



# Location, geography of knowledge sourcing and innovation – Evidence from the ICT sector in Austria

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RSA Conference in Pecs  
May 24-26, 2010

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# External knowledge sourcing and innovation

- Innovation is a result of collective and cumulative knowledge process
- Increasing complexity due to scientific and technological progress
- Relevant knowledge often located outside the firm → concepts of „open innovation“, distributed knowledge base and innovation networks

# External knowledge sourcing and in-house knowledge

- External knowledge sourcing depends, however, also on in-house knowledge  
→ absorptive capacities needed
- In-house knowledge enables firms
  - to source and absorb external knowledge in related fields
  - to apply this knowledge to create new solutions and innovations

# Geography matters for knowledge sourcing:

- **Company location** and **type of RIS**  
→ density of knowledge generating organisations and level of networking
- **Types of knowledge sources** differ regarding the need of geographical proximity
- **Mechanisms for knowledge exchange** used differ in their geographies  
→ some are more local than others

# Research questions

- How do companies source external knowledge?
  - \* Which kinds of knowledge sources?
  - \* Which mechanisms of knowledge exchange?
  - \* At which geographical levels?
- Does pattern of innovation and knowledge sourcing vary between types of RIS?
- How does location (type of RIS) and the pattern of knowledge sourcing relate to the innovativeness of companies?

# Different types of regional innovation systems

- **Regional Innovation Systems** account for density of firms and organisations, interrelationships between actors, underlying institutional settings and policy dimensions  
→ Types of RIS: metropolitan, peripheral, (old) industrial
- Companies in **metropolitan RIS** have more and diverse opportunities for knowledge sourcing and good preconditions for innovation
- Companies in **peripheral RIS** face problem of organisational “thinness” → few knowledge sources on the regional level
- Companies in **industrial RIS** often have advantages of specialised clusters; under certain conditions they may face problem of “lock in” → too strong fix on old technological trajectories in OIAs

# Sectoral Differences: Synthetic and Analytical Knowledge Bases

## Synthetic Knowledge Base

e.g. machinery, engineering,  
some subsectors of ICT

- Recombination
- Tacit practical knowledge
- Incremental innovation
- Customer-Supplier relations

## Analytical Knowledge Base

e.g. biotech, research  
oriented subsectors of ICT

- Discovery
- Codified scientific knowledge
- Radical innovations
- Science-industry relations

# Types of knowledge sources and geographical levels

The role of geographical proximity varies between types of knowledge sources:

- **Knowledge exchange with universities and research organisation** needs to overcome cognitive and relational distance and is favoured by face to face interaction  
→ often at the **regional level**
- **Knowledge exchange with customers and suppliers** is characterised by cognitive and relational proximity and shaped by existing customer / supplier networks  
→ often at an **international level**

# Mechanisms and channels for external knowledge exchange

## Static (knowledge transfer)

## Dynamic (collective learning)

### formal / traded relation

#### ***market relations***

- contract research
- consulting
- licenses
- buying of intermediate goods

#### ***Co-operation / formal networks***

- R&D co-operations
- shared use of R&D facilities

### informal / untraded relation

#### ***externalities / spillovers***

- recruitment of specialists
- monitoring of competitors
- participation in fairs, conferences
- reading of scientific literature, patent specifications

#### ***milieu / informal networks***

- informal contacts

Source: Tödtling et al. 2006

# Hypotheses

- Firms using a larger variety of external knowledge sources tend to be more innovative.
- Knowledge links to universities and R&D institutes can be found more frequently on a regional level than links to clients and suppliers.
- Interactive knowledge transfer mechanisms such as cooperations and informal networks are more frequent on a regional level than static knowledge transfer mechanisms such as buying of technology.
- Firms located in Vienna (“thick” RIS) tend to have more regional knowledge links and they tend to be more innovative than firms located in other regions.

