Intellectual Capital for Communities
In the Knowledge Economy

Intangible investments: Contribution to growth and Innovation policy issues

(IC Metrics project)

Vincent Delbecque

Ahmed Bounfour

Université Paris-Sud

UNIVERSITÉ PARIS-SUD 11

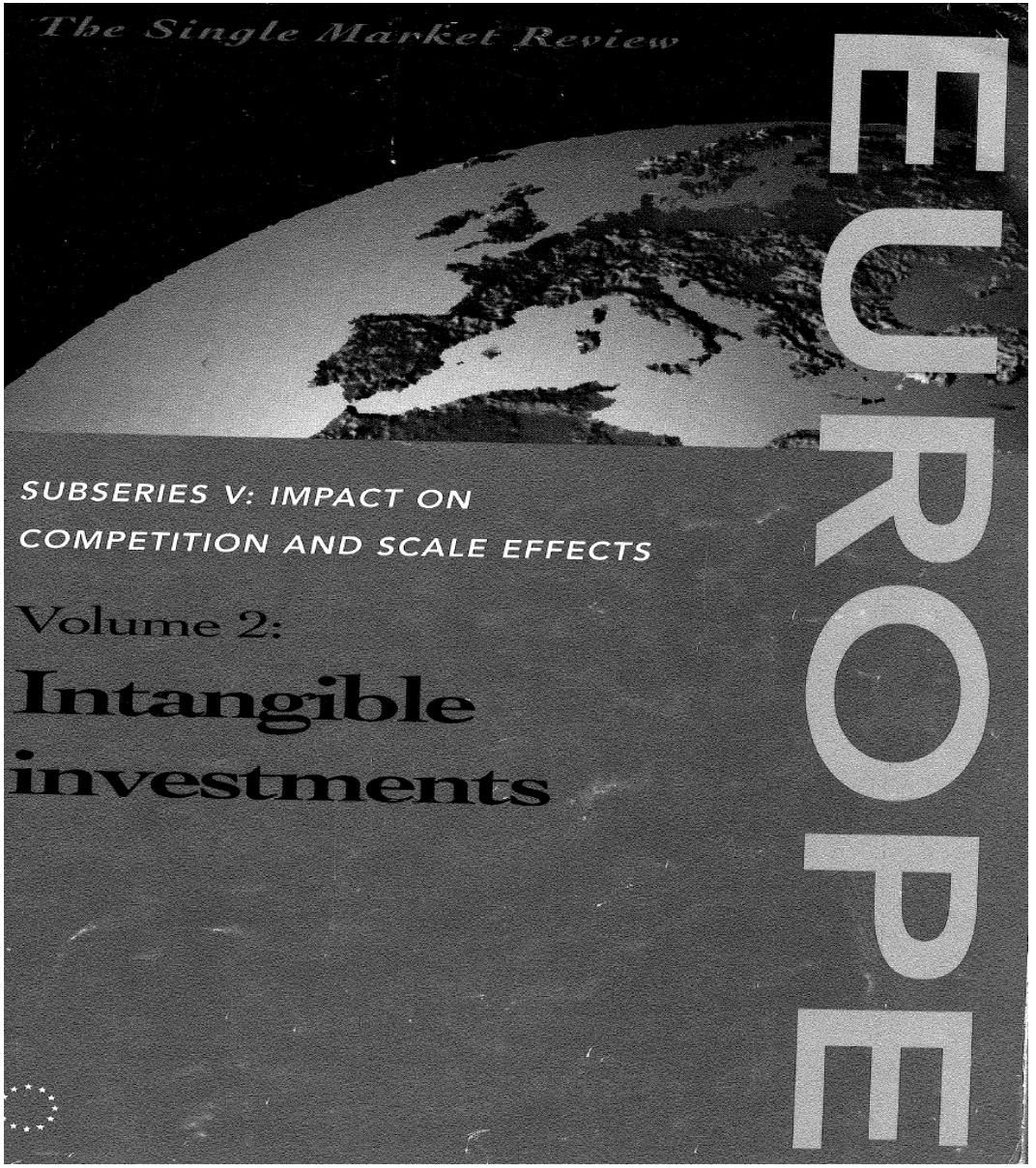
European Chair on Intellectual Capital Management

Background (1/2)

Several studies aimed at identifying and measuring using an « analytical approach »

- Statistics Finland (1987)
- INSEE (1995)
- CSB (NL), 1995
- Intangible investments report for DG XV (1998)
- Nakamura (2000), Corrado , Hulten, Sichel (2005)
- European projects (micro/macro , Coinvest, Innodrive, Saika …)

Background (1/2)



Background (2/2)

List of intangibles

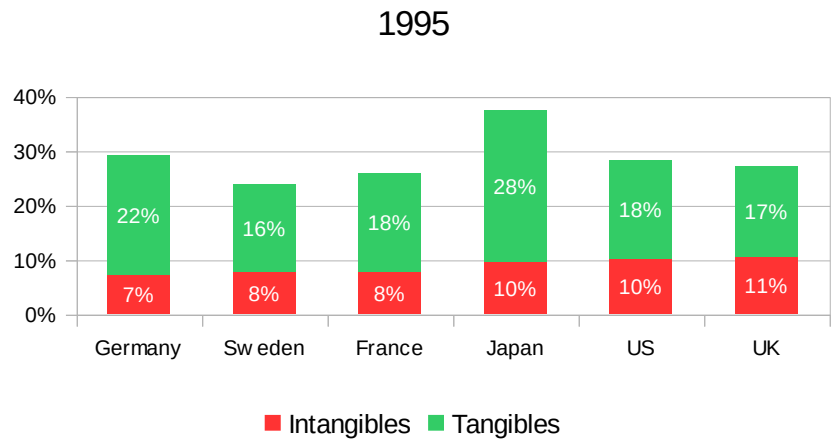
- Software & database
- R&D
- Artistic originals
- Architecture and engineering design
- Advertising
- Organisation
- Training

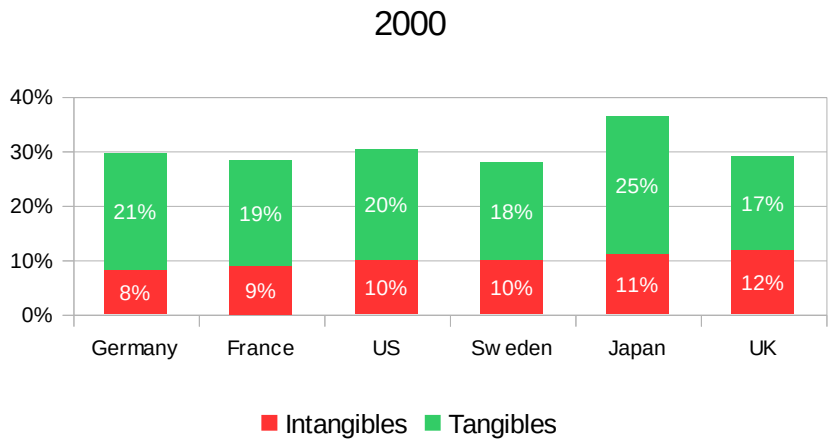
- Long time series
- Focus on production function parameters rather than contribution to productivity

