Innovative Behaviour and Regional Dynamics of Low-Tech Regions in Europe

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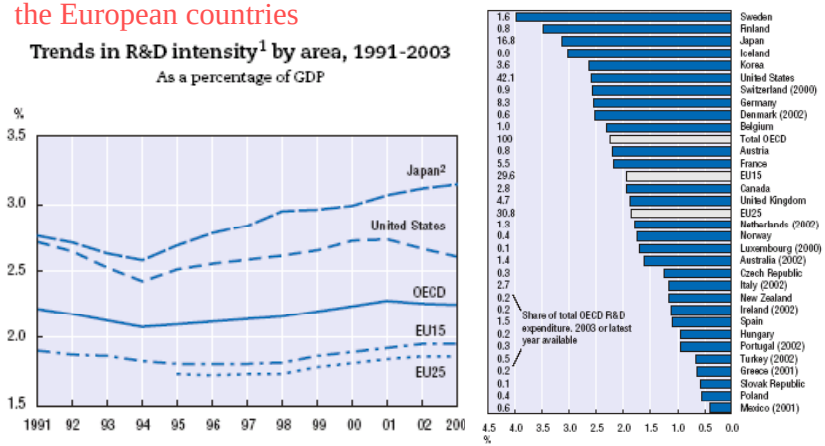
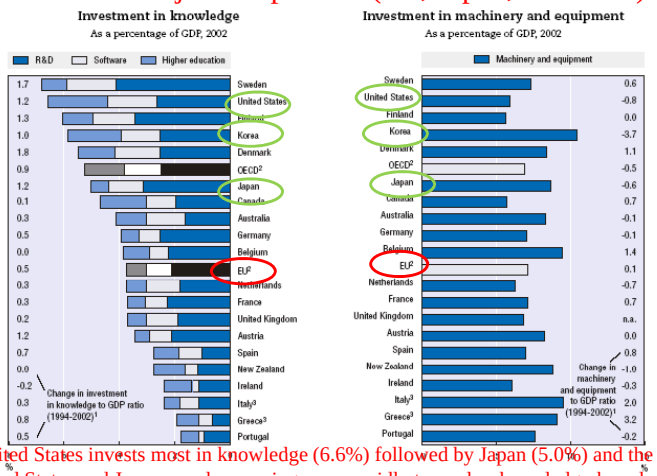
Research and Development Expenditures

Considerable delay of most of the European countries

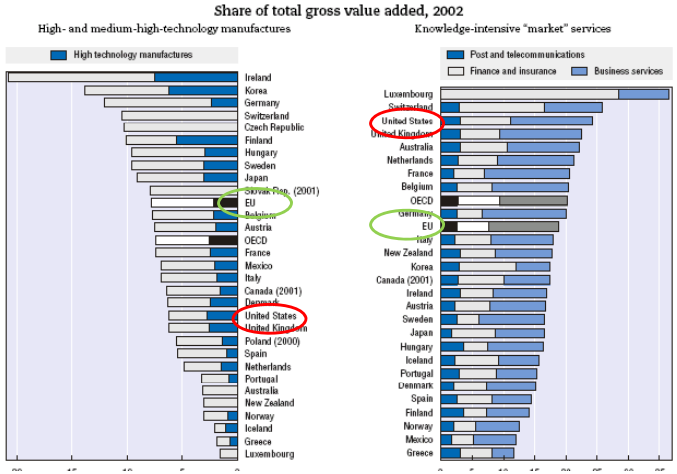


Lower investments in knowledge and machinery in the EU in comparison with major competitors (US, Japan, Korea …)



"The United States invests most in knowledge (6.6%) followed by Japan (5.0%) and the EU (3.8%). The United States and Japan are also moving more rapidly towards a knowledge-based economy than the EU: since 1994, their investment in knowledge to GDP ratios have grown at a higher rate than that of the EU." Source: OECD Science, Technology and Industry Scoreboard 2005

