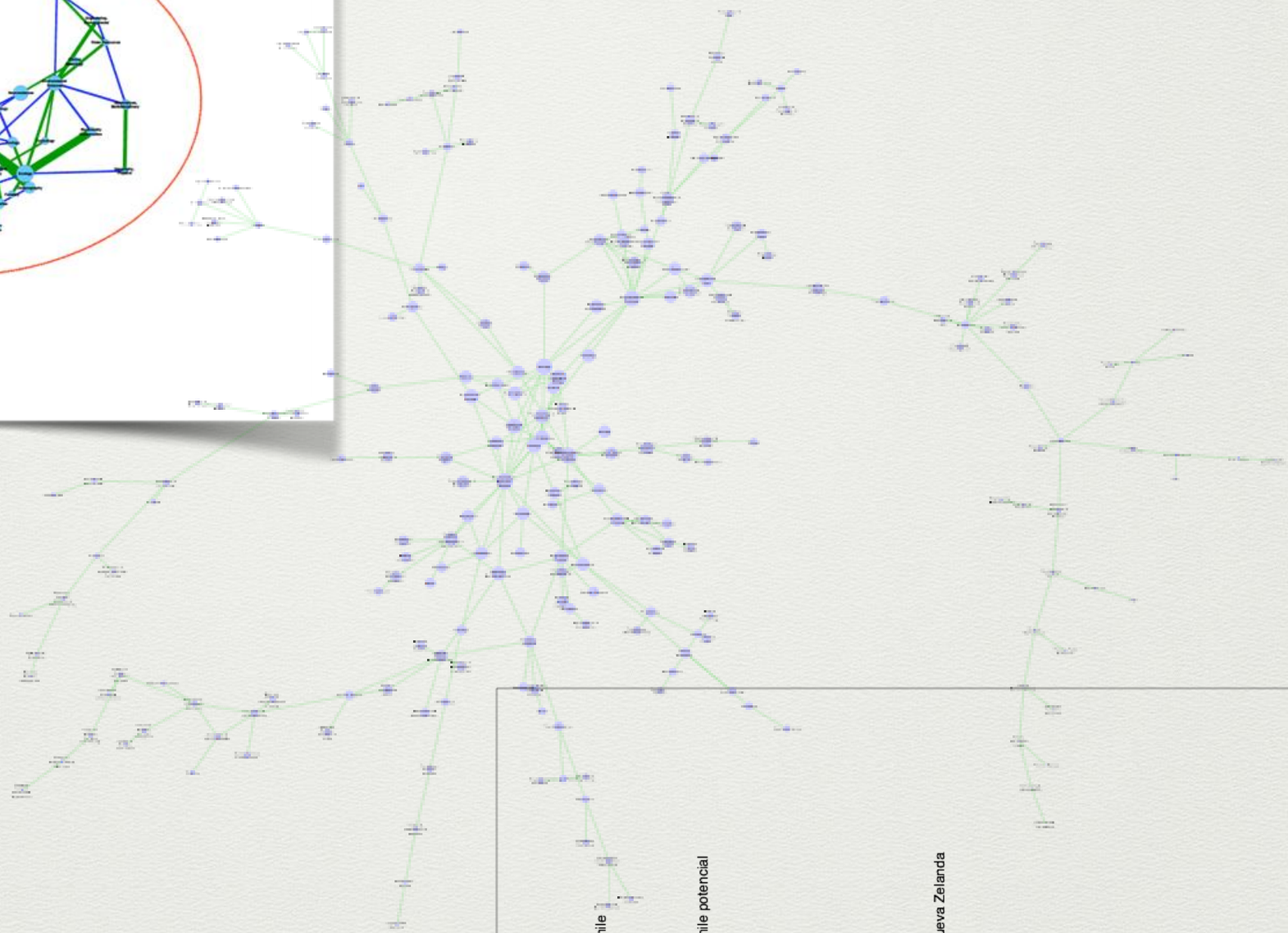
Potenciales

?