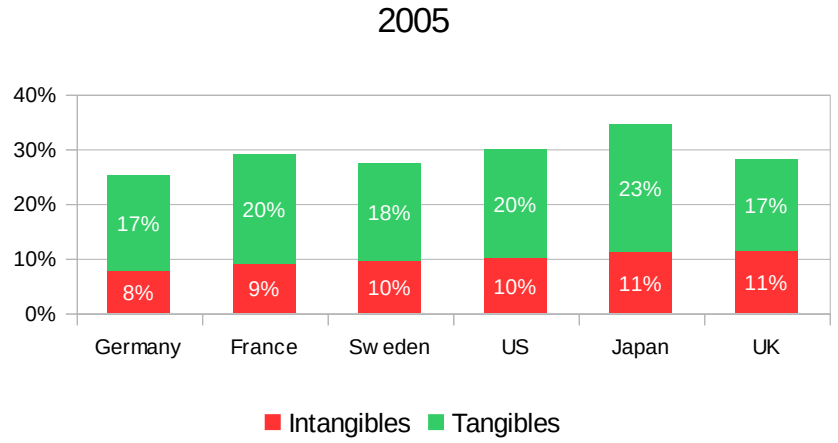
Content

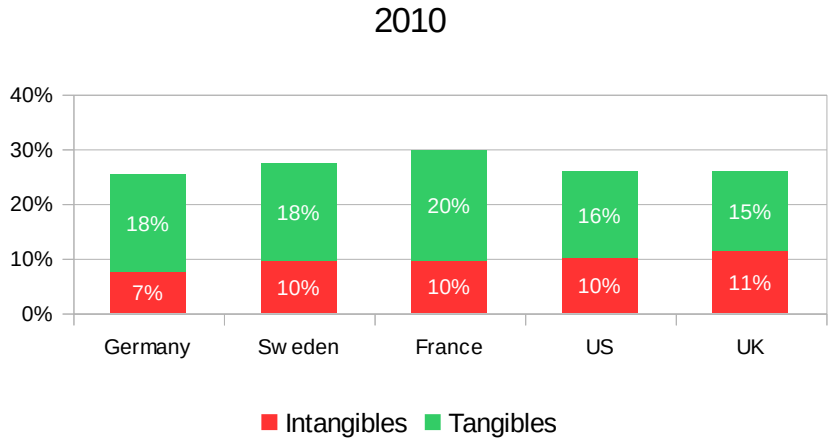
- Data presentation
- Production function estimation
- Issues
- Focus on France and Germany behaviour
- Main findings and conclusion