EU: Lower share of advanced market services, but higher share of advanced technologies



European and US performance compared

	EU25	EU15	US	JP
S&E grads	11,5	12,5	10,2	13.0
Work pop w 3rd educ	21,2	21,8	38,1	36.3
Emp h-tech manuf	6,60	7,10	4,65	--
Public R&D exp	0,67	0,69	0,86	0.80
Business R&D exp	1,27	1,30	1,90	2.32
EPO h-tech pats	26,0	30,9	48,4	40.4
USPTO h-tech pats	9,4	11,2	76,4	75.4
EPO pats	133,6	158,5	154,5	166.7
USPTO pats	59,9	71,3	301,4	273.9
Early stage VC	0,025	0,025	0,072	--
ICT exp	6,3	6,2	6,3	6.1
VA h-tech manuf	12,7	14,1	23,0	18.7

The gap between the US and the EU is further expanding … the main factors underlying this gap are: Patents (50 % of the gap), working population with tertiary education (26 %), R&D expenditures (11%), mainly business R&D, high-tech manufacturing value-added share (11%), early stage venture capital (10%). The EU has an advantage over the US for the Employment in med/high-tech and S&E graduates (-8%), and is on the same level for ICT expenditures." (European Innovation Scoreboard 2004)

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1. Low innovation expenditures: An indicator of backwardness or a European pattern of specialisation?

- Relatively low share of R&D expenditures and other „knowledge investments" of European countries: An indicator for the backwardness or a result of the specialisation on medium and low technologies?
- *Backwardness*: "R&D expenditures and patent based indicators identify a European lag in terms of both lower search investments and lower innovative output. Moreover, this is largely the effect of the weaknesses in technological fields that are considered as the engine of the contemporary "knowledge economy" ... strength related to mechanical technologies and new materials ... lower presence in the sectors based on new technological paradigms - such as ICT and biotechnologies." (Dosi/Llerena/Sylos Labini, 2005)
- *Specialisation*: The EU industry might be specialised on the improvement and diffusion of knowledge and not on the creation of new technological knowledge. Such a specialisation pattern could be explained by the stronger institutional embeddedness of European industries (stronger role of SME, focus on production instead of services, smaller amount of venture capital, stronger role of unions, business

Against the High-tech myopia? Low-Tech Industries and the Knowledge Economy

- **The LMT bias of European industry**: „LMT activities account for somewhere in the region of 97% of all economic activity in Europe. All European economies are trade-specialized in LMT products. All LMT industries are innovative. They generate significant proportions of their sales from new and technological changed products. Many LMT industries and products are surviving and growing on the basis of technological upgrading, high-grade design skills and the intensive application of knowledge to innovation. They have unique forms of industrial organisation and knowledge creation, complex links to science and technology knowledge infrastructures, and important regional dimensions")

Source: Hirsch-Kreinsen, H., Jacobson, D., Laestadius, S. and Smith, H. (2003). Low-Tech Industries and the Knowledge Economy: State of the Art and Research Challenges. In: Working Paper no. 1. University of Dortmund

Low and medium tech industries and European innovativeness

- The innovation systems of Europe and indeed of most industrialised countries are strongly influenced by low-tech industries.
- The products of these industries are often growing rapidly and in surprising ways, as a consequence of quality improvements and technological upgrading
- The knowledge bases of these industries are deep, complex and systemic. They are intensive creators and users of practical knowledge and high-grade design skills. They use engineering and scientific knowledge and are closely integrated with the science and technology infrastructure. The mere fact that they do not do much internal R&D says nothing at all about knowledge intensity or their contribution to the knowledge economy.
- They are very often embedded in specific regional structures and are part of regional company networks that differ from country to country and are part of specific national and regional innovation systems.

