Developing indicators for a knowledge-based economy

Anthony Arundel

MERIT

Role of MERIT in KEI

- **WP1**: Theoretical and conceptual framework for KBE indicators
  - Identify policy needs using scenarios
- **WP2**: Identify useful indicators to meet user and policy needs
- **WP4**: Develop novel indicators, plus solutions for 'missing' indicators

Work structure

- All three WPs are related, with similar requirements:
    - Policy relevance crucial
    - Evaluation of *future* needs
    - Eclectic theoretical framework
        - Need to capture multiple characteristics and drivers of a KBE
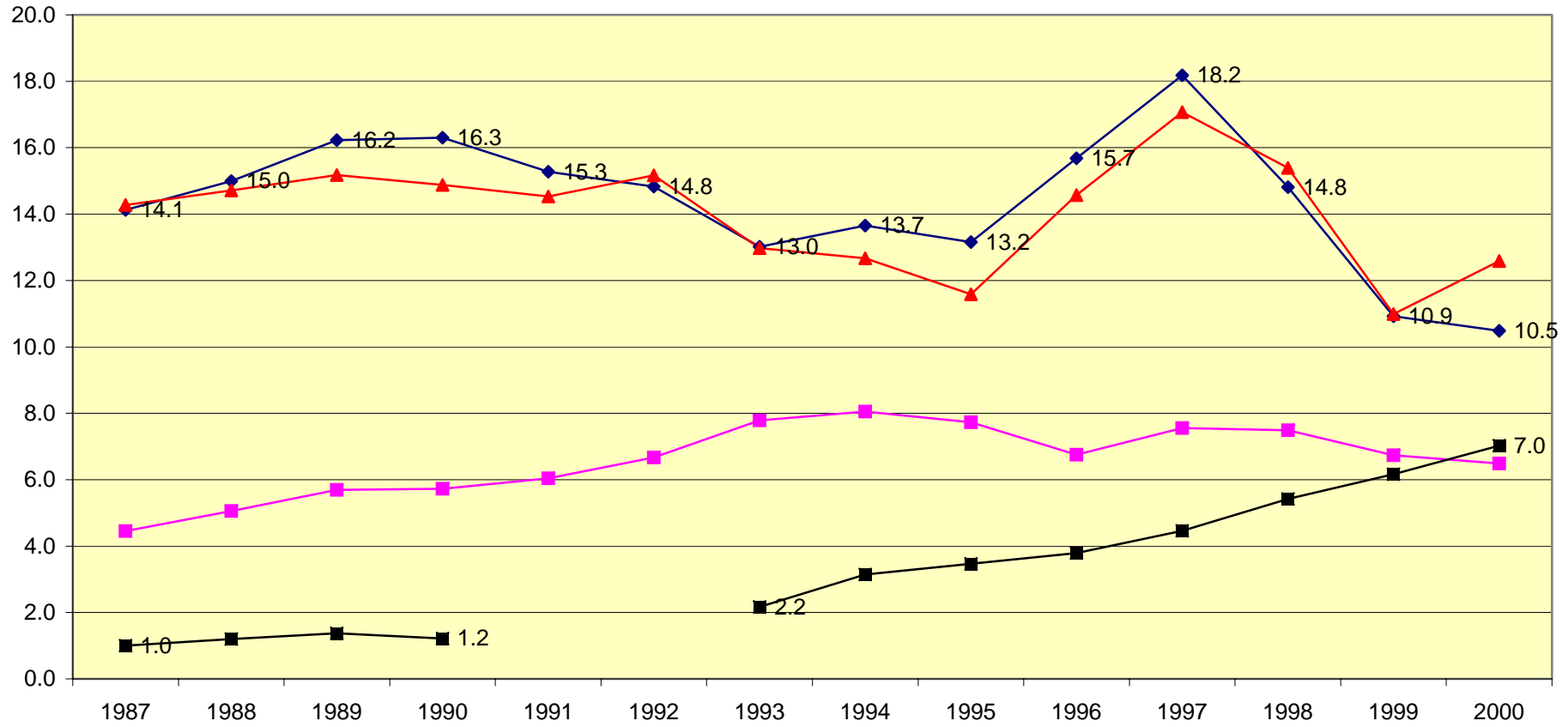
Characteristics of a KBE

