Innovation and Development

Strengths and Weaknesses in the Finnish Information Society

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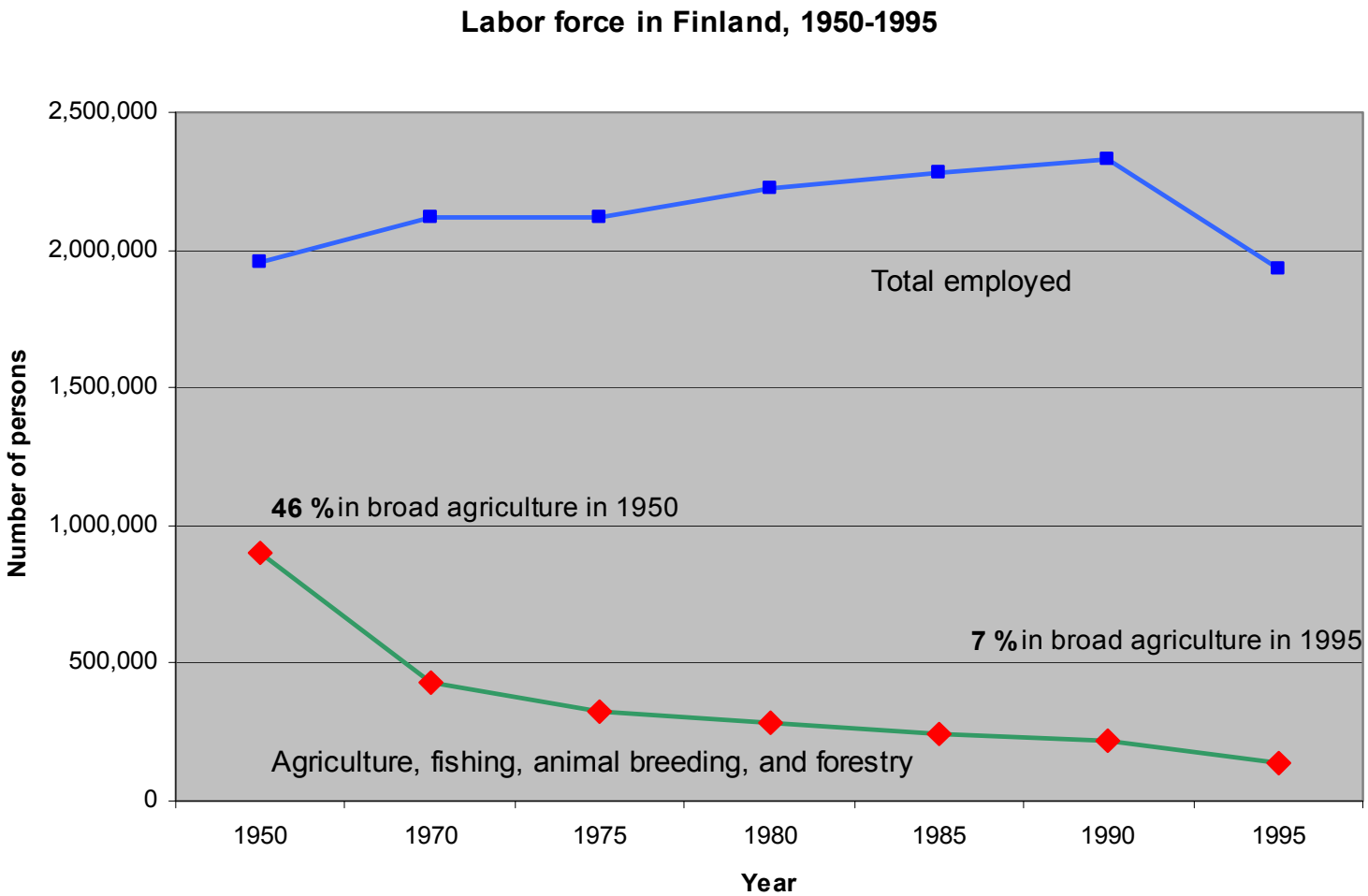
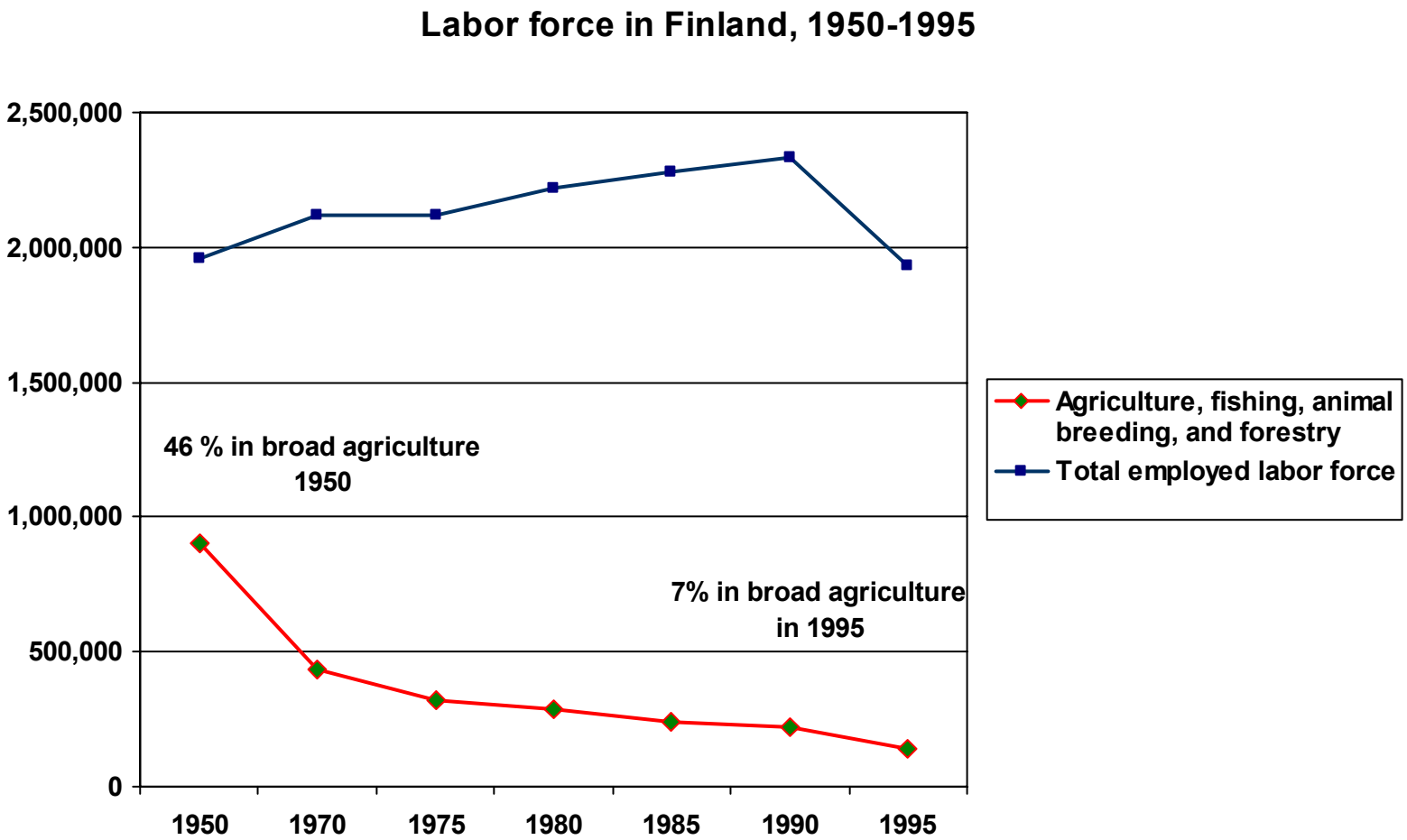
Agenda

- Sources of success: the roots of rapid socio-economic transformation in Finland
  - Some personal observations on the history of the Finnish information society
- An important detail: case Nokia
- New dynamics of innovation networks
  - A few words on Internet-related innovations and the open source development model
- Challenges for the Finnish model and innovation policy