Data – Tangible vs intangible investment

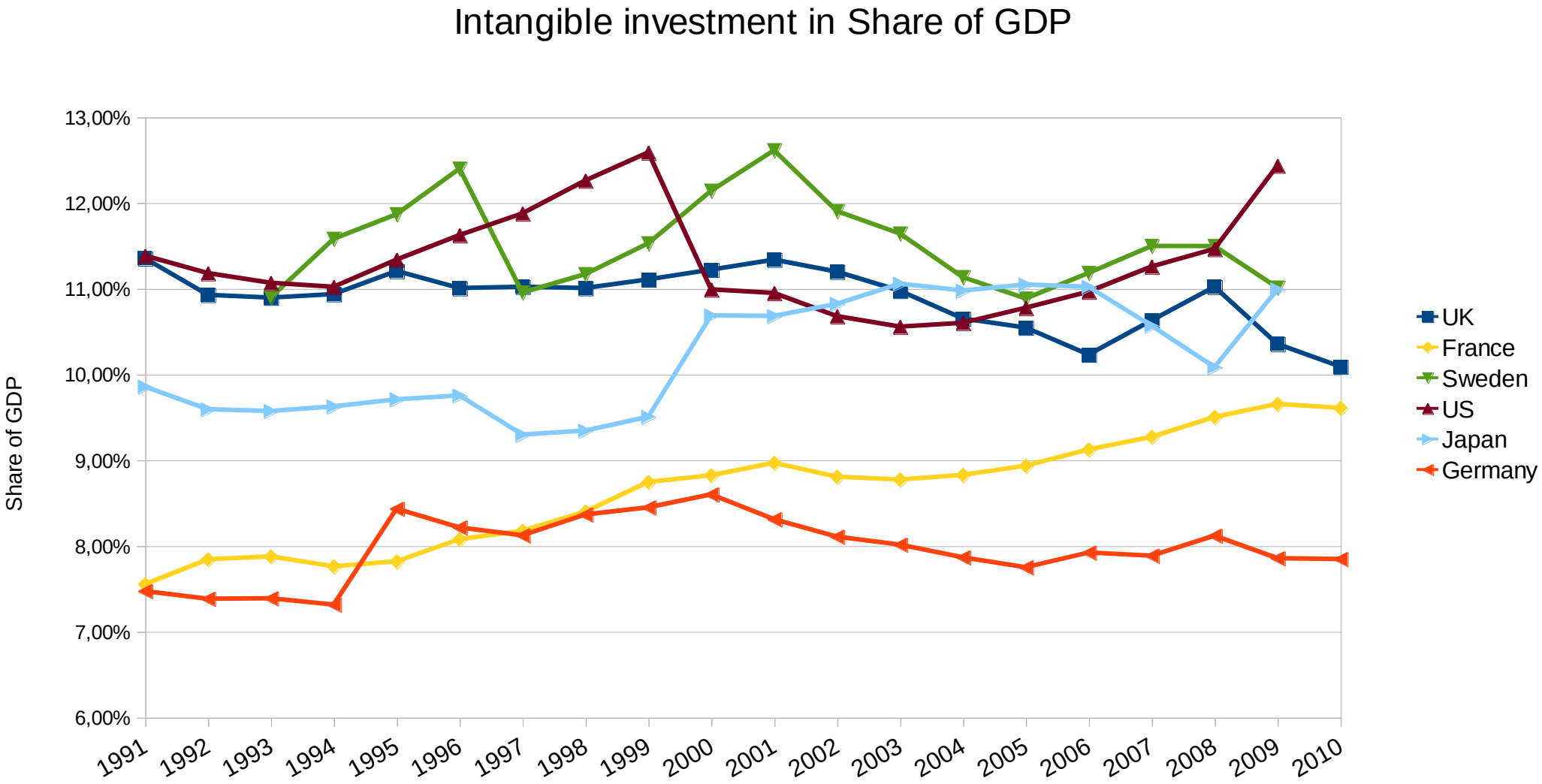




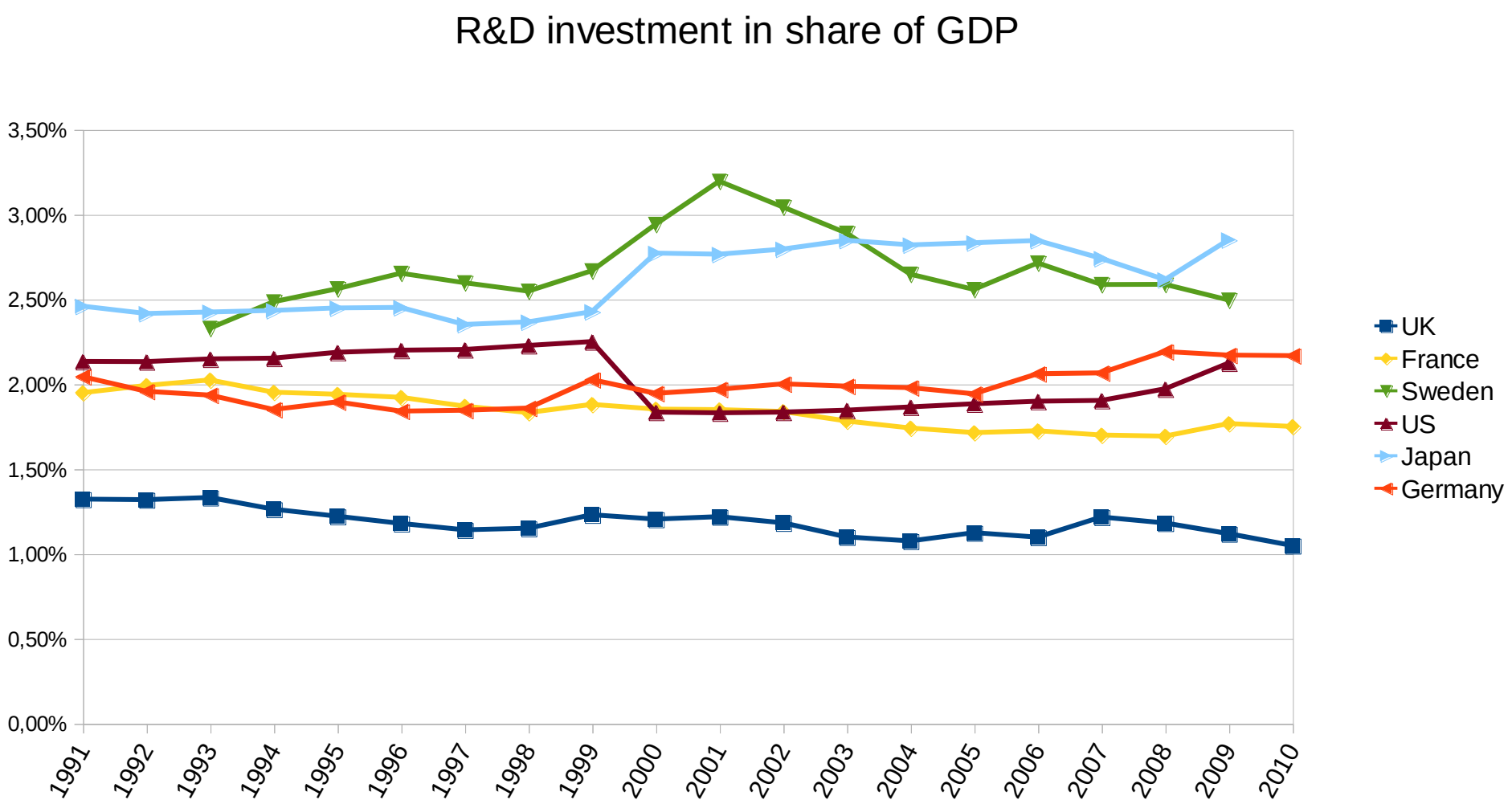




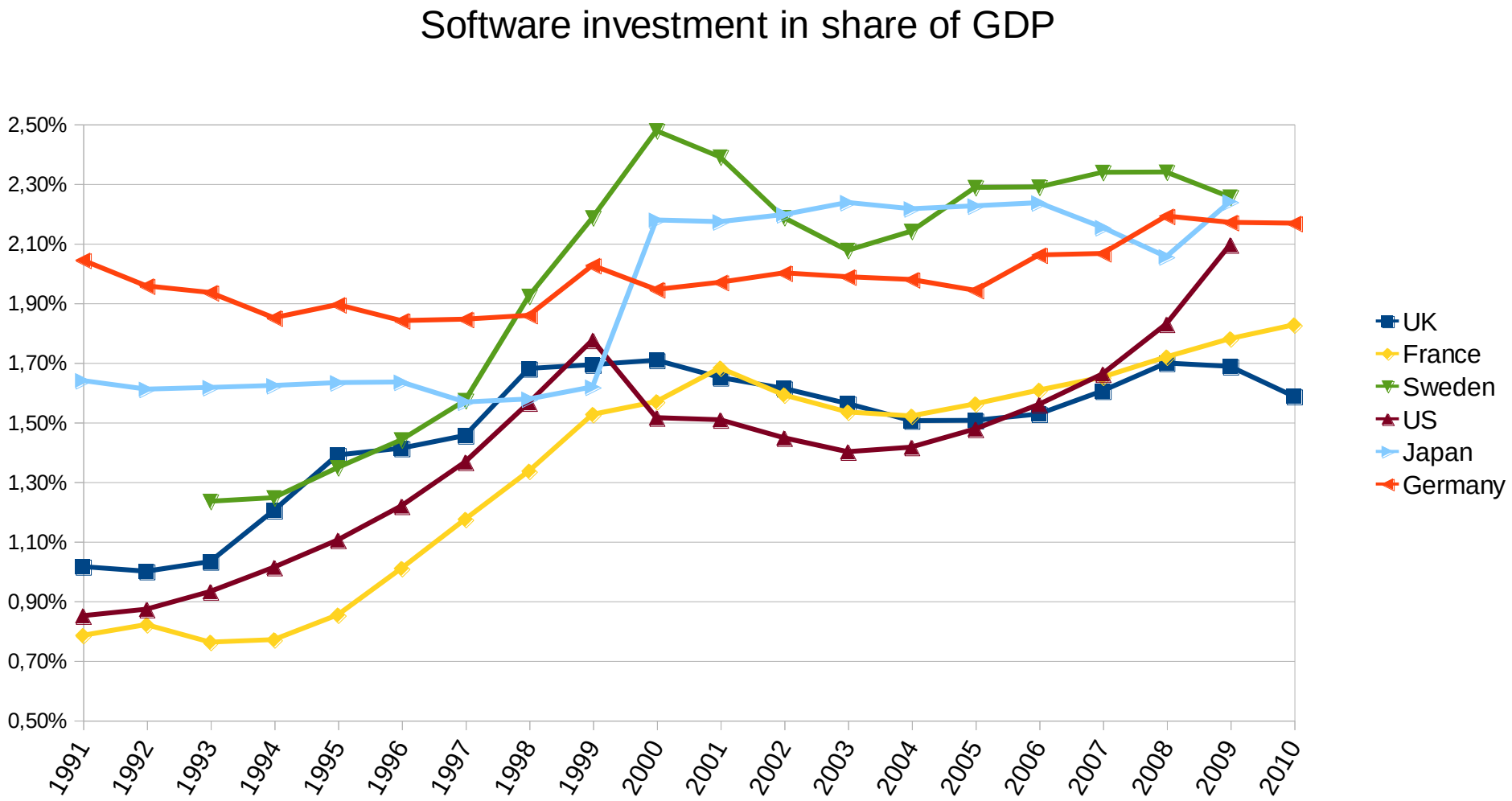
Data – intangible intensity



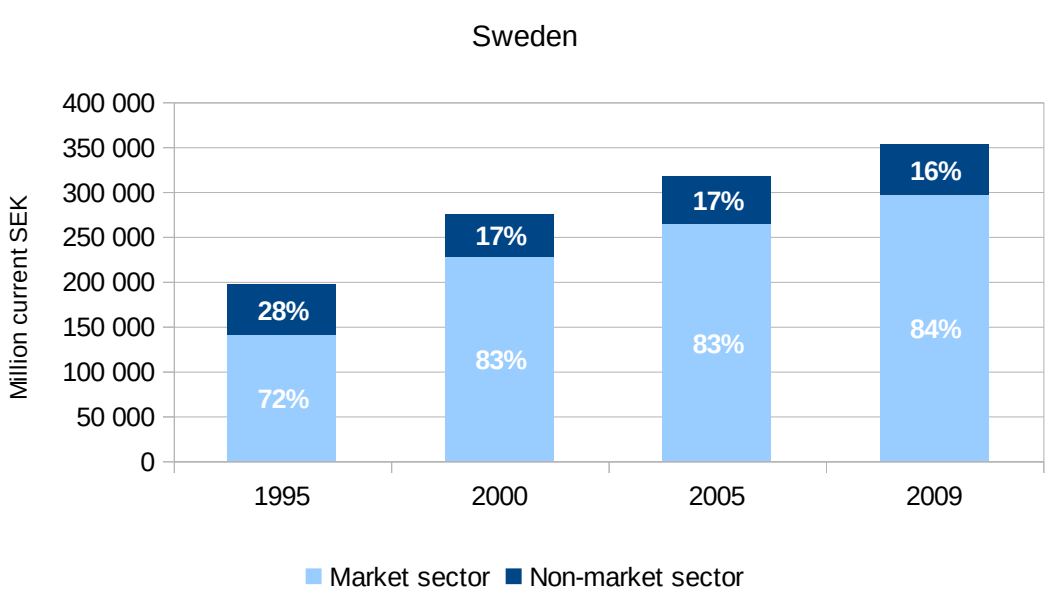
Data – R&D intensity

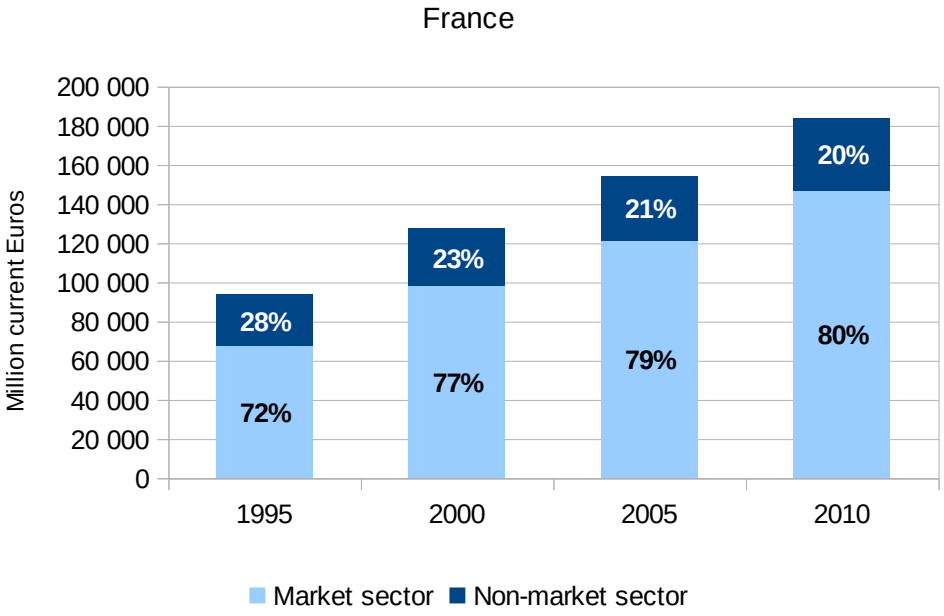


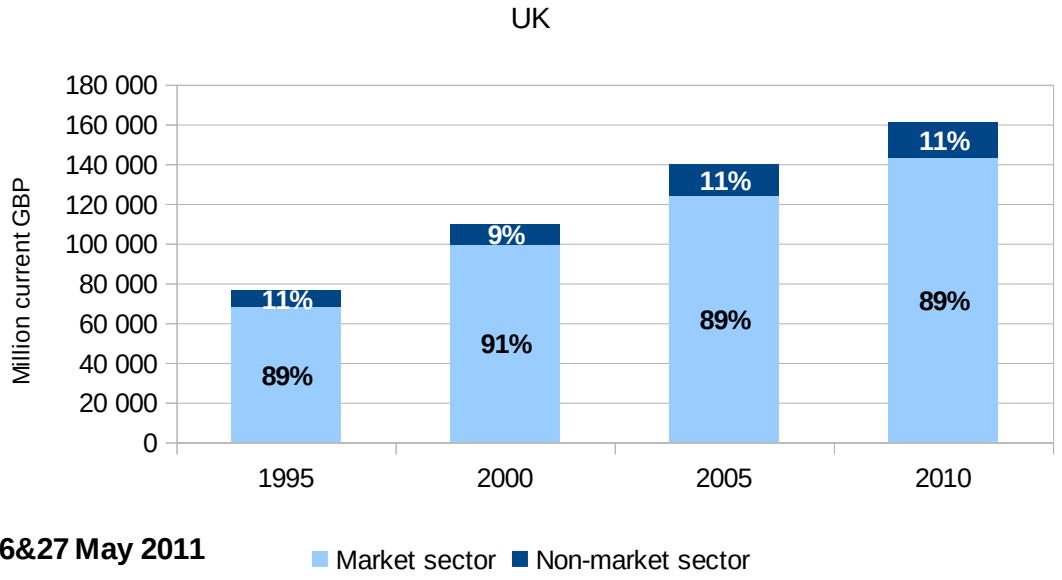
Data – Software intensity

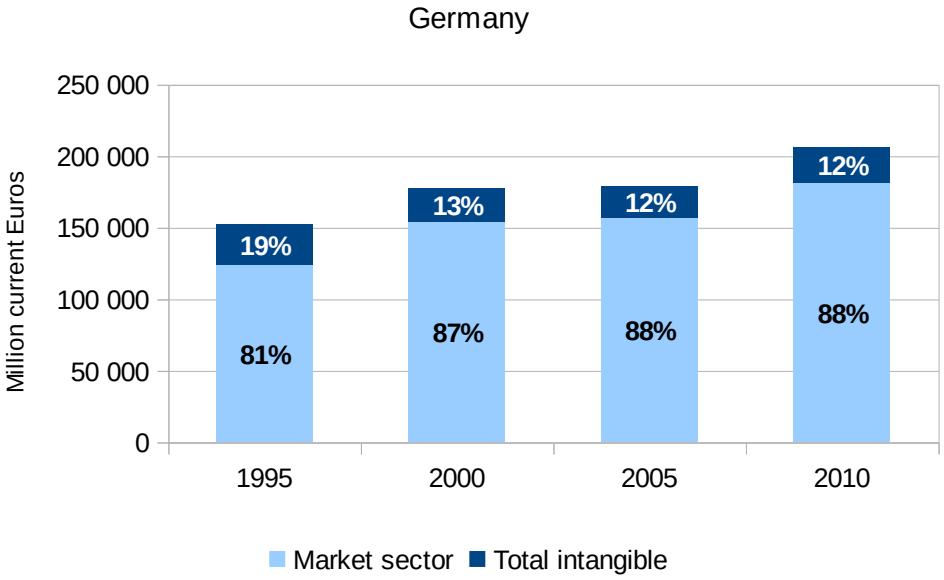


Data – market vs non market









Data - partial correlations

	Labour	Tangibles	soft_data	rd	training	org	copy	arch	fininnov
Labour	1.00000								
Tangibles	**-0.67772** **<.0001**	1.00000							
soft_data	-0.17637 0.1064	0.42040 <.0001	1.00000						
rd	**-0.81355** **<.0001**	**0.83939** **<.0001**	**0.55340** **<.0001**	1.00000					
training	**0.70607** **<.0001**	**-0.75003** **<.0001**	**-0.69613** **<.0001**	**-0.84872** **<.0001**	1.00000				
org	**0.58014** **<.0001**	0.00148 0.9893	**0.52177** **<.0001**	-0.12437 0.2568	-0.04599 0.6760	1.00000			
copy	**0.85482** **<.0001**	-0.39654 0.0002	-0.28319 0.0086	**-0.69652** **<.0001**	**0.67306** **<.0001**	**0.56549** **<.0001**	1.00000		
arch	**0.77608** **<.0001**	**-0.61440** **<.0001**	-0.20187 0.0639	**-0.74219** **<.0001**	**0.62747** **<.0001**	0.29542 0.0061	**0.67007** **<.0001**	1.00000	
fininnov	-0.29375 0.0064	**0.75321** **<.0001**	**0.50569** **<.0001**	**0.59395** **<.0001**	**-0.64781** **<.0001**	0.41642 <.0001	-0.01510 0.8909	-0.38498 0.0003	1.00000