- **ICT as a technological driver**
  - Change in role of 'knowledge'
  - Organisational change
- Entrepreneurship and creative destruction
- Crucial role of human capital and creativity

Cautionary note:

- ICT and "high-technology" sectors are less of a driver of innovation and of a KBE than sometimes thought.
  - Their most important role is as an *enabling* technology that assists productivity transformations in other economic sectors

5

Share of ICT sectors and pharmaceuticals out of total US BERD

Legend:
- ICT (ISIC 30, 31, 32, 72)
- Pharmaceuticals (ISIC 2423)
- R&D services (ISIC 73)
- Core ICT (ISIC 30 & 72)

ICT data points: 14.1, 15.0, 16.2, 16.3, 15.3, 14.8, 13.0, 13.7, 13.2, 15.7, 18.2, 14.8, 10.9, 10.5

R&D services data points: 1.0, 1.2, 1.2, 2.2, 7.0

6

Mean R&D intensities in manufacturing: first and second half of the 1990s

	United States			European Union		
	Average 92-95	**Average 96-99**	**Percent Change**	**Average 92-95**	**Average 96-99**	**Percent Change**
High-tech	10.6	10.7	**0.5**	8.7	7.7	-11.5
Medium-high tech	3.2	3.3	**3.1**	2.6	2.4	-8.6
Medium-low tech	0.8	0.7	-12.1	0.6	0.6	-4.3
Low tech	-	-	-	0.2	0.2	0.0

Socio-political drivers for a KBE

- Demographic change
- Environmental challenges
- Globalisation (driven by many other factors, including ICT, demographics etc)

Indicator requirements for a KBE

- Available and timely
- Complete coverage of all relevant factors
- -   Not only outcomes but motivations
- Relevance to policy
- Interpretable (composite indicators?)

Types of indicators for a KBE

- **Geographical level**

  City, region, nation, supra-national (EU)

- **Firm level**

  Geographical, sectoral, **global** (MNEs, human capital, etc)

- **Main challenge:** indicators for linkages across geographical levels

Identifying indicators

- Start with key policy questions:
  - What is the role of organisational change in productivity growth?
  - What is the role of institutions in necessary social changes (waste management)?
  - How can the European policy ensure an appropriate supply of the highly-skilled to increase the innovative capabilities of the EU?

Example: Policy scenario:
The supply of highly skilled

1. Identify issue or problem from different perspectives
2. Identify evidence (role for indicators)
3. Assess relevant policy response
4. Identify indicators to inform policy

   Example below given from three perspectives

1. Knowledge or 'brain' circulation

1. There is a growing global market for the highly skilled, with more circulation of the highly-skilled across borders. Europe must tap into this.

2. Evidence:

- Growth in foreign students (UK and Australian policy)

- Growth in percent of highly-skilled living abroad

- Survey results show that the primary driver for the highly-skilled to go abroad is for better research conditions and equipment

Knowledge or 'brain' circulation view

3. Policy conclusions:

– Mimic the United States by adapting immigration policies to encourage more highly skilled immigrants.

– Strengthen research base to encourage the most highly skilled domestic people to remain at home.

4. Indicator requirements:

– Better data on the flow of the highly-skilled including their motivations for moving.

– OECD project on the careers of doctorate holders.

Demographic perspective

1. The ageing of the population in most OECD countries, combined with a decline in the supply of new cohorts of youth, will require more immigration, not only for the highly skilled, but for the low and medium skilled.

2. **Evidence**:

   – Demographic data for almost all OECD countries.

Demographic perspective

3. Policy conclusions:

– Adapt immigration policies to encourage immigration of high, medium and low skilled; or encourage indigenous population growth through pro-natal policies, improve work-life balance of women, etc.

4. Indicator requirements:

– Demographic data, fertility rates, etc.