- Data generated through FWF/ESF-funded project “Constructing Regional Advantage”
- Survey in three Austrian regions of firms in the following ICT (sub-)sectors:
  - Vienna (metropolitan RIS): ICT manufacturing
  - Upper Austria (industrial RIS): Software development
  - Salzburg (“thin” RIS): Software development, ICT service and manufacturing
- Descriptive analyses of innovation and knowledge sourcing data
- Multivariate analysis of relationships

# Basic regional characteristics

	Vienna	Upper Austria	Salzburg
Inhabitants in thds. 2009	1.687	1.410	529
... Growth since 2001	8,84%	2,40%	2,72%
Area in km <sup>2</sup>	415	11.980	7.156
Density (persons/km <sup>2</sup> )	4.068	118	74
Capital	Vienna	Linz	Salzburg
... Inhabitants in thousand	1.687	190	149
GRP per capita 2007	43.300	31.800	37.300
... Growth since 2000	18,31%	28,23%	27,74%
Sample (no. of companies)	30	38	42
... % of population	33	25	34

# Innovation indicators

	Vienna	Salzburg	Upper Austria
<b>Percentage of firms introducing the following innovations (last three years)</b>			
Product Innovation	87	79	97
Product Innovation - new to market	73	55	79
Process Innovation	80	52	61
New/significantly changed strategy	53	26	58
New/significantly changed organisational structures	47	19	40
New/significantly changed market concept	50	19	37
<b>Patents (last three years)</b>			
Percentage of firms that have been granted a patent	60	17	11
Percentage of firms that have been granted a co-patent	13	0	2,6
Average number of patents	24,6	0,4	,1
<b>R&amp;D department/employees</b>			
Share of firms with an R&D department	60	29	32
Average number of R&D employees	118	4	12
Median number of R&D employees	4,5	1	3

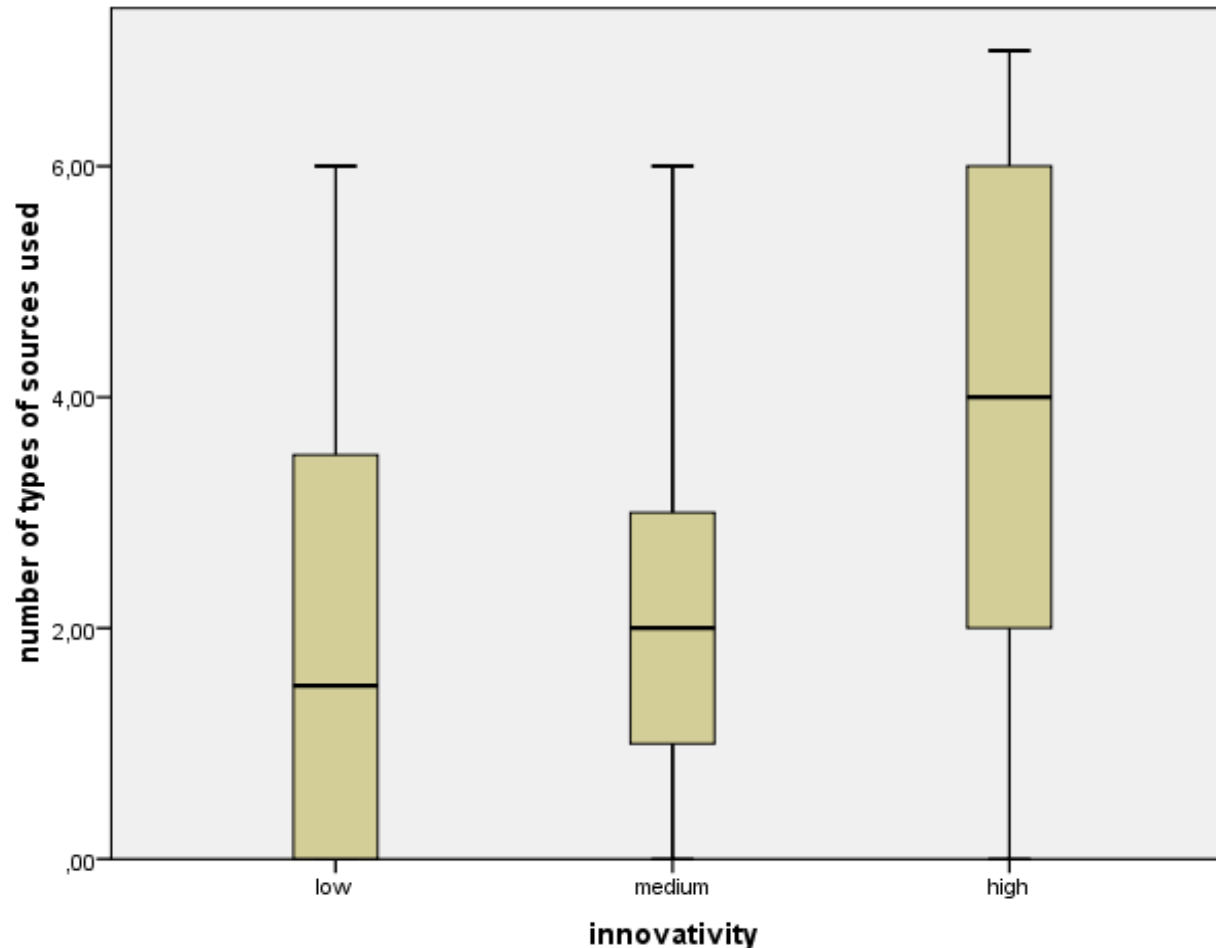
# Geography of knowledge sources (% of total)