Source: Hirsch-Kreinsen, H., Jacobson, D., Laestadius, S. and Smith, H. (2003). Low-Tech Industries and the Knowledge Economy: State of the Art and Research Challenges. In: Working Paper no. 1. University of Dortmund

Stark und schwach eingebettete Innovationsregime

	Gesellschaftlich stark eingebettete Innovations-regime	Gesellschaftlich schwach eingebettete Innovations-regime
Technische Spezialisie-rung	inkrementale Innovatio-nen (hochwertige Tech-nologien)	radikale Innovationen (Hochtechnologien)
Unternehmens- und Wirtschaftsstrukturen	Routinisiertes Regime (etablierte Unternehmen)	Unternehmerisches Re-gime (viele Neugrün-dungen)
Institutionelle Regulie-rung der Wirtschaft	Starke Verbände und Regierungen	Minimale Regulierung durch Verbände und Re-gierungen

Heidenreich, Martin, 1999: Gibt es einen europäischen Weg in die Wissensgesellschaft? S. 293-323. In: Gert Schmidt und Rainer Trinczek (Hg.): Globalisierung. Ökonomische und soziale Herausforderungen am Ende des zwanzigsten Jahrhunderts. Sonderband 13 der "Sozialen Welt". Baden-Baden: Nomos.

2. The Networked Character of Low-tech Innovations. Three Hypotheses

(H1) LMT industries can compensate the low level of own research and development activities by the procurement of high-quality machinery and software and by qualified employees. Disembodied innovative activity (proxied by R&D intensity) can partially or completely be substituted by competences embodied in machinery, software or persons (*other inputs*).

(H2) LMT industries compensate the low level of own R&D activities by close co-operation with (often regional) suppliers, customers, research institutes and competitors (*other withinputs*).

(H3) Since low-tech innovations and the corresponding branches are based less on research and development, product innovations will be less important. LMT-companies compensate this by other forms of innovations – for example by a special design, a higher quality and flexibility and other organizational and process innovations (*other outputs*).

R&D expenditures and other Innovation Expenditures of European Companies (23 countries; 2004)

	Expendi-ture in intramu-ral R&D in 2004 (in % of turnover 2002)	**Total in-novation expendi-ture (in % of turnover 2002)**	**Expendi-ture in intramu-ral R&D in 2004**	**Expendi-ture in extramu-ral R&D in 2004**	**Expenditure for acquisition of machinery, equipment and software in 2004**	**Expendi-ture for ac-quisition of other ex-ternal knowledge in 2004**
			(in % of total innovation expenditure)			
Low and medium low technology manufactur-ing sector	**0,8%**	**2,2%**	33,8%	5,4%	**51,0%**	2,2%
High and medium high technology manufactur-ing sector	**2,4%**	**4,6%**	53,0%	12,7%	**20,8%**	4,4%
Industry	1,7%	3,6%	48,2%	10,9%	28,4%	3,9%
Services	0,6%	1,2%	51,3%	8,6%	32,1%	7,3%
Total	1,1%	2,4%	45,8%	9,9%	30,6%	4,9%

Source: Fourth Community Innovation Survey.

H1: compensation through high quality machinery, software, employees

➔ **partly rejected**: compensation is very incomplete

Innovation activity and co-operation during 2002-2004 (in percentage of all innovative enterprises)

	Enterprises with innovation activity. % of all enterprises	All types of co-operation; in % of all innovative enterprises	Within the enterprise group	Suppliers	Clients or customers	Competitors	Private R&D institutes	Universities	Public research institutes
			Co-operation partners; in % of all innovative enterprises						
Manufacturing	41,7%	25,2%	8,5%	16,1%	13,7%	7,3%	8,9%	9,6%	5,8%
LMT-Industries	**37,0%**	**21,6%**	6,3%	14,3%	11,3%	6,2%	7,4%	6,6%	4,1%
High- and Medium High Technologies	**56,0%**	**32,1%**	13,0%	19,7%	18,6%	9,5%	12,0%	15,6%	9,1%
Services	26,8%	27,4%	10,7%	18,9%	12,2%	9,3%	9,0%	6,6%	5,3%
Total	39,5%	25,5%	9,5%	16,5%	13,9%	8,3%	8,9%	8,8%	5,7%