Data - principal component analysis

	Overall Innovation index	Training vs Organisation	Training & Organisation vs R&D	Mainly architecture	Software vs R&D	Organisation vs advertising
	1st PC	2nd PC	3rd PC	4th PC	5th PC	6th PC
Share of total dispertion	52%	26%	16%	3%	2%	1%
Software	0.513809	-.160726	-.243217	0.207315	0.776944	-.066264
R&D	0.468470	0.024126	-.513608	0.350021	-.530415	0.335121
Advertising & Market research	0.509460	-.105767	0.346576	0.031269	-.319327	-.711478
Architecture and design	0.396276	0.506428	-.076072	-.751131	0.029969	0.124954
Training	0.118292	0.657634	0.505818	0.493437	0.102326	0.209096
Organisation capital	0.293187	-.522921	0.543413	-.160781	-.040976	0.563709

Estimation - production function

- Cobb-Douglas production function

$$Y = F(K, L, I) = AK^{\alpha} L^{\beta} I^{\gamma}$$

- Y= real GDP including new intangibles

K= real stock of tangible fixed capital

L= labour input (nb of employees)

I = estimated real stock of intangible capital

Estimation - Data

- *Tangible capital:* Stock of real capital (EUKLEMS)
- *Labour*: Average Number of employees per year (OECD)
- *Intangible capital*: CHS-type stock of real intangible capital (CHS, Fukao et al., COINVEST, own calculations),

Estimation - parameters

- Panel data
  - Country x time dimensions
  - Allowing for fixed-effects country specific productivity parameter :

$$Y_{it} = A_i K_{it}^{\beta_1} L_{it}^{\beta_2} I_{it}^{\beta_3}$$

  - Using log-log form :

$$\log Y_{it} = \beta_{0i} + \beta_1 \log K_{it} + \beta_2 \log L_{it} + \beta_3 \log I_{it} + \beta_4 TIME + \epsilon_{it}$$

- Individual country OLS

Estimation - panel data results (1)

Inputs	A	B	C	D
K	0.96***	1.12***	1.01***	0.80***
L	0.76***	0.57***	0.40**	0.38***
I		0.07***		
$I_{activated}$			0.16	
$I_{not\ activated}$			0.00	
Prin1				0.02***
Prin2				-0.01***
Prin3				0.01***
R^2	**0.99**	**0.99**	**0.99**	**0.99**

Estimation - panel data results (2)

Inputs	A	B	C	D	E	F	G
K	0.96***	1.12***	1.17***	0.81***	0.83***	0.89***	0.63***
L	0.76***	0.57***	0.61***	0.50***	0.65***	0.45***	0.43***
I		0.07***					
$I_{R\&D}$			0.04***				-0.06***
I_{Soft}				0.07***			0.06**
$I_{training}$					0.00		0.01
I_{org}						0.11***	0.13**
R^2	**0.99**	**0.99**	**0.99**	**0.99**	**0.98**	**0.99**	**0.99**

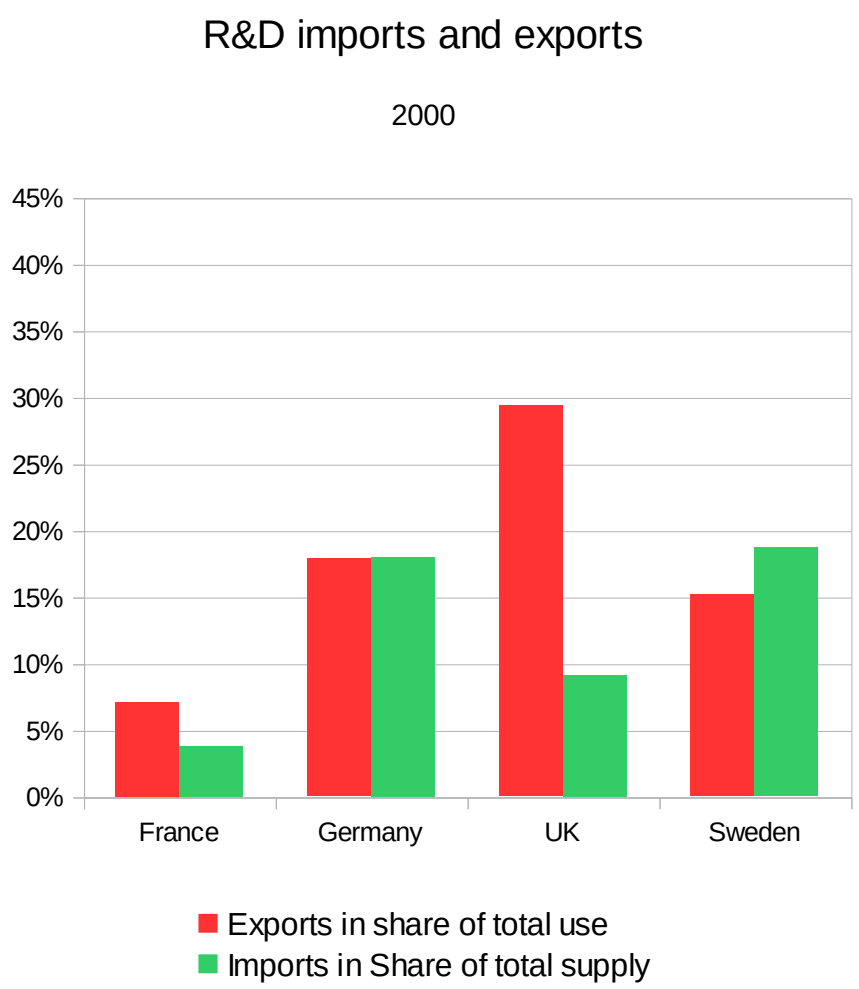
Estimation - OLS results

		Germany	France	Sweden	UK	US	Japan
Baseline	***K***	0.56***	0.73***	0.91***	0.76***	0.42***	-0.03
	L	0.53**	0.66***	0.27	-0.05*	1.23***	3.34***
	I	0.01	-0.00	0.01	0.11***	-0.01	-0.00
	Rsq	0.98	0.99	0.99	0.99	0.99	0.90
Quadratic form	***K***	0.23	0.52***	1.03***	0.46***	0.44***	-1.16***
	L	0.74***	0.66***	0.35	0.10**	0.84***	3.44***
	I	-1.89**	-1.28*	0.90	-7.75***	-1.61**	-13.53***
	I^2	0.08**	0.06*	-0.04	0.33***	0.06*	0.39***
	Rsq	**0.99**	**0.99**	**0.99**	**0.99**	**0.99**	**0.93**