	Vienna (N=177)				Salzburg (N=60)				Upper Austria (N=181)			
	Regional	National	Inter-national	Total	Regional	National	Inter-national	Total	Regional	National	Inter-national	Total
Suppliers	12,4	2,8	10,7	26	8,3	11,7	13,3	33,3	6,1	14,9	13,8	34,8
Customers	5,1	0,6	11,9	17,5	1,7	5	16,7	23,3	1,7	3,9	3,3	8,8
Firms of the same sector	1,7	3,4	4	9	3,3	1,7	6,7	11,7	2,8	2,8	6,1	11,6
Firms of diff. sectors	3,4	2,8	2,8	9	1,7	1,7	0	3,3	2,2	2,2	2,2	6,6
Universities and technical colleges	13,6	9,6	2,8	26	8,3	5	1,7	15	22,1	3,9	2,2	28,2
Research institutes	4	2,8	0,6	7,3	1,7	0	0	1,7	2,2	0,6	0	2,8
Others sources	1,1	3,4	0,6	5,1	6,7	0	5	11,7	5	1,1	1,1	7,2
<b>Total</b>	<b>41,2</b>	<b>25,4</b>	<b>33,3</b>	<b>100</b>	<b>31,7</b>	<b>25</b>	<b>43,3</b>	<b>100</b>	<b>42</b>	<b>29,3</b>	<b>28,7</b>	<b>100</b>