– Number and quality (educational attainment, etc) of immigrants

– Work-life balance and other factors influencing fertility
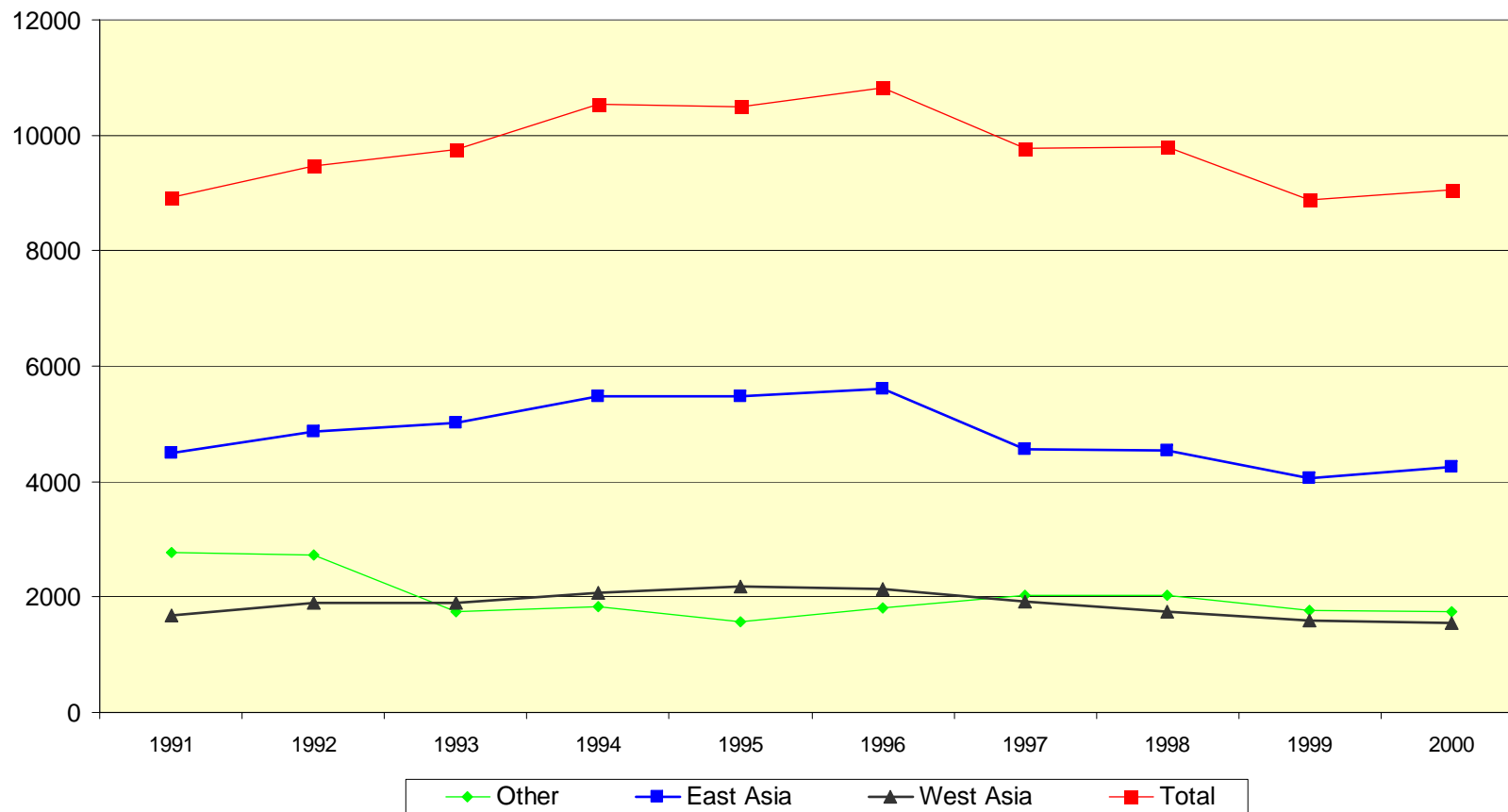
Dynamic, long-term, *global* perspective

1. As the number of global loci for innovation increases, the physical movement of the highly-skilled could be increasingly replaced with the global movement of *ideas and knowledge*, while the highly-skilled increasingly remain in the same place.