From Agriculture to Industrial Society

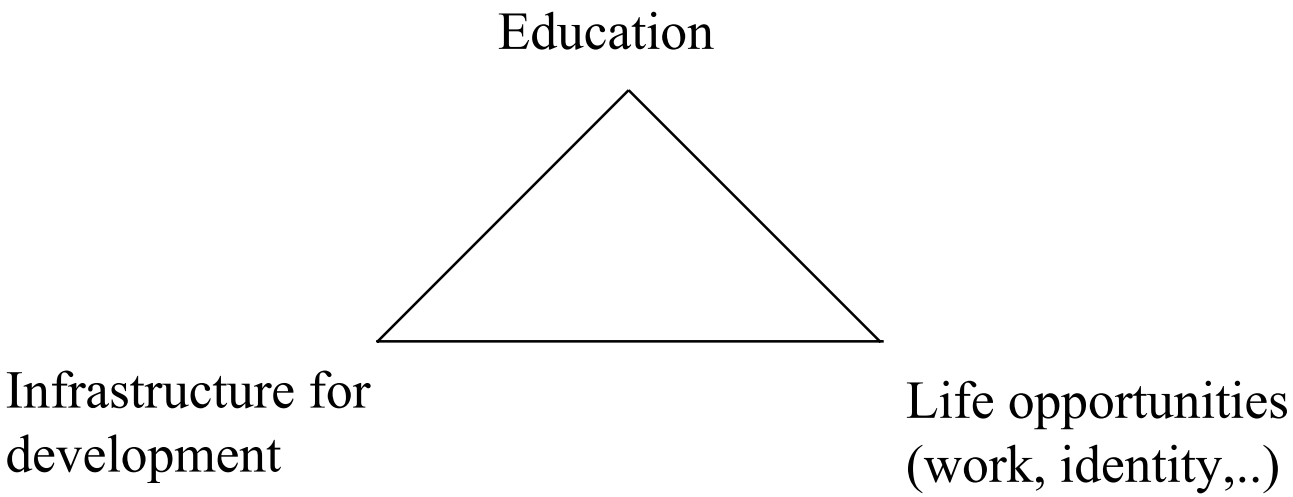


From Agriculture to Industrial Society

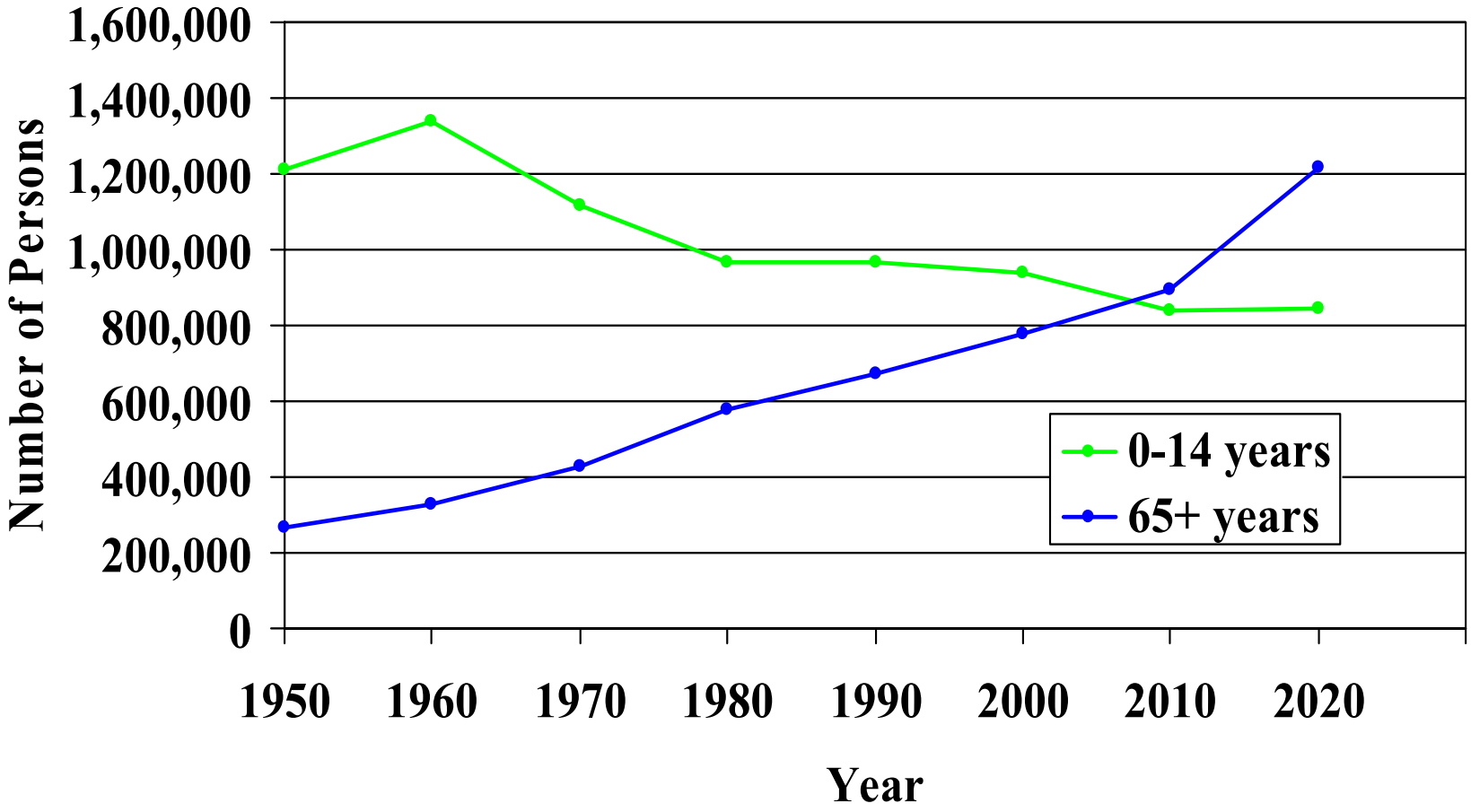


Nordic Welfare State in Finland, 1965-1975

- Baby boom of 1945-1955
- Expansion of the public sector
- Increasing levels of education
- Investment in regionally balanced university system, libraries, culture
- Rapid urbanization
- Shared experiences of war and relocation of people who lost their homes



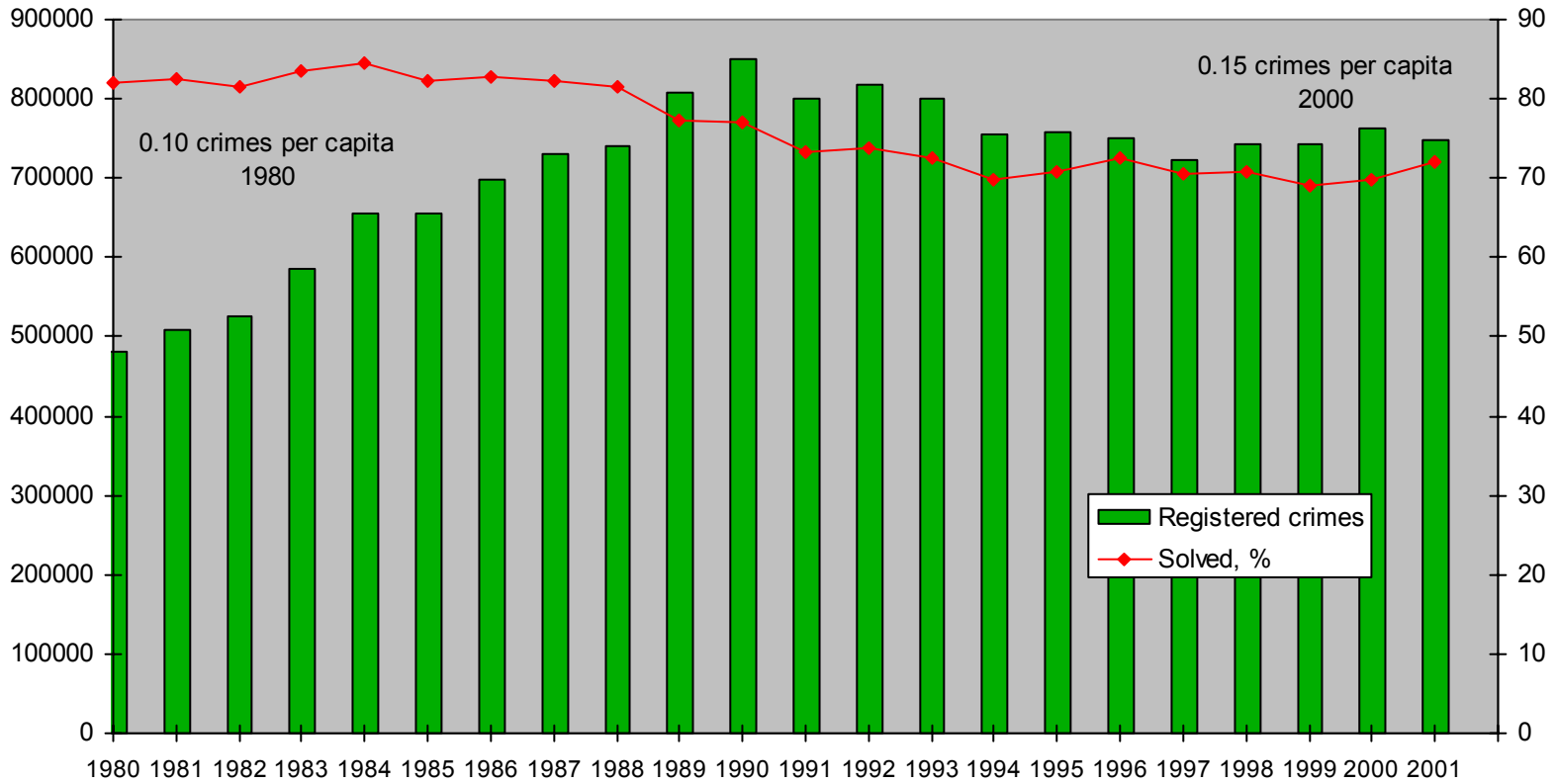
The baby boom in 1960s
(and the aging of the population)



Characteristics of the Finnish Culture in the 1980s

- Small cultural and economic differences
- High social mobility through education
- Low hierarchy and open communication culture
- High trust culture
  - Non-existent corruption
  - High trust on public services and institutions
  - Low crime rates

Crime in Finland



Technical Infrastructure, 1980s

- **1978**: The Finnish Technology Committee introduces the theme of "Information Society" (inspired by *Nora – Minc: L'Informatisation de la société*)
- **1980**: Telset videotex service started (similar to Minitel, 1981)

- Computer networks
  - Public data network launched in 1983
  - Ministry of Education launches FUNET, the Finnish University Network, 1983
  - FUNET links the Finnish university computer centers, 1985
  - **1988**: Finland gets access to NSFNET/Internet, in a joint effort by Nordic countries (first countries to join the net: .ca, .sw, .dk, .no, .ic, .fi, .fr)
  - **1988**: "General information network and the citizen's knowledge terminal" -project. This leads to broad development of information services, commercial e-mail systems, electronic banking, etc. In 1988 it was predicted that about 20 per cent of the Finnish population will be users of the information network by 2000.
  - **1988**: Online share trading starts in Finland

Technical Infrastructure, 1980s

- Telecommunications
  - Nordic Mobile Telephone (NMT) system launched 1982
  - Competition starts in digital communications (X.25 packet-switched networks), 1985
  - New telecommunications law, 1986
  - Ministry of Traffic and Communications orders the competing digital networks to provide connections between the networks, 1989

Some Internet Milestones

- **1988**: Jarkko Oikarinen distributes IRC (Internet Relay Chat, University of Oulu)
- **1991:** Linus Torvalds distributes the first version of Linux (University of Helsinki)
- **1992:** First graphical WWW-browser developed (Erwise, Helsinki University of Technology)
- **1992:** FUNET and Helsinki University of Technology launch the 5th and 8th WWW –servers in the world,

  (first three are CERN, 4th is Dutch High-energy physics)