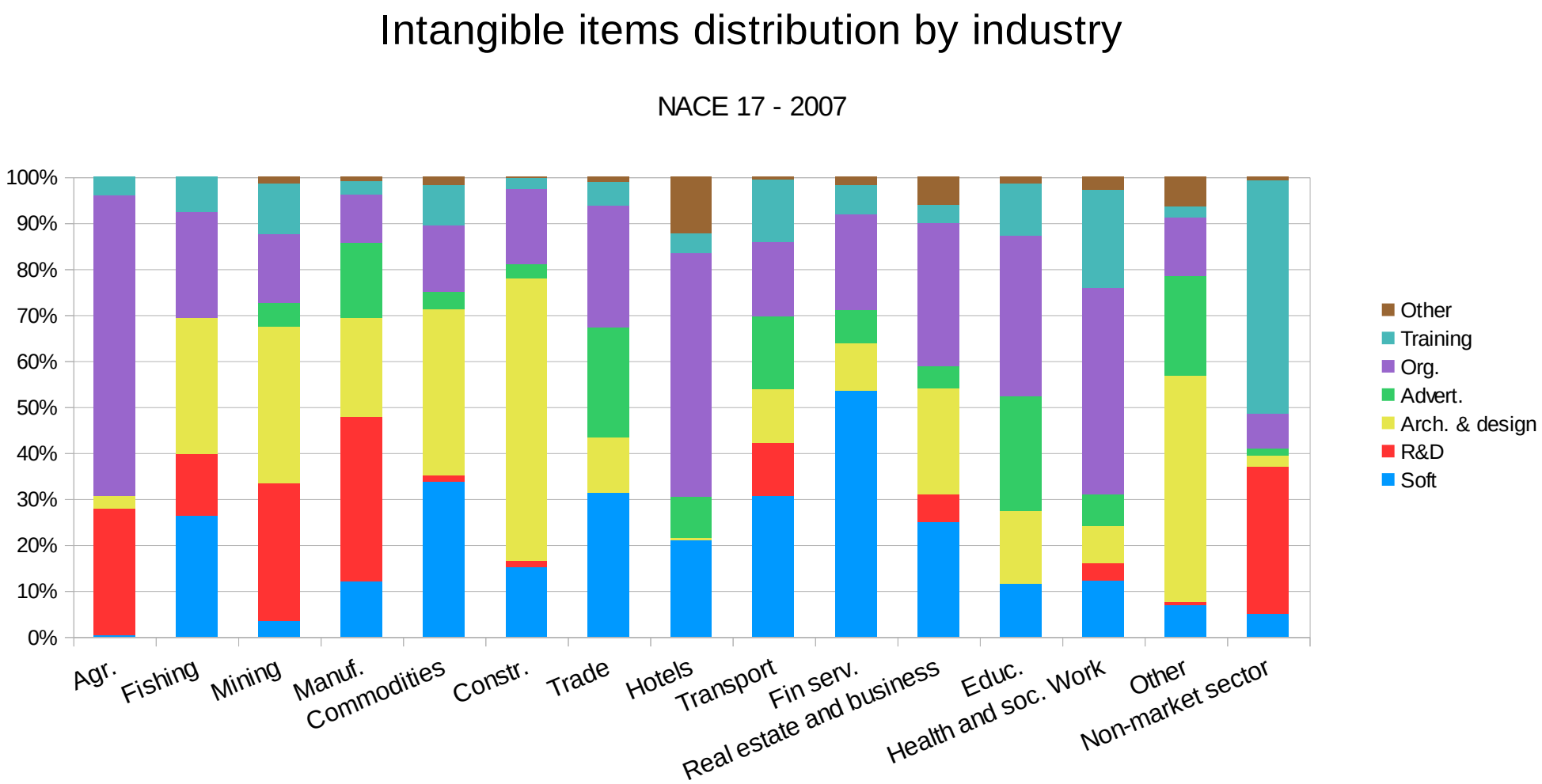
Issues - surprising results ?

- On panel data:
  - Level of tangible vs intangible capital
  - Closed/open economy
  - Collinearity
- On individual OLS
  - Time coverage
  - Within-country heterogeneity