H2: compensation through cooperations

➔ **rejected**

Product and process, organisational and marketing innovations (2002-04; in % of all innovative enterprises)

	Enterprise introduced organisational and/or marketing innovations	Enterprise introduced organisational innovation	Enterprise introduced marketing innovation	Novel innovators, product only	Novel innovators, process only	Novel innovators, product and process innovators
Manufacturing	54,5%	47,3%	27,7%	20,2%	26,8%	37,3%
LMT-Industries	53,3%	45,6%	27,8%	**16,5%**	**32,0%**	34,6%
High- and Medium High Technologies	56,8%	50,8%	27,6%	**27,6%**	**16,6%**	42,7%
Services	64,3%	57,7%	32,8%	19,4%	41,1%	35,1%
Total	55,5%	49,2%	27,8%	19,5%	27,2%	34,8%

Source: Own calculations on the basis of the Fourth Community Innovation Survey

H3: less product innovation, but more process and organisational innovation

➔ **confirmed**

3. Low-Tech-Innovation - a Complementary or an Alternative Innovation Pattern?

- **The crucial question**: „Should Europe focus on so-called high-technology or science-based industries in attempting to solve growth and employment problems? Or should it look to the growth prospects within the industries on which the European economy is actually based: low-technology and medium-technology industries (LMT) in manufacturing and services? (Hirsch-Kreinsen et al. 2003)
- **"Engine of growth"-hypothesis (H4a)**: Even if "innovation is much more than R&D", high technologies might be drivers of growth and innovation also for other industries. High- and low-tech innovations might be *complementary* to each other
- **Alternative growth path (H4b):** R&D-based innovations are only one possible way to growth and unemployment; alternative growth paths are based on practical, socially and often regionally embedded, often tacit knowledge.

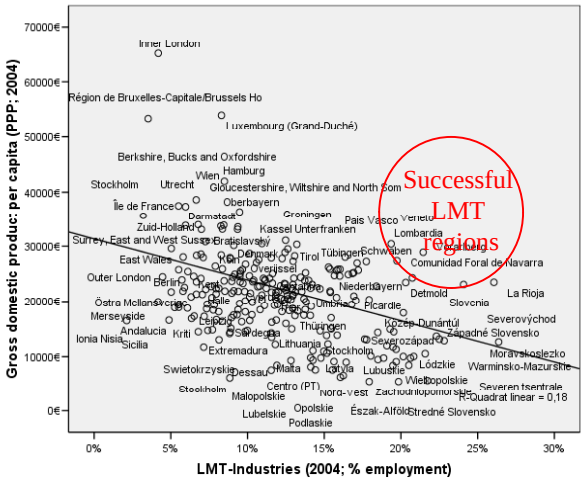
Displacement of LMT-industries into the East European Periphery

Increasing territorial differentiation of the European territory: „Mainly slow growing and unskilled labour intensive industries have become more concentrated, usually in peripheral low wage economies" (Midelfart-Knarvik et al. 2000) => Support for H4a

Countries (sorted by GDP)	LMT 1995	LMT 2006	Change
Luxembourg	11.7	7.4	-4.3
Ireland	12.1	7.6	-4.5
Netherlands	10.9	9.5	-1.4
Austria	15.4	11.8	-3.6
Denmark	12.6	9.2	-3.4
Belgium	12.4	10.4	-2
UK	11.3	7.5	-3.8
Sweden	11.1	8.7	-2.4
Germany	14.0	11.4	-2.6
Finland	13.8	11.2	-2.6
France	11.7	10.0	-1.7
Italy	15.4	13.4	-2
Spain	14.1	11.2	-2.9
Cyprus	12.5	9.5	-3
Greece	12.9	10.4	-2.5
Slovenia	24.8	18.9	-5.9
Czech Republic	19.5	17.9	-1.6
Portugal	20.5	15.7	-4.8
Malta	13.2	11.2	-2
Hungary	16.2	13.5	-2.7
Slovakia	19.0	16.6	-2.4
Estonia	19.8	17.8	-2
Lithuania	14.8	15.2	**0.4**
Poland	15.4	15.5	**0.1**
Latvia	18.3	13.4	-4.9
Romania	15.1	16.1	**1**
Bulgaria	17.8	18.9	**1.1**
EU27	13.9	11.7	-2.2

Employment in LMT sectors (1995-2006; in % of total employment). Source: Eurostat. Regio-Data.