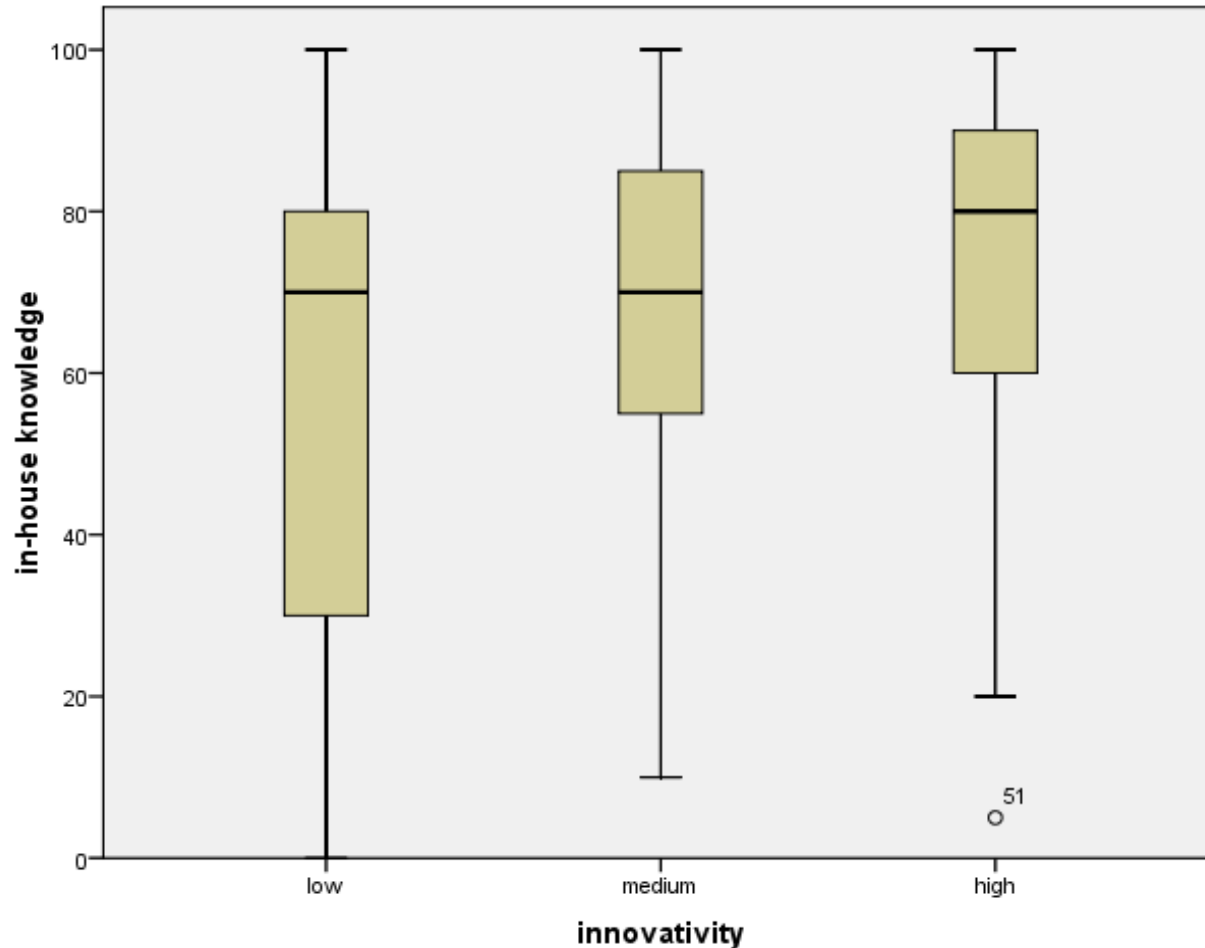
# Geography of knowledge transfer channels (% of total)

	Vienna				Salzburg				Upper Austria			
	Contacts to partners in ...				Contacts to partners in ...				Contacts to partners in ...			
	Regional	National	Inter-national	Total	Regional	National	Inter-national	Total	Regional	National	Inter-national	Total
Contract research	7,1	3,9	5,3	16,3	8,6	4,8	10,5	23,8	5	5,2	4	14,1
Licences, machinery, software	2,9	1,3	3,2	7,4	3,8	3,8	3,8	11,4	1,8	4,4	5,4	11,6
R&D cooperation	10,5	7,4	4,2	22,1	6,7	5,7	8,6	21,0	7,8	4,4	3,8	15,9
Informal contacts	13,2	4,5	10,0	27,6	2,9	6,7	6,7	16,2	9,8	5,2	7,4	22,3
Employment of specialist	2,1	3,7	1,8	7,6	1,9	0,0	0,0	1,9	8,8	1,6	1	11,4
Monitoring of competitors	0,5	0,3	4,5	5,3	1,9	0,0	5,7	7,6	2,4	1,4	3	6,8
Conferences, fairs	3,9	0,5	6,3	10,8	1,9	1,9	7,6	11,4	2,4	3	3	8,4
Academic journals, magazines	0,5	0,8	1,6	2,9	1,9	0,0	4,8	6,7	2,8	2,8	4	9,6
<b>Total</b>	<b>40,8</b>	<b>22,4</b>	<b>36,8</b>	<b>100</b>	<b>29,5</b>	<b>22,9</b>	<b>47,6</b>	<b>100</b>	<b>40,6</b>	<b>27,9</b>	<b>31,5</b>	<b>100</b>

# External knowledge sourcing and innovativeness



# In-house knowledge (relative importance) and innovativeness



# Multivariate analyses (1/3)

- Four ordinal regression models:
  - Using alternatively logit and cauchit link functions
  - Considering alternatively the different variance depending on whether the companies belong to ICT manufacturers or to software and service companies
- The models improve when considering the different variance and using the cauchit link function

# Multivariate analyses (2/3)

- The **dependent variable** was constructed as follows:
  - Low innovativeness: Companies with no patents nor product innovations new to the market
  - Medium innovativeness: Companies with patents or product innovation new to the market
  - High innovativeness: Companies with patents and product innovations new to the market
- **Independent variables** represent external knowledge sourcing, in-house knowledge, location, company size and ICT sub-sector