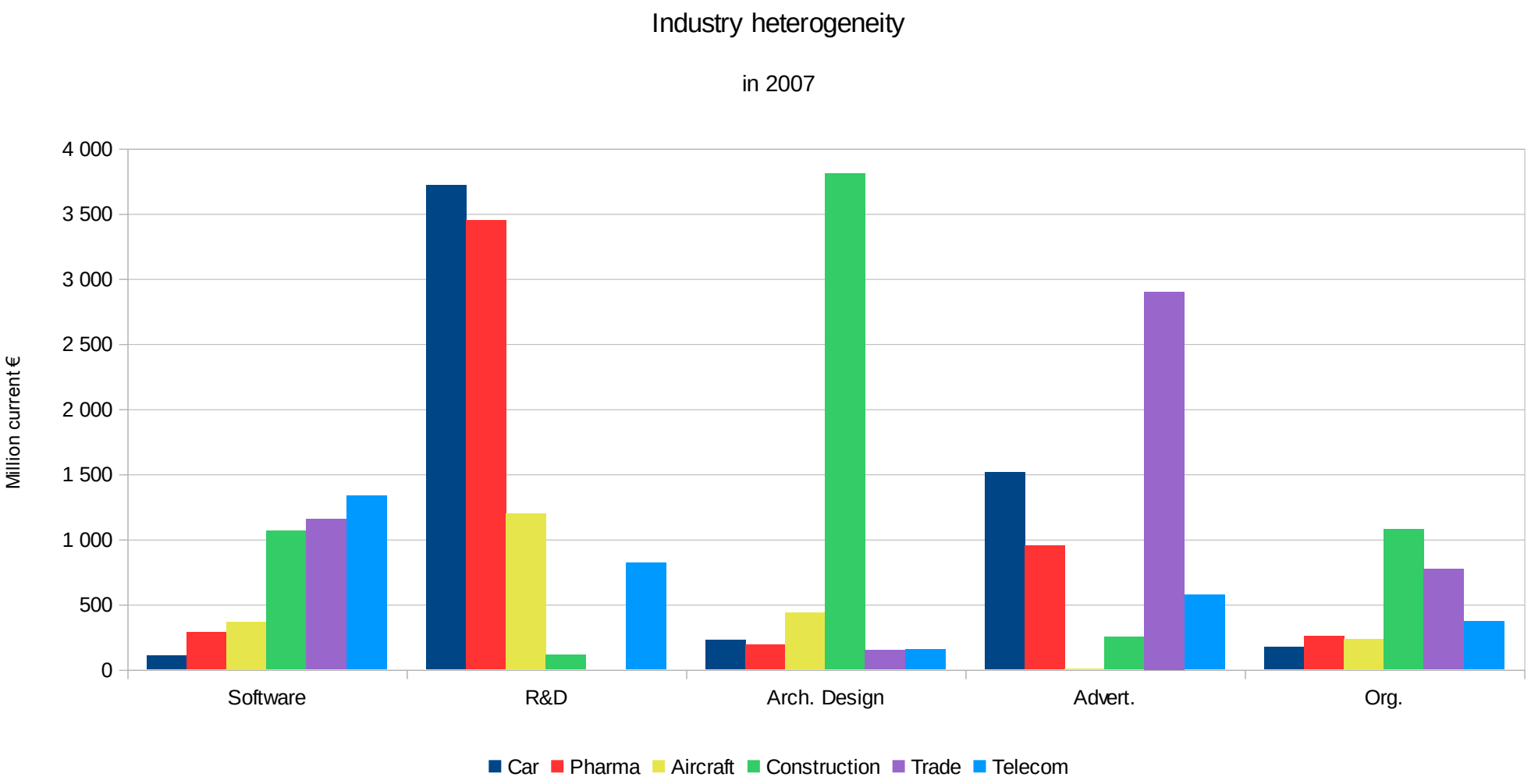
Issues - Import and Export



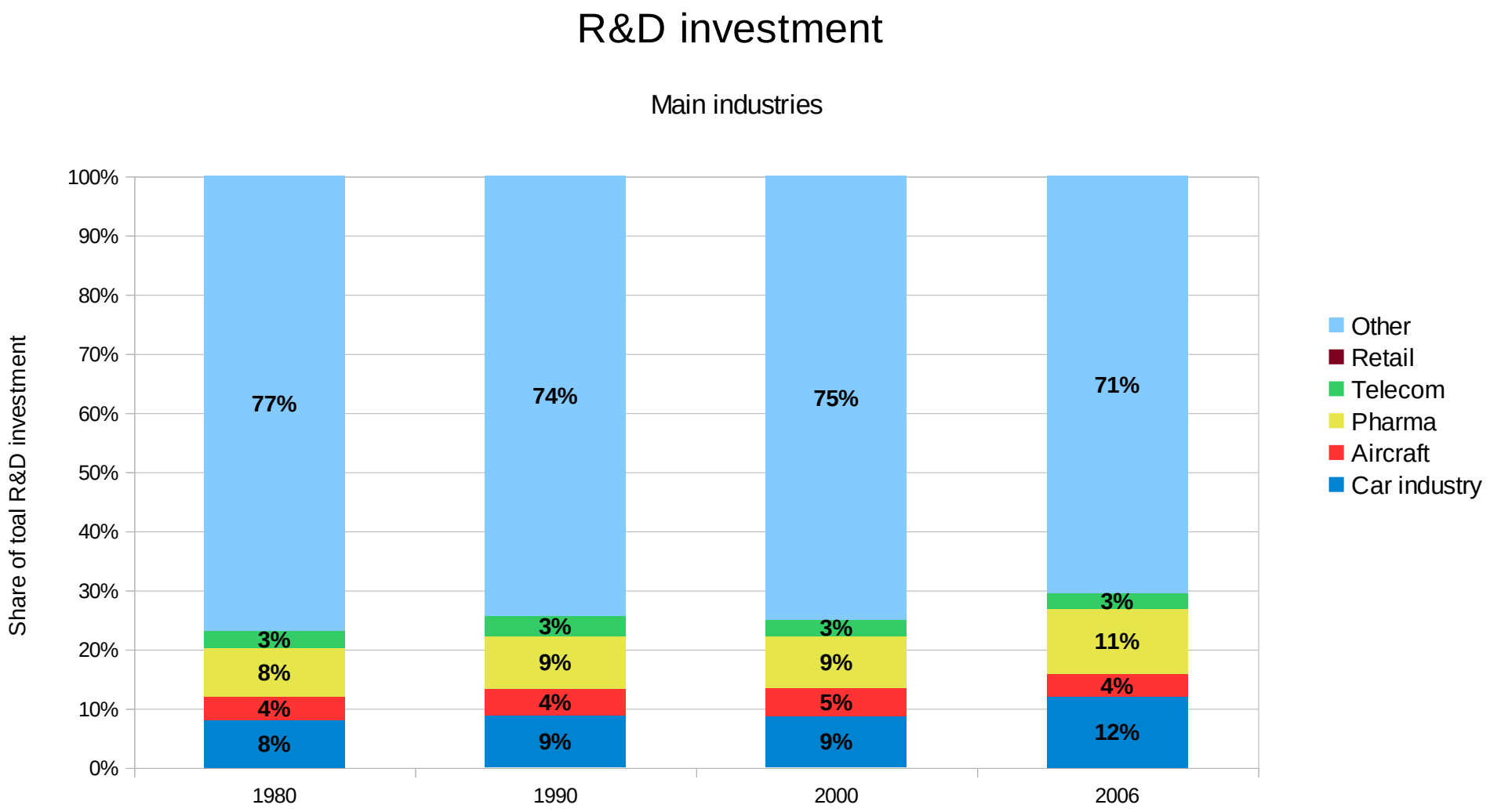
Issues - Industry heterogeneity (1)



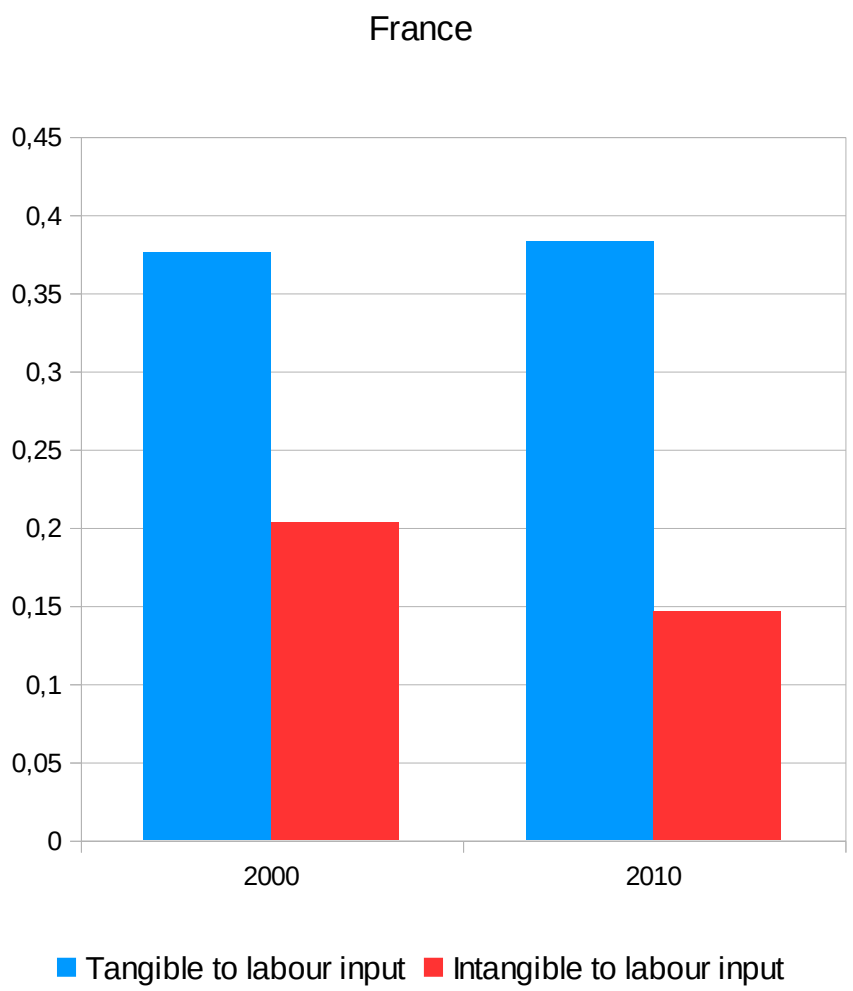
Issues - Industry heterogeneity (2)