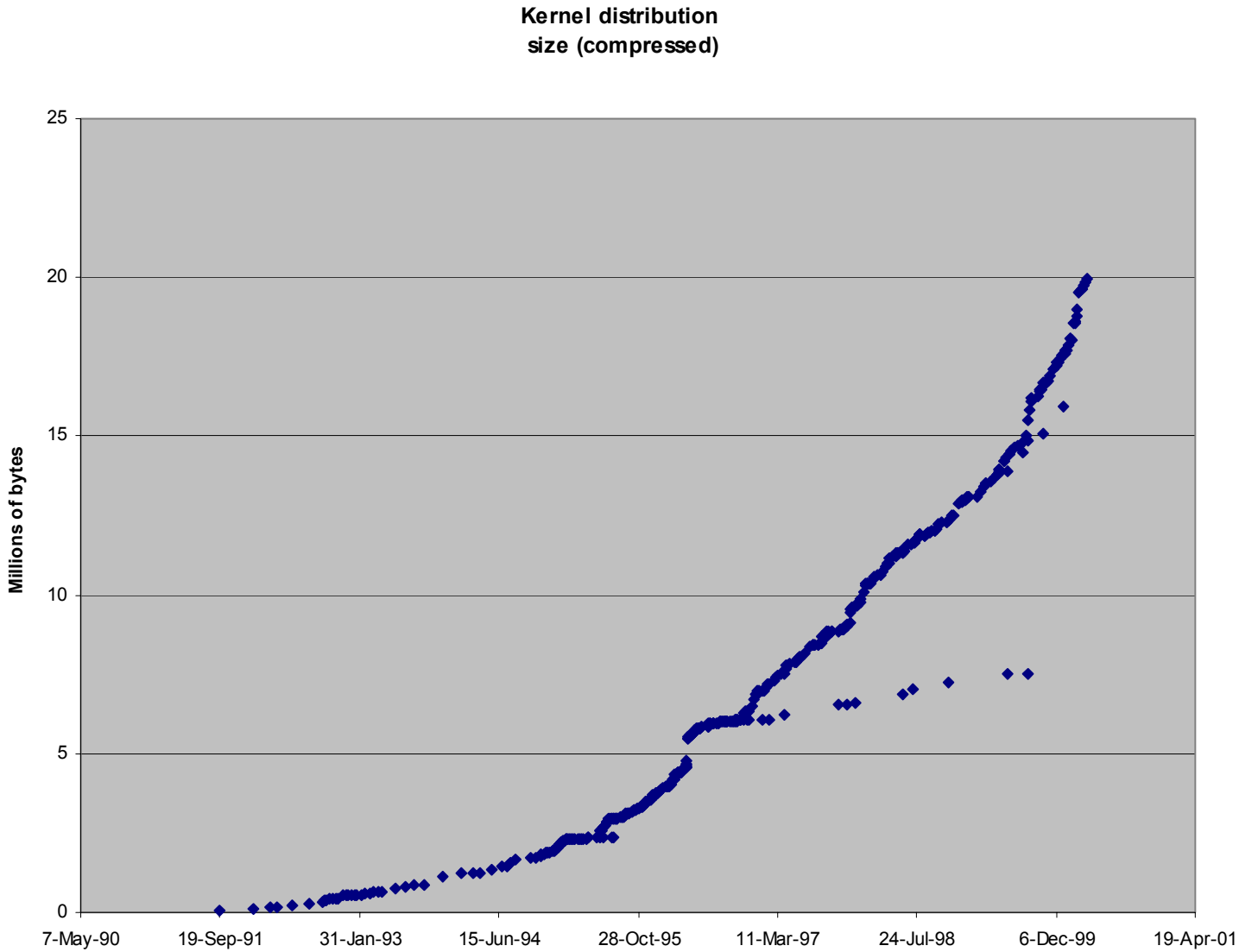
- **1993**: The First "Information Society Strategy." Focus on information and communication technologies and related competencies (similar to NII).
- **1993**: A "drivers license" for information networks (consists of seven modules)
- **August 1998**: Finland is the first country where mobile phone penetration exceeds 50% of the population

Mobile Phone Penetration

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Finland	3	2	2	**1**	3	3	**1**	**1**	**1**	**1**
Sweden	**1**	**1**	**1**	2	**1**	**1**	3	3	3	4
Norway	2	3	3	3	2	2	2	2	2	2
Island	4	4	4	5	6	6	6	7	4	3
USA	7	6	5	6	5	5	8	9	14	16

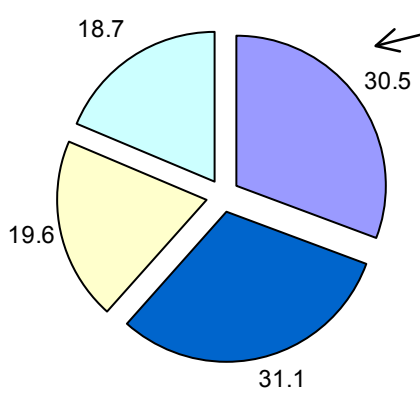
Source: OECD, 2000

Evolution of Linux Source Code

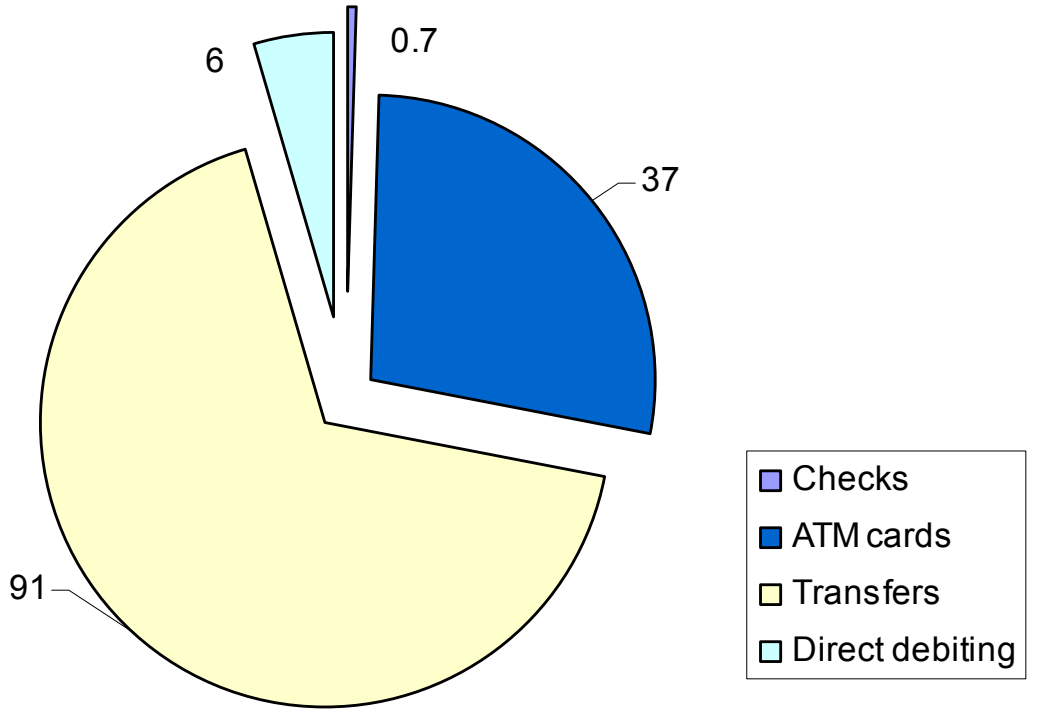


Electronic Banking in Finland: customer transactions in 1998

Great Britain 1997:
over 30 % checks



1982: Telephone banking
1988: Online share trading
1992: Banking by mobile phone
1996: Internet banking



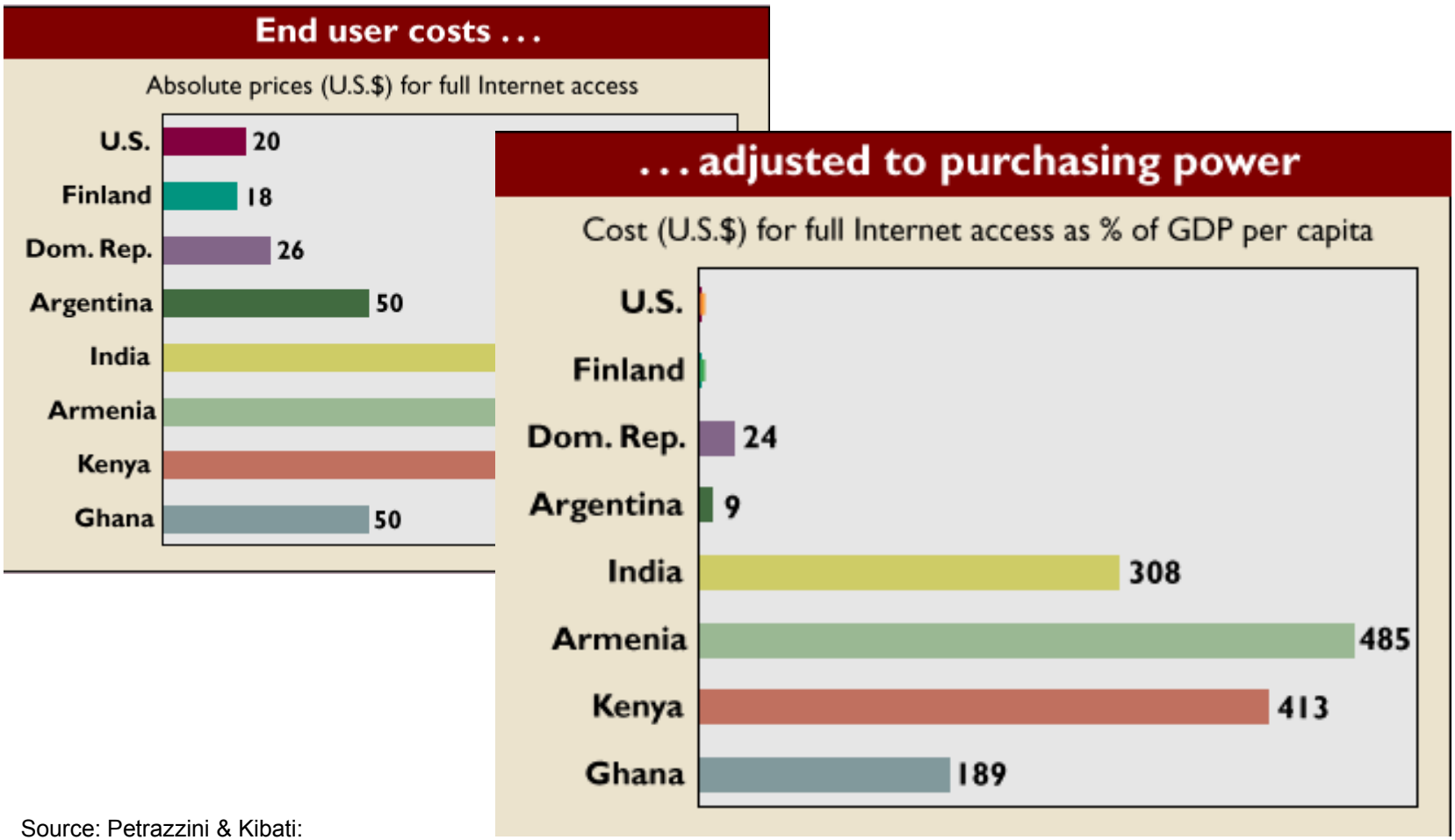
Electronic Banking in Finland (2)

- 82 % of transactions were paperless in 1998
- Within EU, the amount of cash in circulation was the lowest in Finland: 2.35 per cent of GDP (in Spain 10.7, average EU 5.2)
- On-line invoicing 1998
  - You buy through the net, get a bill as a web form, accept it, and your bank account is debited by the amount transferred:
  - both the payee and payer are verified through the bank; (today you can also do this using your mobile phone)
- At the beginning of 1999, the biggest bank in Finland had about 600,000 online customers; this was the biggest customer population in the world, in absolute numbers.
  - To compare: US has 50 times bigger population than Finland

Why Finland Became a Leader in Electronic Banking?