Optimización (GA)

Enlaces Potenciales





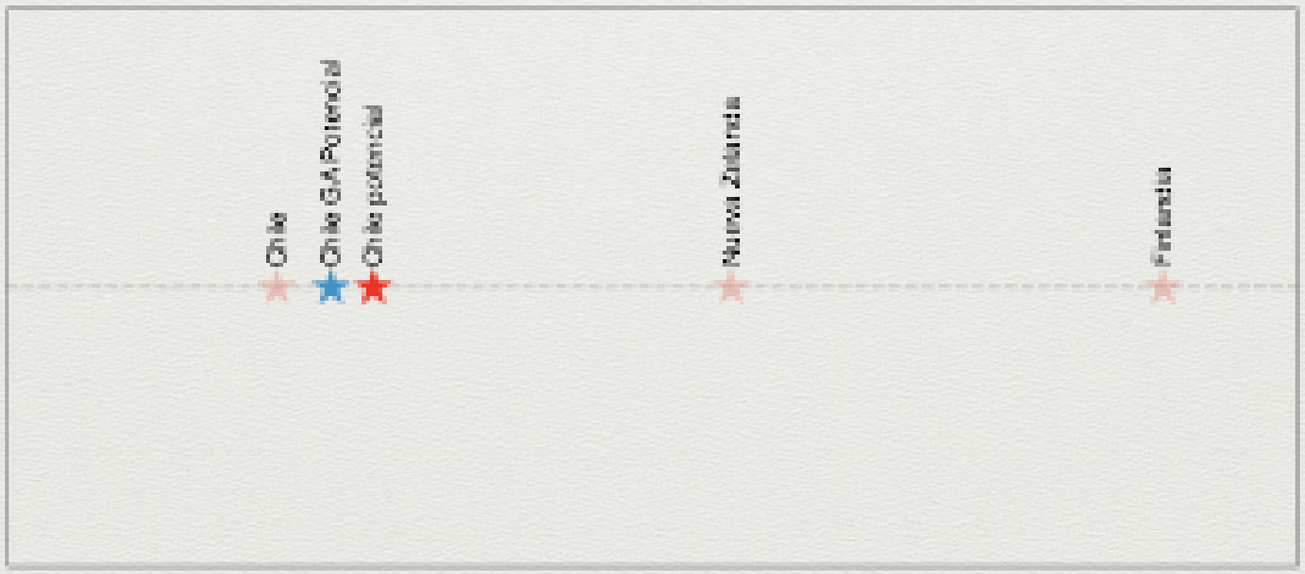
+38 enlaces

status quo?

Optimización
de vínculos potenciales

Enlaces añadidos

1. Zoology **<->** Biochemistry & Molecular Biology
2. Physiology **<->** Biochemistry & Molecular Biology
3. Plant Sciences **<->** Marine & Freshwater Biology
4. Environmental Sciences **<->** Biodiversity Conservation
5. Plant Sciences **<->** Biochemistry & Molecular Biology
6. Chemistry, Medicinal **<->** Biochemistry & Molecular Biology



- ⟵ Sofisticación del Sistema de Conocimiento ⟶ +

CONCLUSIONES

1.- El estudio muestra la forma en que se articula el conocimiento científico, lo que permite:

Identificar potenciales que en el futuro pudieran ser traducidos en nuevos productos y procesos

Contribuir al diseño de políticas públicas en ciencia, tecnología, innovación.

CONCLUSIONES

2.- El sistema científico nacional sería reflejo de un sistema poco demandante de conocimiento sofisticado

Mayoría de disciplinas del núcleo ligadas a recursos naturales.

Baja densidad de enlaces en la Cartografía.

CONCLUSIONES

3.- Chile presenta indicadores de complejidad del sistema científico inferiores a Nueva Zelanda y Finlandia:

Conectividad, densidad, frecuencia, heterogeneidad

4.- La dinámica “natural” del sistema de conocimiento chileno no lo conducirá necesariamente a un estado de complejidad como el observado por ejemplo en Finlandia, denso en vínculos y con alta capacidad de generar nuevas áreas de conocimiento.

Se requieren políticas de I+D más activas y dirigidas que induzcan demanda de nuevos conocimientos


nature
THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE
SKYWATCHER
MIND MARVEL
INVISIBLE HAND
DOC QUANTUM
CAPTAIN MEDICA
CONTROL-X
BIOLOGENE
DTrippe
INTERDISCIPLINARITY
Why scientists must work together to save the world PAGE 305

Gracias

"When everything is connected to everything else, for better or for worse, everything matters."

Bruce Mau, Massive Change