Low- and medium-technology regions and their economic performance (2004)



A cluster of economically more successful low-tech regions, as would be expected in the sense of the "Alternative-Path"-Hypothesis (H4b), cannot be detected => Support for 4a.

Correlations between the sectoral structures of 249 European NUTS2-Regions (EU 25; 2004)

	GDP	KIS	Services	LT	LMT	HMHT
Gross domestic product (GDP)	1	0,73	0,66	-0,46	**-0,43**	ns
Knowledge-intensive services (KIS)	**0,73**	1	0,90	-0,64	**-0,68**	ns
Services	0,66	0,90	1	-0,71	**-0,75**	ns
Low technology	-0,46	-0,64	-0,71	1	0,88	ns
Low and medium low technology	-0,43	-0,68	-0,75	0,88	1	0,32
High and medium high technology	ns	ns	ns	ns	**0,32**	1

Source: Eurostat. REGIO database.

The employment ratio of the LMT industries correlates positively with the proportion of other industrial branches. This can be interpreted as an indication of the *complementarity* of high and low technologies => Support for H4b.

Regional Inequalities of the Industrial Structure in the enlarged Europe

(1995 and 2006; mean logarithmic deviation; 246 NUTS2-regions)

	Low and medium low technology manufacturing (% of total employment)		High and medium high technology manufacturing (% of total employment)		Total knowledge-intensive services (% of total employment)	
	1995	2006	1995	2006	1995	2006
EU18	0.06	0.08	**0.14**	**0.17**	**0.03**	**0.03**
Within-state inequality	0.05	0.05	0.08	0.08	0.01	0.01
	83%	65%	59%	49%	38%	36%
Between-state inequality	**0.01**	**0.03**	**0.06**	**0.08**	0.02	0.02
	17%	**35%**	**41%**	**51%**	62%	64%

Source: Own calculations on the basis of Eurostat, REGIO-database.

The sharp increase in the inequalities of the distribution of LMT-industries in Europe as a whole is mainly a result of the increasing between-state inequalities. In some, mostly East European countries the LMT-industries become more important, while their employment share declines in other, especially West European countries. Thus, the between-state regional inequalities as a share of the total inequalities in the enlarged Europe have increased from 17 % (1995) to 35 %

LMT: No indicator of backwardness, but also no basis for an alternative development trajectory

- *No low-technology regions as a specific type:* Regions with a high proportion of LMT industries are first of all industrial regions. An autonomous type of low-technology region does not exist. We observe only a varying degree of permeation of high technologies into low-tech and medium-tech regions.
- Regions with a high proportion of LMT industries are clearly less prosperous than other regions
- Increasing specialisation of Central and Eastern European countries in LMT
- *A focus on low-and medium technology branches is not the result of an active choice of promising niche markets, but a defensive reaction which is based most of all on the lower labour costs in Eastern Europe*

4. Conclusion: LMT are no "engines of growth"

- Comparatively high patterns of organisational and marketing innovation; higher importance of process innovation
- *Low and medium-tech industries are not characterised by especially intensive intercompany cooperation pattern*
- *No autonomous regional specialisation pattern based mainly on LMT industries*
- *Regions with a high proportion of LMT have below-average growth rates*
- Displacement of LMT-industries from Western to Eastern Europe; increasing intra-European heterogeneity: territorial separation between Western high and medium high technology branches and peripheral low and medium low technology branches