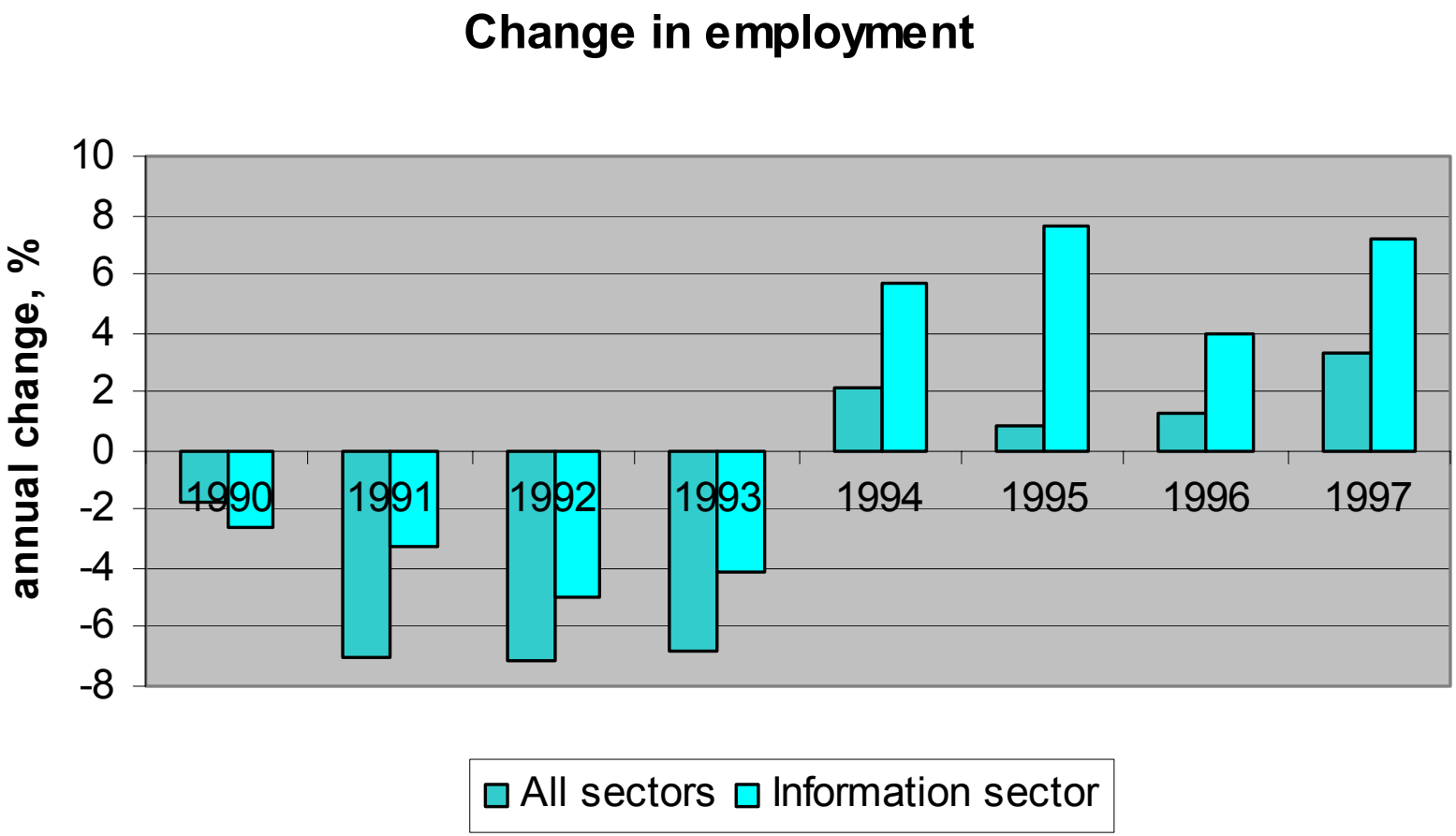
- In Finland, work is expensive (heavy taxation)
  - Wide use of computer applications to support bank operations and customer service (1970s-)
  - High return on investment in ATMs (Automatic Teller Machines; 1980s-)
- Reliable telecommunications infrastructure
  - Digitalized networks widely available
- Competition in banking
  - Cost competition
  - No monopolies
- Close ties between Finnish ICT manufacturers and banks
  - Good knowledge of ICTs potential (1970s - 1980s)
- **In Finland, money is information**
  - transfers widely used in 1970s
  - everyone has one or more bank account
  - reliable institutions (no need for physical money)

End-User Costs for Internet Access



Source: Petrazzini & Kibati:
Communications of the ACM, June 1999
Vol.42 (6), p.31-6.

Recession and Safety Nets
"The Finnish Trampoline"



Between 1990-1994 household income dropped 18 % in Finland;
due to income transfers, however, the usable income dropped only 10 %

Some Drivers in the Finnish ISoc

- Culture
  - common interest in technological opportunities

    In Finland you don't survive the winter without planning
    - Finland had its first telecom operator 3 years after Bell invented the phone
  - open communication culture, effective communication

    People don't talk much; when they do, they mean what they say
  - high level of education
  - low hierarchy
  - homogeneous culture
  - shared expectations

Some More Drivers

- Institutions
  - Deregulation of telecom (started 10 years before the EU)
  - Acute need for change

    Disappearing USSR

    At the beginning of 90's, deregulation of financial markets created a "bubble economy"
  - Nordic countries are egalitarian and emphasize social responsibility

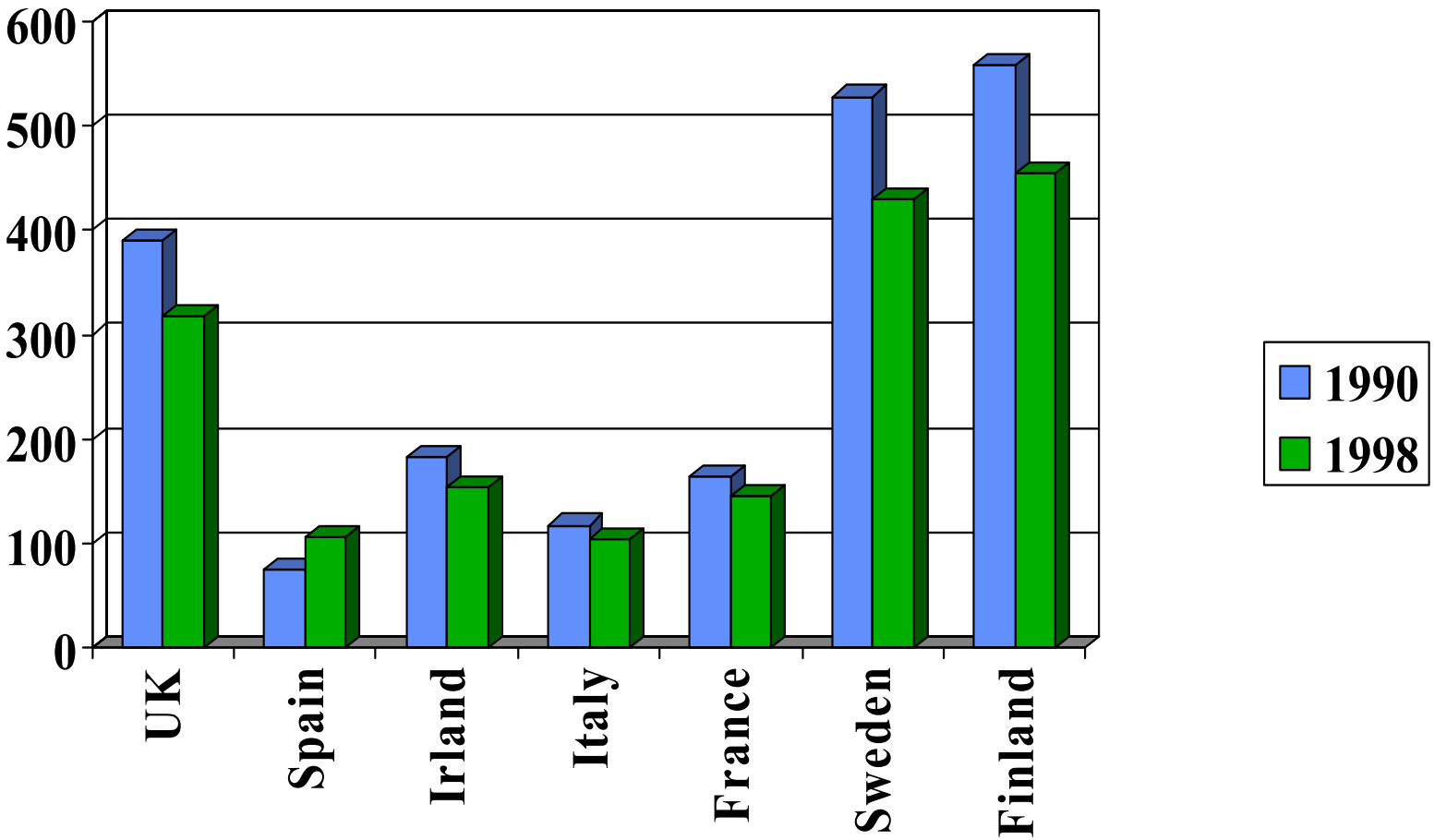
    Heavy investments in the educational system

    Well developed library system (over 80 % of public libraries offer free internet access)

    Non-existent illiteracy (in Finland newspaper circulation is 473 per 1000, in the US the number is 228)