# Multivariate analyses (3/3)

## Factors with significant positive effect on innovativeness:

- R&D cooperations
- Regional knowledge sourcing
- International knowledge sourcing
- In-house knowledge (relative importance)
- Share of employees with science degree
- Location in metropolitan region of Vienna

# Results of multivariate model

	Logit						Cauchit					
	Esti- mate	Std. Error	p- value	Esti- mate	Std. Error	p- value	Esti- mate	Std. Error	p- value	Esti- mate	Std. Error	p- value
<b>Threshold ( )</b>												
Category = 0	1,537	0,951	0,106	0,409	0,553	0,460	-0,192	1,128	0,865	0,092	0,416	0,824
Category = 1	4,532	1,050	0,000	1,736	0,763	0,023	5,278	1,588	0,001	1,561	0,672	0,020
<b>Location ( )</b>												
Regional sources	0,342	0,268	0,202	0,196	0,113	0,083	0,897	0,407	<b>0,028</b>	0,255	0,118	<b>0,030</b>
National sources	-0,247	0,274	0,368	-0,156	0,110	0,156	-0,404	0,371	0,277	-0,195	0,120	0,104
International sources	0,297	0,207	0,151	0,082	0,084	0,329	1,000	0,361	<b>0,006</b>	0,146	0,081	0,073
R&D cooperations	0,472	0,164	<b>0,004</b>	0,206	0,079	<b>0,009</b>	0,528	0,235	<b>0,025</b>	0,120	0,067	0,073
In-house knowledge	0,020	0,008	<b>0,016</b>	0,011	0,004	<b>0,008</b>	0,029	0,011	<b>0,012</b>	0,010	0,004	<b>0,020</b>
Academics	-0,003	0,008	0,709	0,000	0,003	0,988	0,000	0,010	0,994	0,001	0,002	0,531
Science graduates	0,021	0,012	0,065	0,005	0,004	0,207	0,043	0,017	<b>0,010</b>	0,008	0,005	0,129
Lower density	-0,909	0,933	0,330	-0,564	0,724	0,436	-2,670	1,455	0,067	-0,608	0,679	0,371
Salzburg	-1,387	0,905	0,125	-0,797	0,725	0,272	-3,553	1,397	<b>0,011</b>	-0,791	0,692	0,253
Linz	-0,500	0,944	0,596	-0,426	0,718	0,553	-1,706	1,380	0,217	-0,258	0,668	0,699
Firm size	0,255	0,150	0,090	0,071	0,062	0,256	0,161	0,201	0,424	0,082	0,058	0,155
Services	-0,869	0,805	0,280	-0,471	0,620	0,448	-1,692	1,179	0,151	-0,509	0,593	0,391
<b>Scale (τ)</b>												
<b>Services</b>				-1,404	0,319	0,000				-2,425	0,516	0,000
r <sup>2</sup> - Cox and Snell	0,399			0,508			0,453			0,541		
r <sup>2</sup> - Nagelkerke	0,454			0,577			0,514			0,615		
r <sup>2</sup> - McFadden	0,240			0,335			0,284			0,367		
Observations	106			106			106			106		
Correctly predicted	62%			68%			71%			74%		

# Conclusions (1)

## Pattern of knowledge sourcing

**External knowledge sourcing is of considerable importance for investigated ICT companies  
→ different patterns can be observed:**

- Knowledge from universities, R&D institutes and other knowledge providers is predominantly sourced on the regional level (Vienna, Upper Austria)
- Knowledge from suppliers and customers is often sourced internationally (in particular in “thin” RIS of Salzburg)
- Highly interactive mechanisms for knowledge exchange, in particular R&D cooperations, occur frequently on the regional level
- Formal and informal networks are used at both regional and international levels (→ beyond local buzz and global pipelines)

# Conclusions (2)

## Relation to innovation performance

- Both in-house knowledge and external knowledge sourcing (in particular R&D cooperations) strengthen the innovation performance of firms
- Positive effects of both regional and international knowledge sourcing on the innovation performance of firms
- No evidence for the importance of national sources for innovativeness
- Some evidence found that firms in Vienna are more innovative than those in other locations

# Thank you!