- The highly-skilled may show no preference to move abroad, given adequate opportunities at home.
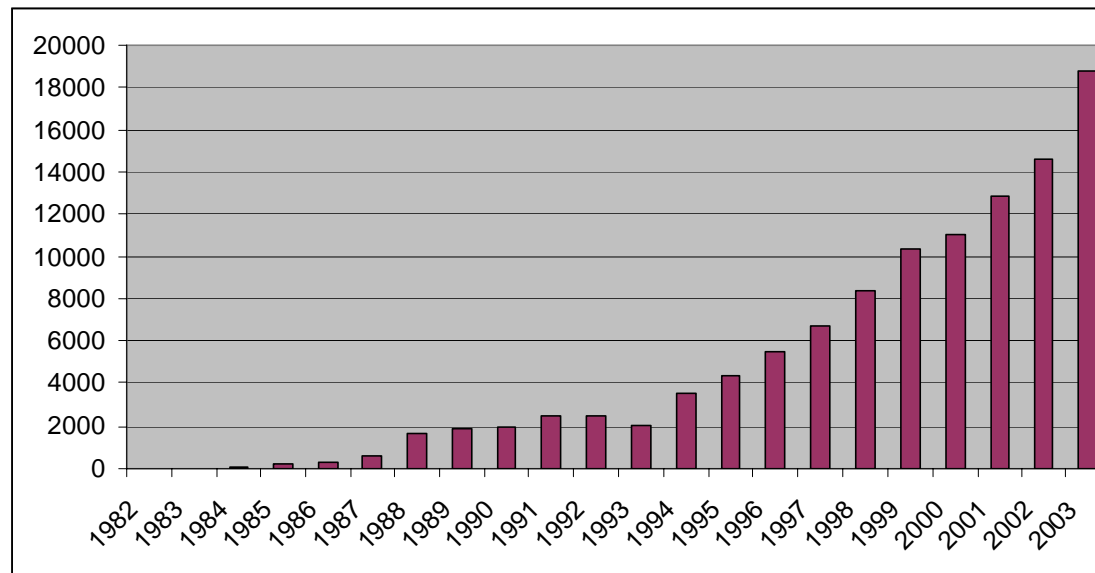
Dynamic, long-term, *global* perspective

2. Evidence:

- Growing R&D opportunities in India and China

- Highly skilled are 'move-adverse'
  - Only 1% of highly skilled Americans and Japanese live abroad
  - Less than 3% of recent American PhDs intend to move abroad (over half do not follow-through)

- Decline in foreign students (pre-dates 2001)
  - UK: 5.3% decline in tertiary students from outside of the EU between 2003 and 2004
  - Sharp decline in foreign PhD students in US from *1996*, particularly from West and East Asia. Number from East Asia declined 24% between 1996 and 2000, while large increase in PhDs granted in China from 1996 on.

Number of non-US citizens awarded American doctorates in the sciences and in engineering, by region of citizenship and year of doctorate

19

Doctoral Degrees Awarded in China

Source: Weiguo and Zhaohui, 2004

Dynamic, long-term, *global* perspective

3. **Policy response:**

    – Promote immigration of highly skilled as a *short-term* solution.

    – Adapt immigration policy to meet the needs of short-term (under two years) transfers of the highly skilled.

    – Increases indigenous S&E strengths and an interest in science among current elementary and secondary students.

    – Support transfer of ideas and knowledge and create forums for their circulation: shared research programs and scholarly exchanges with universities in China and India.

Dynamic, long-term, *global* perspective

4. **Indicator requirements**: (for both EU and other global loci)
    - Global flows of highly skilled, including short-term movement
    - Motivations for highly skilled to move
    - MNE R&D expenditures by country
    - Demographic data in EU and in 'donor' countries
    - Interest in science and engineering on the part of youth
    - Attractiveness of science careers (income in PPP, etc)
    - Quality of national research base

Lessons for identifying KBE indicators

- Develop different perspectives (scenarios) to identify policy needs

- Globalisation may have a significant impact on many issues for a KBE

- Dynamic analysis is more useful than a static approach

Future challenges

- Which indicators are best for a composite framework?

- Firm level 'global linkages' indicators
  - R&D and innovation
  - Knowledge flows

- Indicators *of* policy?