Newspaper circulation

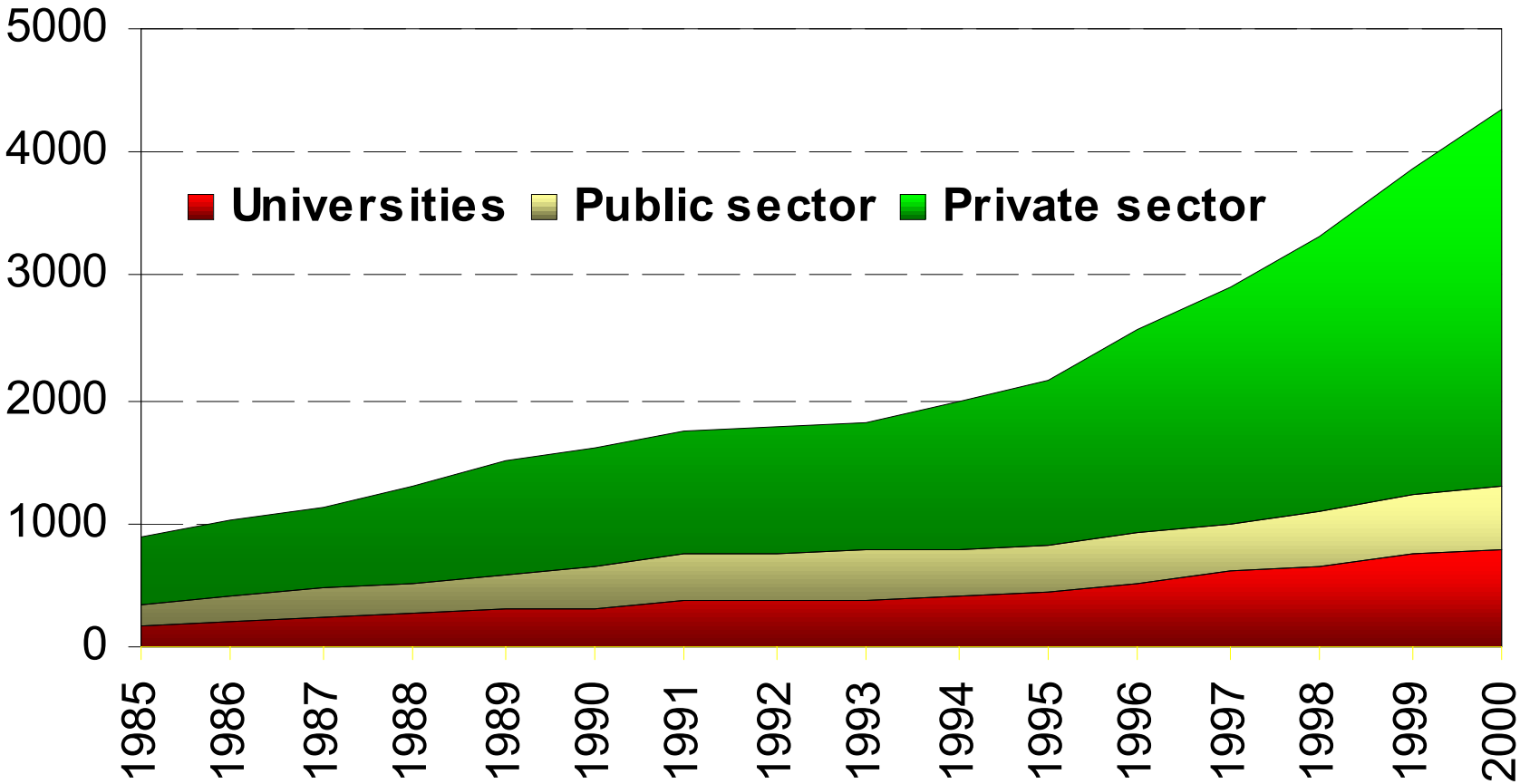
per 1000 inhabitants



…and even more…

- Economy
  - critical mass of networked people (the biggest community in the world?)
    - about 100% of primary and secondary schools have Internet access
  - low income differences: growing, but still small
    - 1994: top-ten percent had 3.9 times the income of bottom ten percent
    - 1997: the ratio was 4.6
    - this leads to shared lifestyles, easy propagation of new ideas and products
  - high taxation on work
    - investment in technology instead of human work; this is a big difference between Europe and the US
    - taxation, however, makes good public infrastructure and services possible
  - low telecom tariffs
    - about half of the OECD average
    - caller pays: no need to hide your phone number
    - Nordic countries were the first to deregulate telecom, digitalize telecom infrastructure, and start international competition
  - Nokia

R&D expenditure by sector EUR Million



Finland as a Breeding Ground for Nokia

- Mobile communications and digital transmission systems developed in Finland from 1960s
- Joint effort to get a Nordic mobile phone system in place (starting at the end of 1970s)
- Fairly open competition among operators and equipment suppliers, promoting innovation and diffusion of new technology
- Close supplier-operator collaboration, leading to effective user-producer learning
- Close interaction between firms, universities and research institutes, leading to effective competence development and utilization of state-of-the-art technology and know-how
- Flexibility in the adjustment to the new techno-economic environment
- Availability of skilled human resources
- Enthusiasm of Finnish organizations and consumers to adopt new technology

Modified from: Tarmo Lemola, Ministry of Trade and Industry, Finland, 17.4.2002

Finland as a Breeding Ground for Nokia (2)

- Laying the infrastructure for rapid growth
  - Broad competence development in ICT in 1970s-1980s
  - Entrepreneurial innovators (often with radio-amateur background)
  - Active redefinition of Nokia's strategy in the 1980s towards consumer electronics, communication, and personal computers
  - Active globalization of Nokia's business in the 1980s
  - Evolving international R&D collaboration (in particular in the EU research programmes)

- The Nokia crisis of 1991
  - leadership crisis in Nokia
  - unprofitable consumer electronics division
  - disappearing Soviet Union market
- Nokia in 1992
  - a quick reorientation to global growth markets
  - new top management team
  - focus on mobile communications

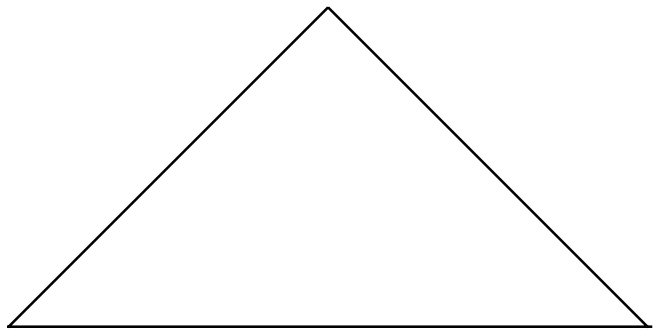
Finland as a Breeding Ground for Nokia (3)

- The Finnish economic crisis of 1992-1994
  - Over 20 % (official) unemployment touched all Finnish families and created a pool of highly educated unemployed people
  - General crisis consciousness, with ICT (Nokia) as the only economic growth sector
  - Rapid adjustment of educational system towards producing ICT competencies
  - National high-profile policies on making Finland the leader in the information society transformation
  - Policies and societal atmosphere pro-ICT and Nokia
  - Taxation system that ensured “trickle-down”
- Extremely rapid growth of mobile telecommunications

