UNDERSTANDING INNOVATION ECOSYSTEMS

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NEW ZEALAND’S ECONOMIC HISTORY
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GDP per capita
$US (2008)

100
1000
10000
100000

1850 1900 1950 2000

NJ
Switzerland
Netherlands
USA

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NEW ZEALAND’S ECONOMIC HISTORY

“The mystery is why a country that seems close to best practice in most of the policies that are regarded as the key drivers of growth is nevertheless just an average performer.”

*OECD Economic surveys: New Zealand (2003).*

“If we adopt an economic geography perspective, there is nothing really paradoxical about New Zealand’s productivity performance.”

*Phil McCann, New Zealand Economic Papers (2010).*
SCIENCE AND INNOVATION

• It is generally recognised that science and innovation are the key drivers of long run productivity growth.

• NZ under-invests in R&D compared to other OECD countries but is not an outlier given its size, distance from markets and industrial mix (Crawford, 2007).

• That is, we look like Australia.

• We need to understand the economic geography of the production of knowledge before we can identify causes.
UNDERSTANDING KNOWLEDGE

- Knowledge is a partially excludable, non-rival good

- Firms benefit from R&D conducted by others via knowledge spill-overs

- Firms will under-invest in R&D and/or an economy may become too specialised

- The value of knowledge spill-overs is of the same order of magnitude as the private returns from R&D
UNDERSTANDING KNOWLEDGE

• The *economic value* of scientific knowledge is considerably greater than it’s market value

• If government can stimulate science and innovation then its economy could grow faster than under *laissez-faire*

• Governments have a key role in addressing this market failure (patents, R&D grants, R&D tax credits, public research system)
KNOWLEDGE IN SMALL COUNTRIES

• New Zealand produces 0.2% of the world’s scientific knowledge so much of the knowledge we use will be generated overseas

• We can’t free-ride as our ability to absorb knowledge depends on the strength of our own R&D capability (Cohen and Levinthal, 1989)

• Decisions on where or how we invest should be made with regard to “the rest of the world” (Jaffe 2013)
KNOWLEDGE IN SMALL COUNTRIES

But small countries face choices:

• Scale (intra-industry spill-overs) or diversity (inter-industry spill-overs)?

• Competition or collaboration (public/private)?

We need to understand the economic geography of innovation before we can understand the implications of these choices.
THE INNOVATION ECOSYSTEM
THE INNOVATION ECOSYSTEM

Number of companies with greater revenues

Average mass (grams)

Density (plants per square metre)
THE INNOVATION ECOSYSTEM

% of firms with more than N patents

Average mass (grams)

Density (plants per square metre)

Number of patents, N

Biomass distribution

New Zealand patents

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% of firms with more than N patents

Number of patents, N

United States
Australia
New Zealand
Finland

Average mass (grams)
Density (plants per square metre)
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THE INNOVATION ECOSYSTEM

- Finnish Engineering PhDs per year
- New Nokia inventors per year
Stylised fact: Bigger cities produce more patents per capita
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Stylised fact: Innovators are better connected in bigger cities
KNOWLEDGE SPILLOVERS FROM DIVERSITY

• Some knowledge is highly specialised; other types of knowledge are broadly applicable
• Some knowledge travels (codified) but some knowledge doesn’t (tacit); tacit knowledge is difficult to observe
KNOWLEDGE SPILLOVERS FROM DIVERSITY

- Examine the revealed comparative advantage of regions or countries
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KNOWLEDGE SPILLOVERS: WORLD

Patent Space (TL3 Regions)
KNOWLEDGE SPILLOVERS: NEW ZEALAND

Surgical tools

Food processing

Biotech

Clocks

Enzymes & biomolecules

Semiconductors & nanotechnology

Amplifiers; resonators; oscillators

NZ
KNOWLEDGE SPILLOVERS: REGIONS

North Island

South Island

Electronics

Auckland

Canterbury

Electronics
DIVERSITY VS POPULATION

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ECONOMIC GEOGRAPHY OF INNOVATION

*Stylised fact:* Bigger cities produce more patents per capita

*Stylised fact:* Innovators are better connected in bigger cities

*Stylised fact:* Bigger cities support a greater diversity of patents
UBIQIUTY VS POPULATION

![Graph showing the relationship between mean ubiquity and population. The x-axis represents population, ranging from 10,000 to 10,000,000, and the y-axis represents mean ubiquity, ranging from 400 to 1600. The scatter plot displays a trend where higher populations correspond to lower mean ubiquities.]
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Hypothesis:

Innovators are exploiting the density and diversity of the networks available to them to generate new knowledge
We need to build a city of four five million people
OPEN INNOVATION

10% of companies now produce 80% of all patents
We need to build a city of four/five million people

We need a dating service for ideas

Callaghan Innovation
CHOICES IN SMALL COUNTRIES

New Zealand

Denmark
CHOICES IN SMALL COUNTRIES

R&D spending (2010, million dollars)

Private sector
Public sector

Primary
Manufacturing
Services
PATENT COMPLEXITY

• Which regions have the most *novel and transferrable (complex)* sources of knowledge?
Canterbury has comparative advantage in a diverse range of novel patent classes.
Patent complexity does not scale with population size.
PATENT COMPLEXITY

Patent Complexity Index

JP, US, KR, DE, NL, FR, CH, GB, IT, CN, SE, BE, FI, CA, AT, AU, ES, IL, DK, NO, LU, IN, ZA, IE, BR, NZ, PL, TR, CZ, SI, GR, MX, PT, SK, EE, CL, IS
PATENT COMPLEXITY

% of firms with more than N patents

Number of patents, N

Patent complexity index

Exponent, $\beta$
We need to build a city of four five million people

We need a dating service for ideas

We need to diversify our science and innovation portfolio
Shaun Hendy & Paul Callaghan

GET OFF THE GRASS

Kickstarting New Zealand’s Innovation Economy

Te Pūnaha Matatini
The Centre for Complex Systems and Networks
We need to build a city of four-five million people.

We need a dating service for ideas.

We need to diversify our science and innovation portfolio.

We need to place a higher value on knowledge.