The Nokia Miracle

Technological
& market
discontinuity

Business Opportunity



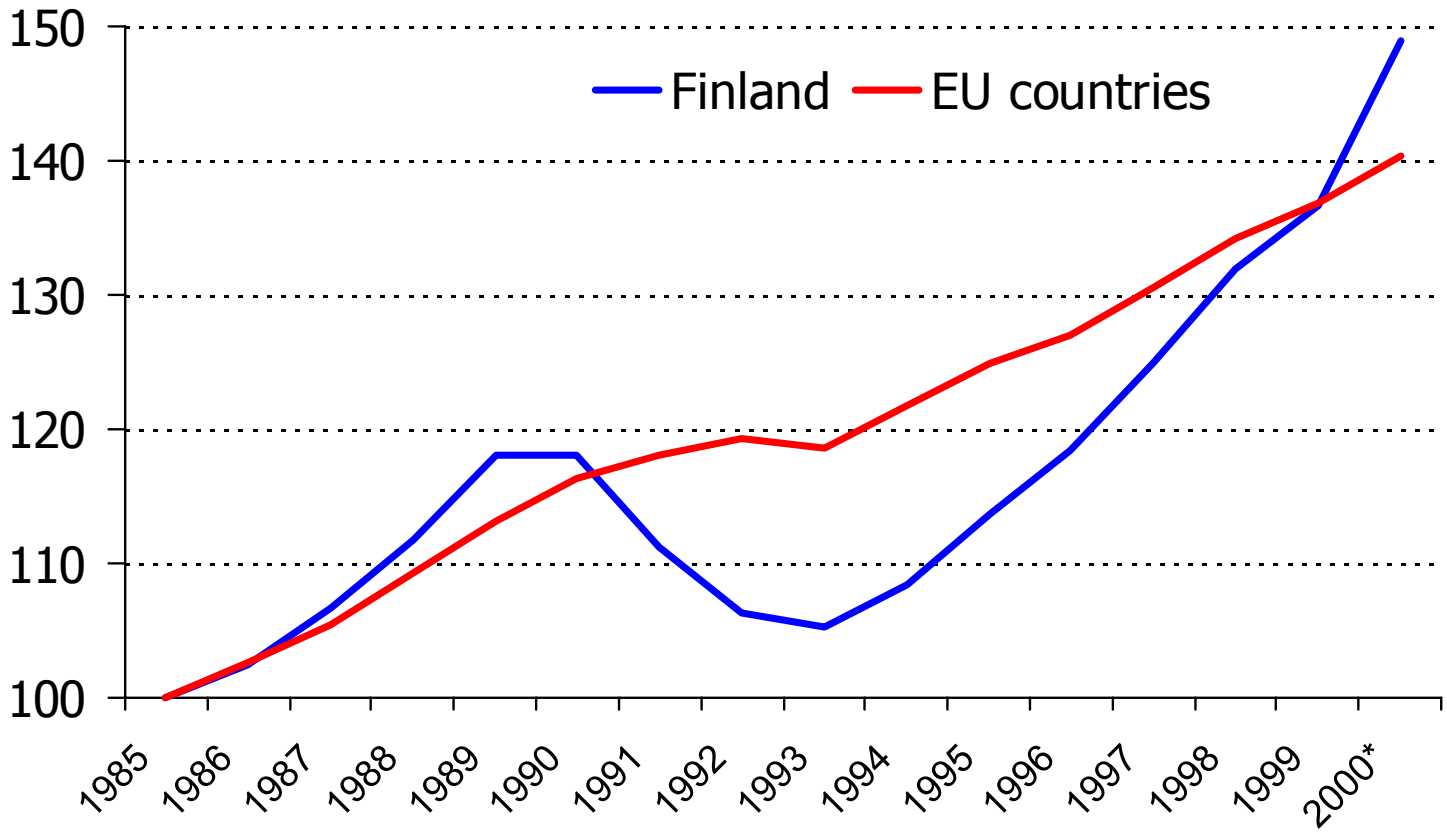
Crisis

Organizational
& environmental
crisis

Institutional and Organizational Flexibility

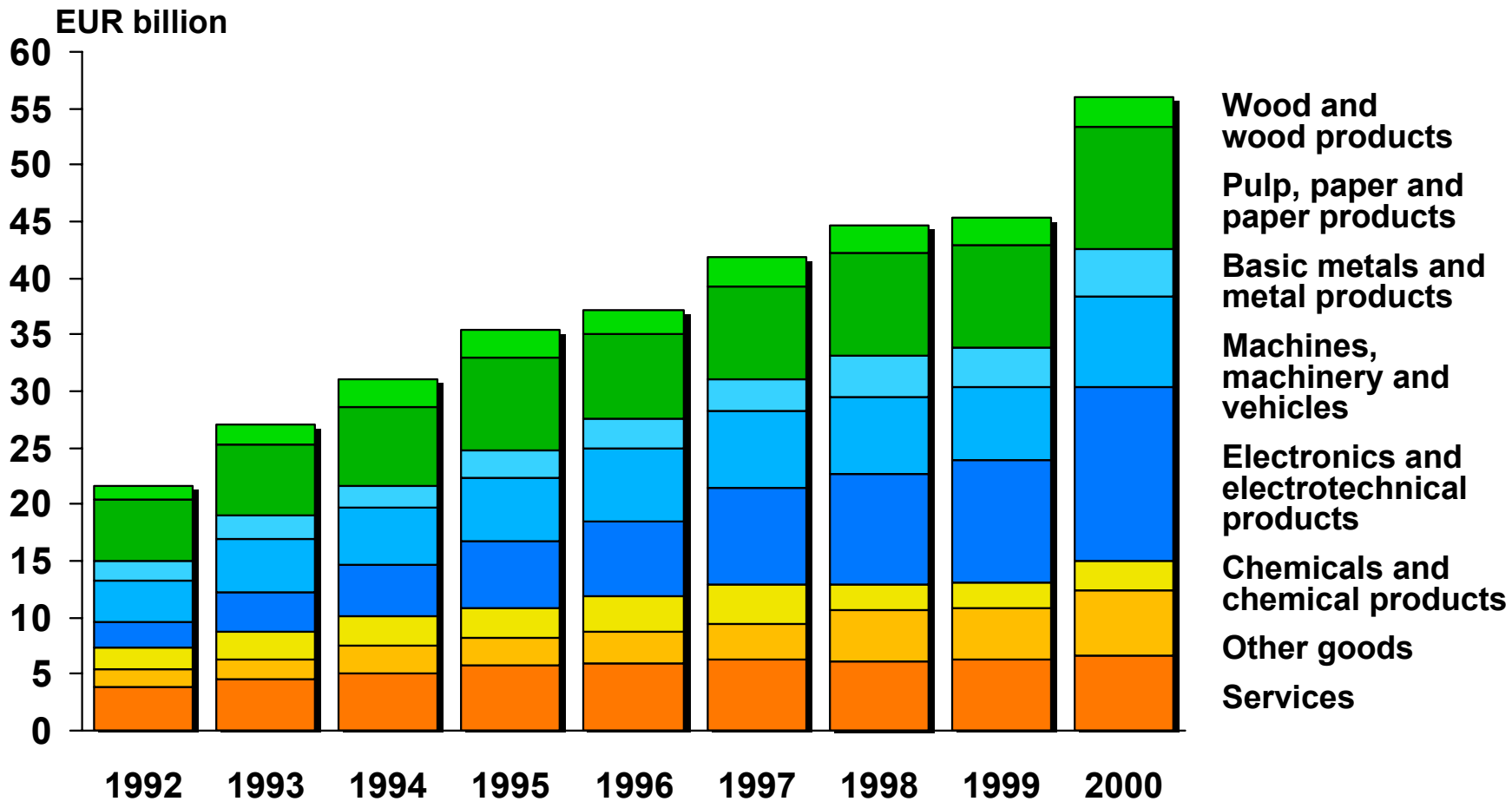
Competent labor and management
Social capital
Low hierarchy
Open communication

GDP 1985=100 (at market prices per capita)

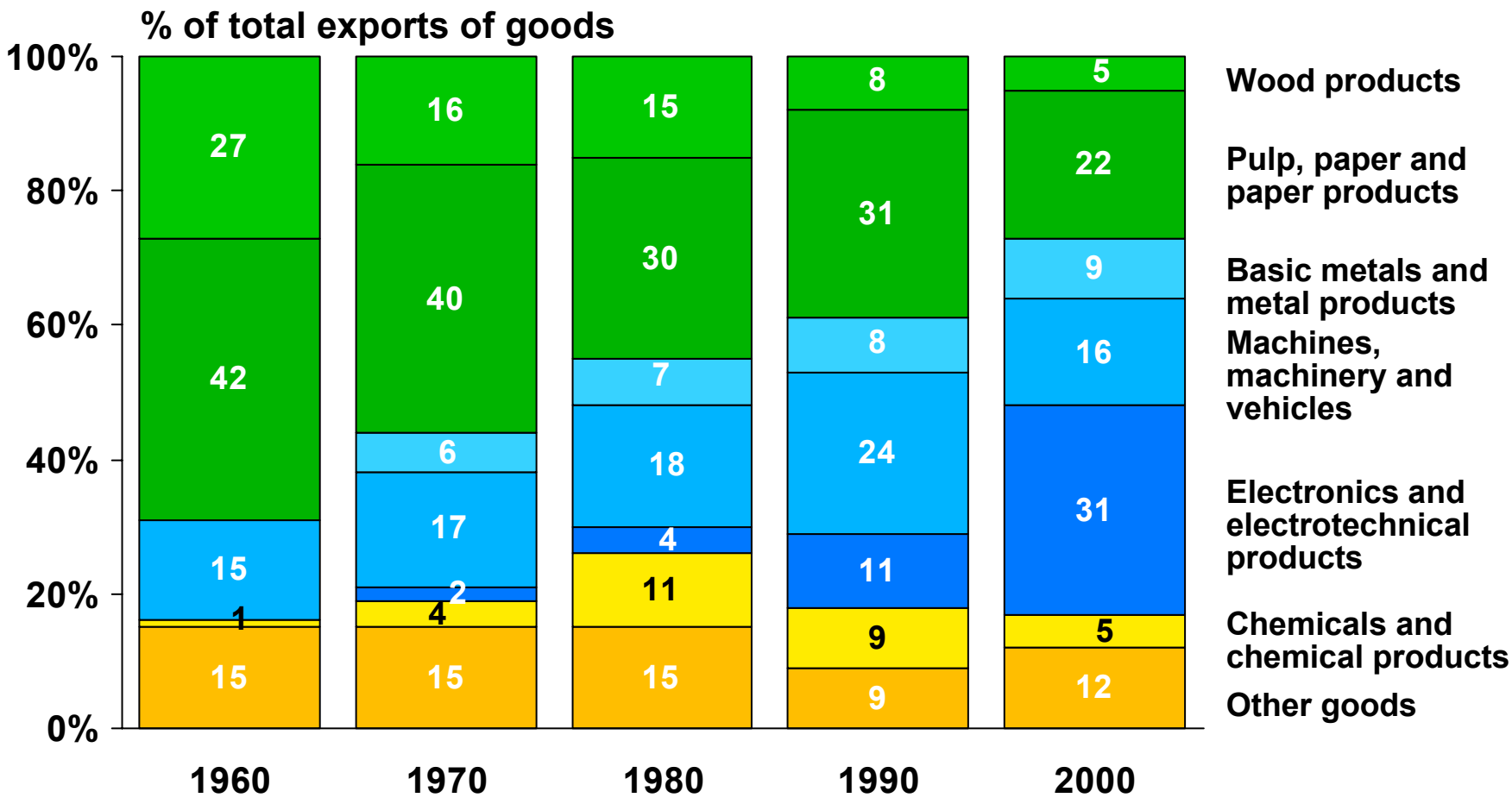


Source: Tarmo Lemola, Ministry of Trade and Industry, Finland, 17.4.2002

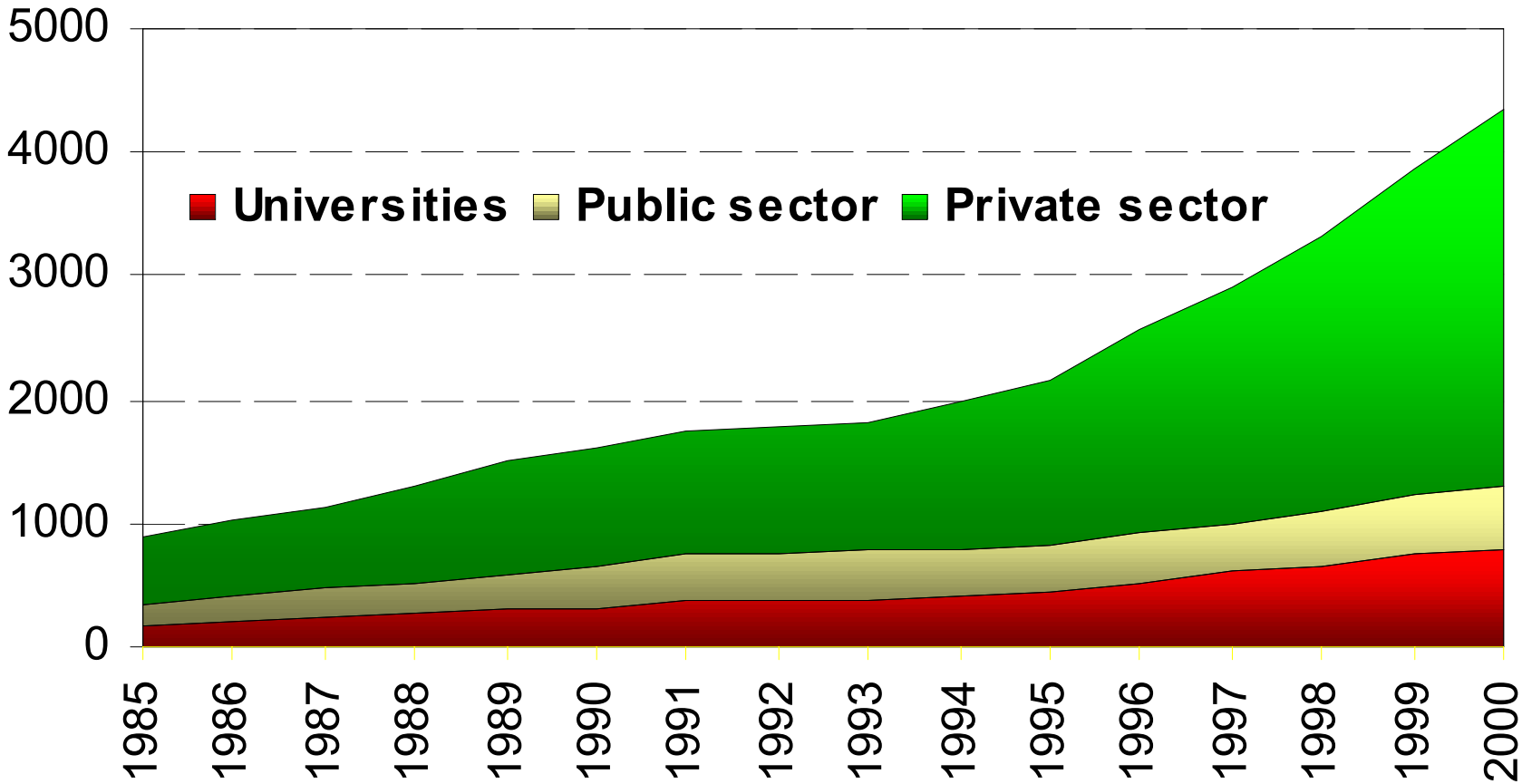
Finnish Exports by Industry



Finnish Exports of Goods



R&D expenditure by sector EUR Million

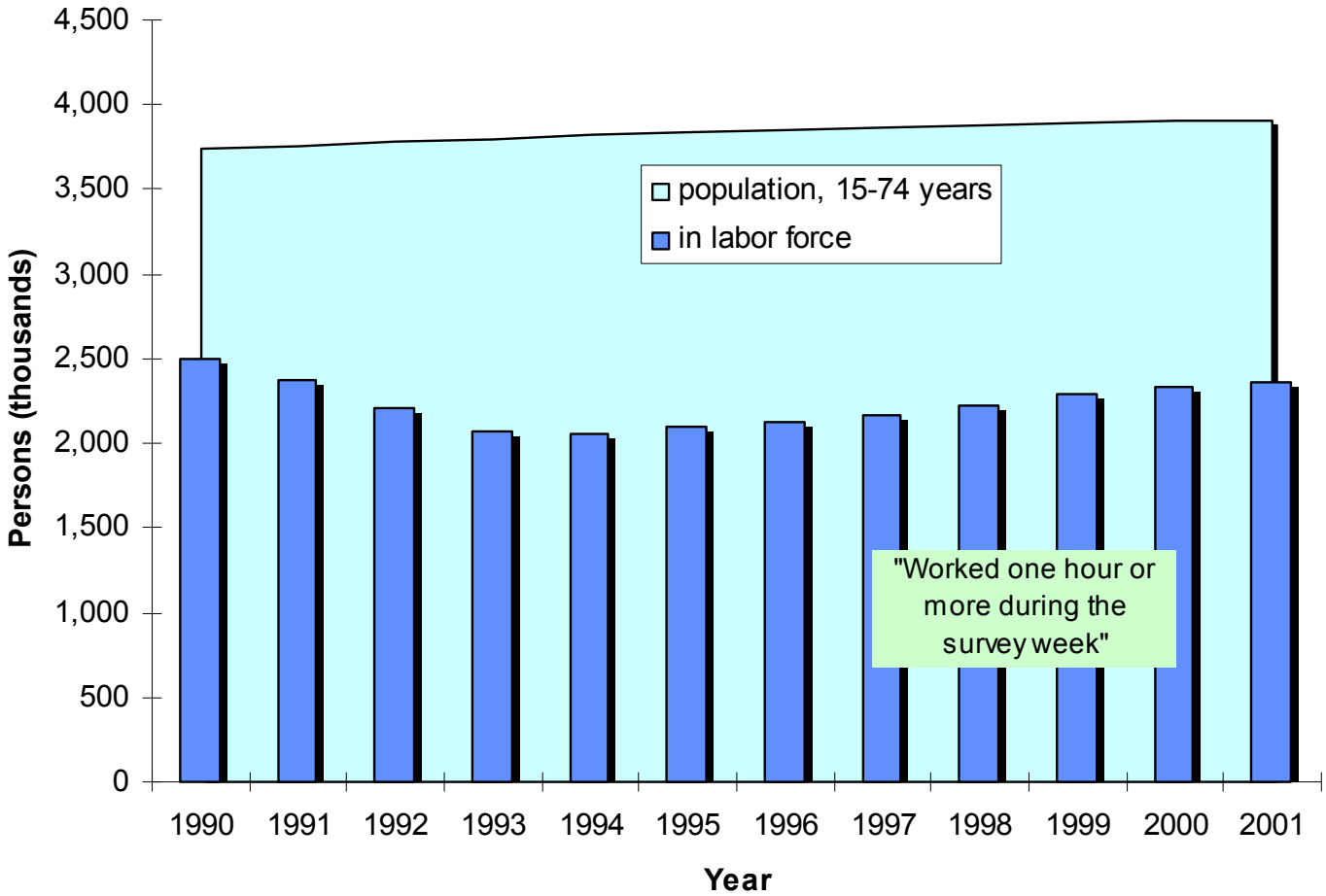


Nokia's Contribution to the Finnish Economy

- 1.1 % of total employment, 30 % of the ICT cluster employment (25,000 employees in Finland)
- 300 first-tier partnerships in Finland (18,000-20,000 employees), 10 % of Nokia's turnover
- 24 % of exports, 80 % of ICT cluster exports
- 30 % of the total Finnish R&D, 43-47 % of the business enterprise sector
- 50 % of the growth in total R&D expenditure
- 54 % of the company's R&D input is spent in Finland

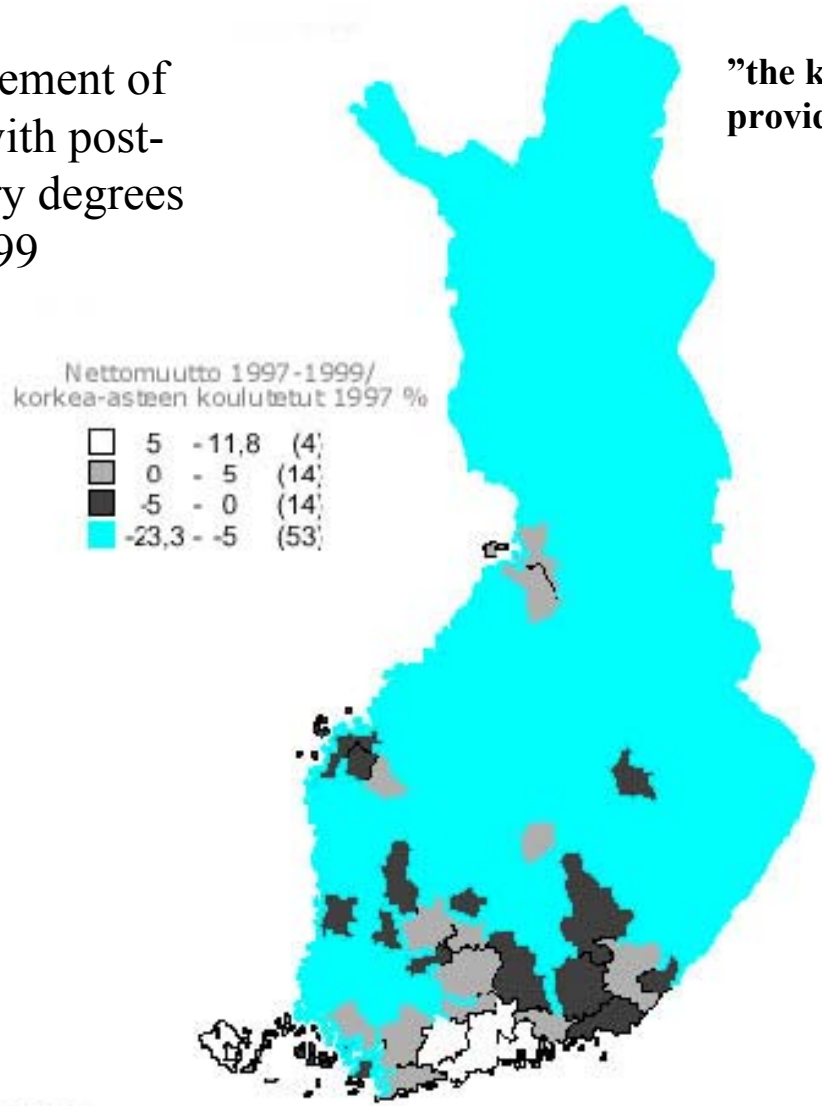
Source: Tarmo Lemola, Ministry of Trade and Industry, Finland, 17.4.2002

Challenge: Jobless Growth



Challenge: Space Matters

Net movement of people with post-secondary degrees 1997-1999



”the killer app of the knowledge society provides access to life opportunities”

But,
There is a new mode of technology and knowledge creation emerging

Tuomi, I. (2002): Networks of Innovation: Change and Meaning in the Age of the Internet. Oxford University Press.

Two Different Dynamics of Innovation

- Innovation based on evolving specialization
  - Requires gradual change of underlying social practices and stocks of knowledge
  - “Spin-off” from existing communities of practice
- Combinatorial innovation
  - Recombination of resources so that they become meaningful for existing social practices
  - Recombination of resources so that they enable new social practices

- Silicon Valley has become specialized in the combinatory model
  - Little original technology and knowledge development but very rapid experimentation with recombinations
  - Silicon Valley has a specialized role within a global innovation system; it does not make sense as a social model

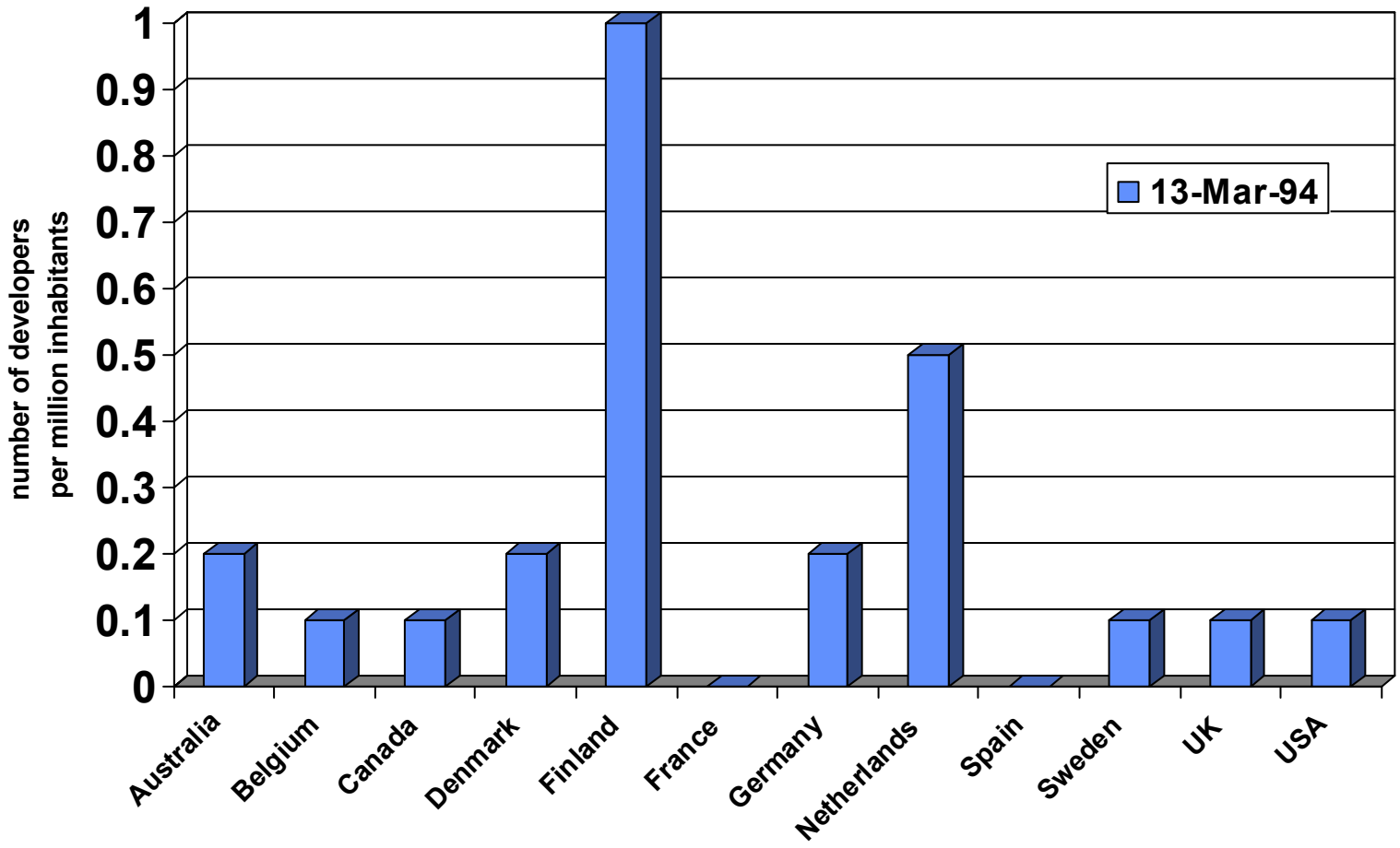
”Old Theory”

- linear innovation model
  - heroic inventors and entrepreneurs
  - idea generation – invention – R&D – marketing – diffusion
- separation between basic and applied research
- economic and entrepreneurial theory of innovation
  - e.g. patents (limited monopoly) needed for new innovations to emerge
  - adoption based on individual preferences and choices
  - corporate R&D units as focus of innovation
- product-centric view
  - focus on functionality and product attributes
  - focus on technological artifacts

Elements of the New Theory

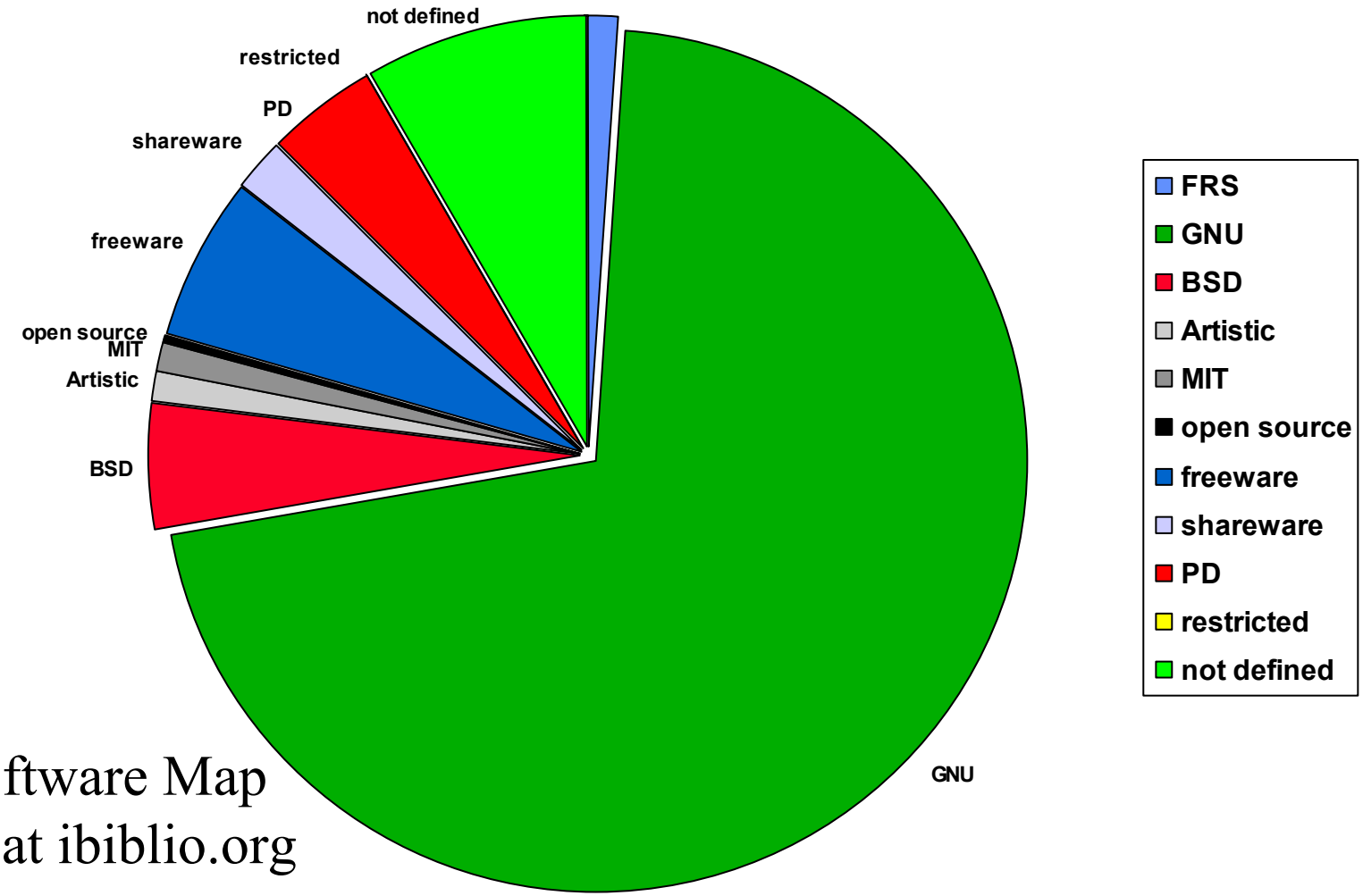
- meaningful products
  - interpretative flexibility
  - social practices and communities as the foundation of meaning
  - identity construction using artifacts
  - product adoption as meaning creation
- focus on down-stream resources and innovation capability
  - unintended dominant uses
  - adoption constrained by social learning and change capability in downstream user communities
  - multifocal innovation model
- user-centric instead of product-centric
  - ”all innovation is social innovation”
- social dimension
  - control, coordination, power, and division of labor
- corporate R&D
  - integration with social innovation processes
  - management beyond organizational boundaries
  - demand articulation and platform innovations
  - flexible products

Linux Developers
in the First Credits File



I. Tuomi. Internet, innovation, and open source: actors in the network. *First Monday* 6 (1), 2001.

Licenses Make Open Source Possible



Linux Software Map database at ibiblio.org

Tuomi, I. (2002): Networks of Innovation: Change and Meaning in the Age of the Internet.

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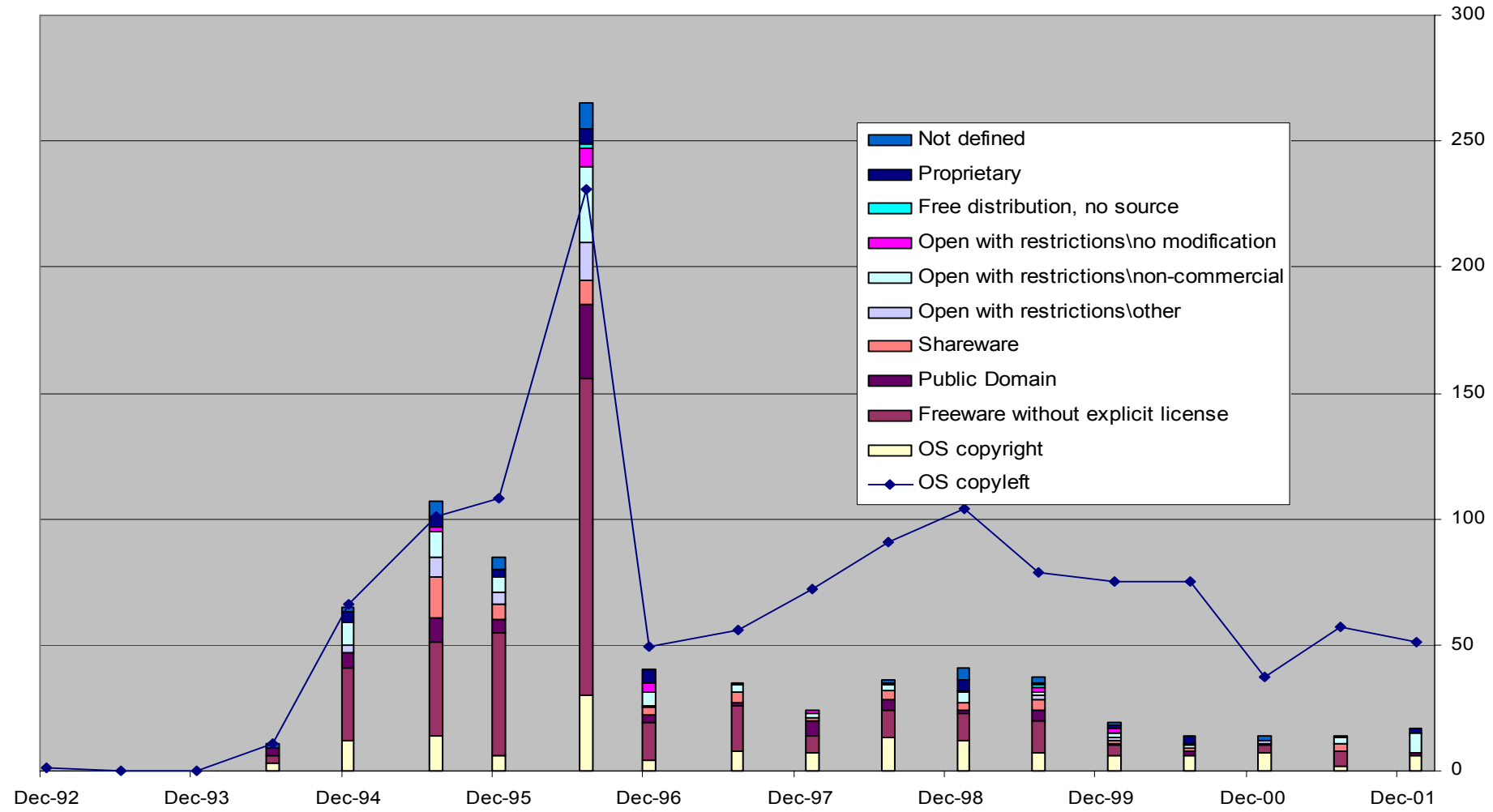

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The Open Source Model

- Key factors driving rapid growth:
  - **Multi-focal user-centric innovation model**

    Innovation occurs where it makes a difference

    Lack of centralized decision-making makes knowledge, innovation, and implementation local
  - Evolution instead of implementation of predetermined design
  - Successful **"universal" interfaces** facilitate recombination of resources
- Boundary conditions:
  - Tight control of core is needed to enable continuous growth in the periphery
  - Standard interfaces (technical and procedural) necessary to reduce complexity and to translate sub-networks into resources
  - Requires **constraints that substitute for design** (e.g. a given processor architecture)

I. Tuomi. Internet, innovation, and open source: actors in the network. *First Monday* 6 (1), 2001.

The Final Challenge

- How to develop innovation policy when:
  - Innovators almost always miss the actual dominant uses of new technologies
  - When radical new technologies emerge they are always ill-defined, unclear, and worse than existing technologies
  - The decisions on resource allocation heavily over-emphasizes the winners of the previous generation
  - ICT seems to accelerate regional change faster than we have realized
  - Policy development occurs in slower time-scales than technology architectures evolve
  - National innovators can only operate successfully if they are parts of global networks
  - Statistics are based on national accounting which gives an increasingly misleading picture of innovation activity