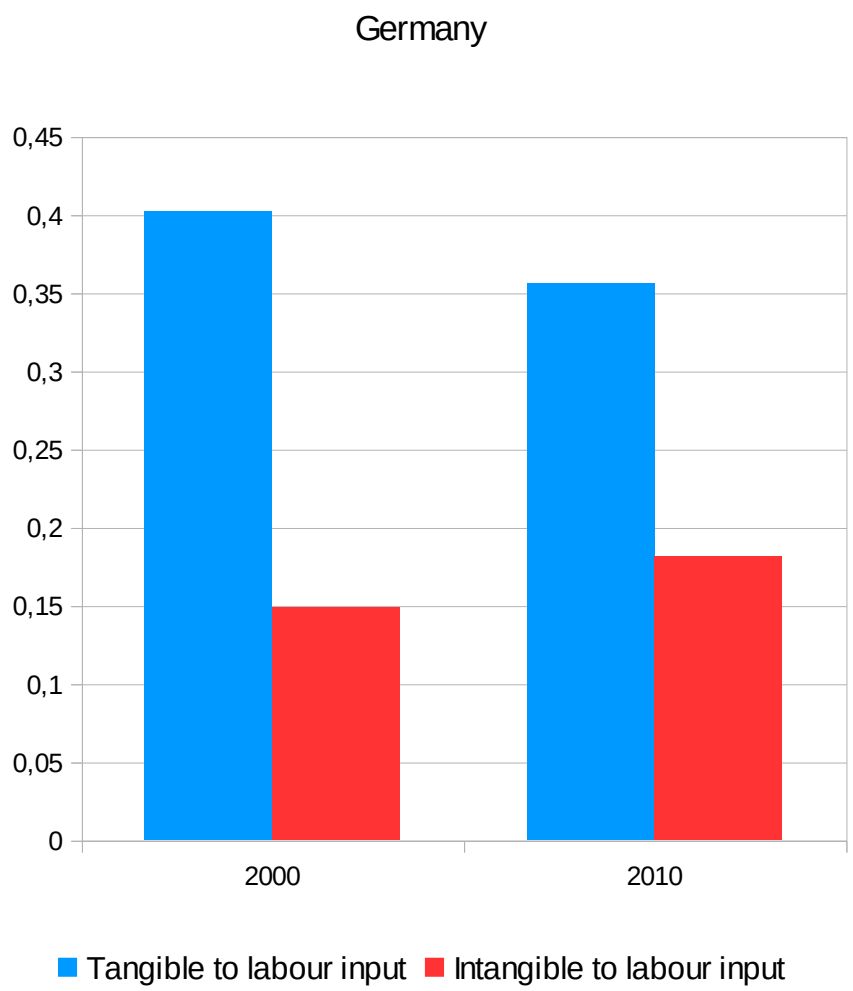


Issues - Industry heterogeneity (3)



France and Germany – highlights





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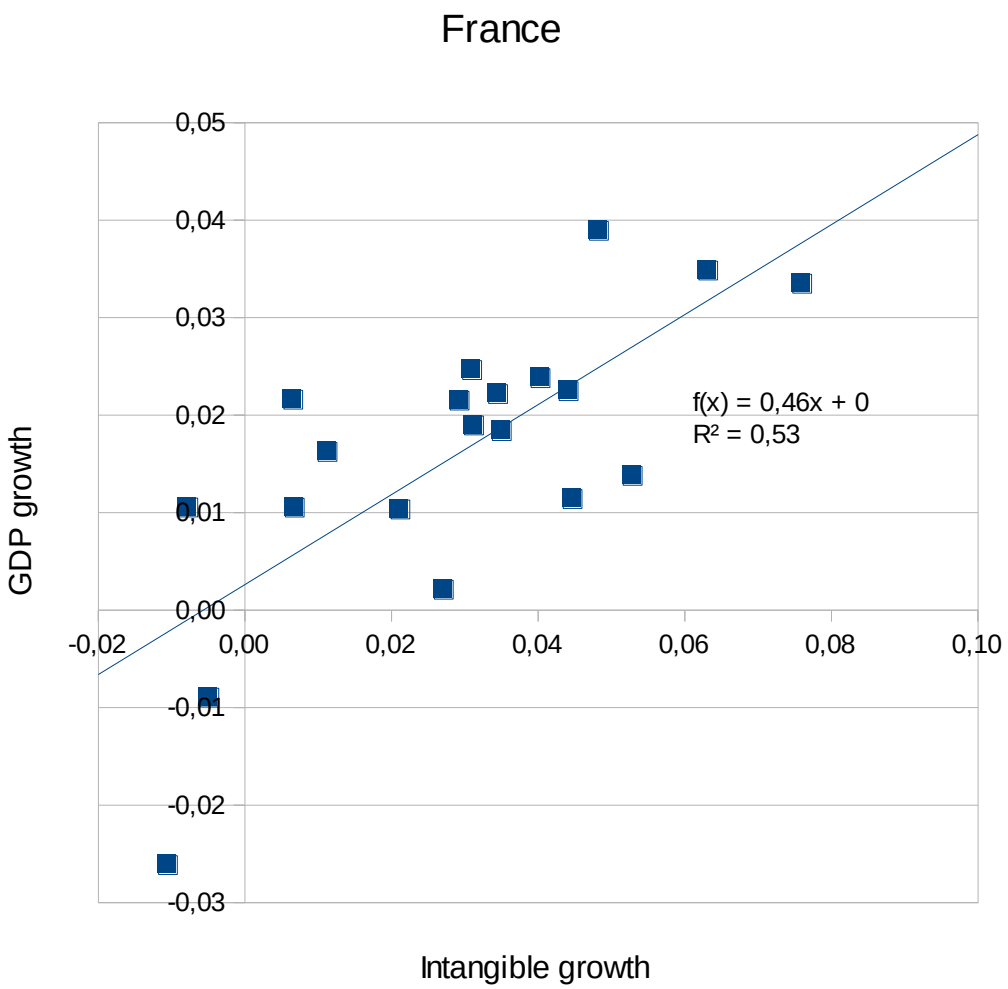

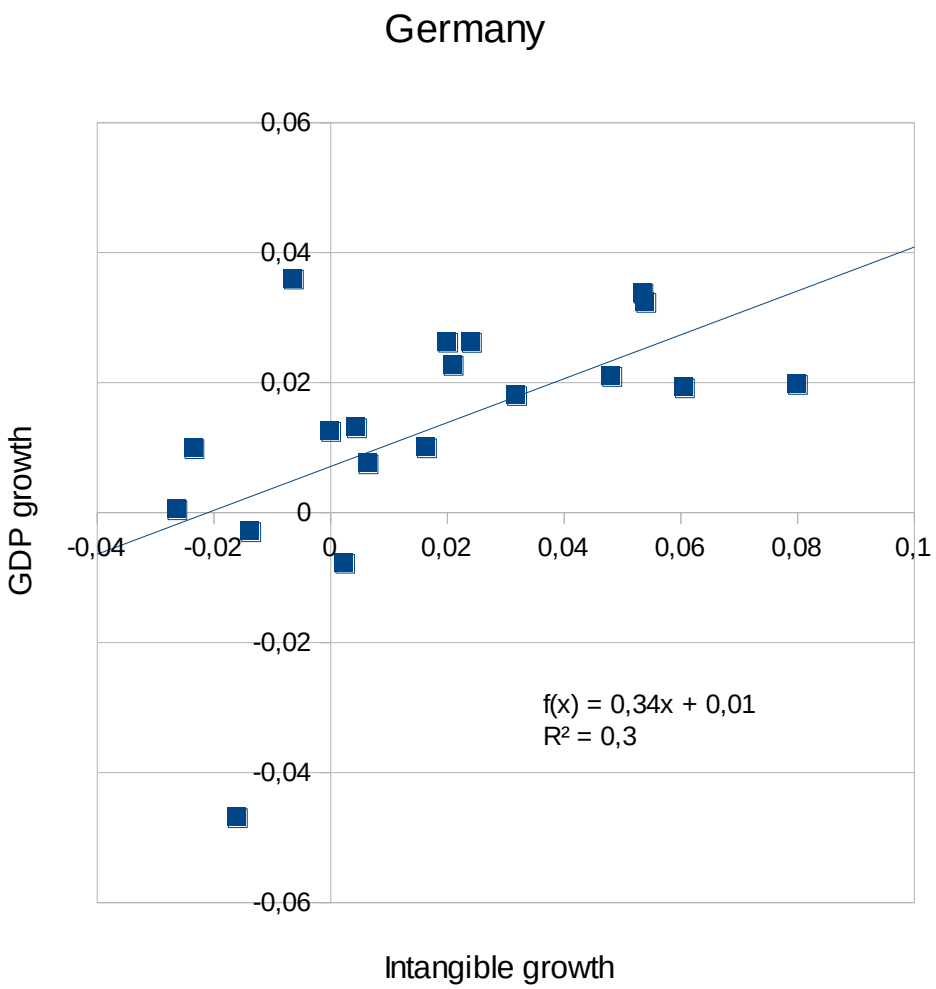

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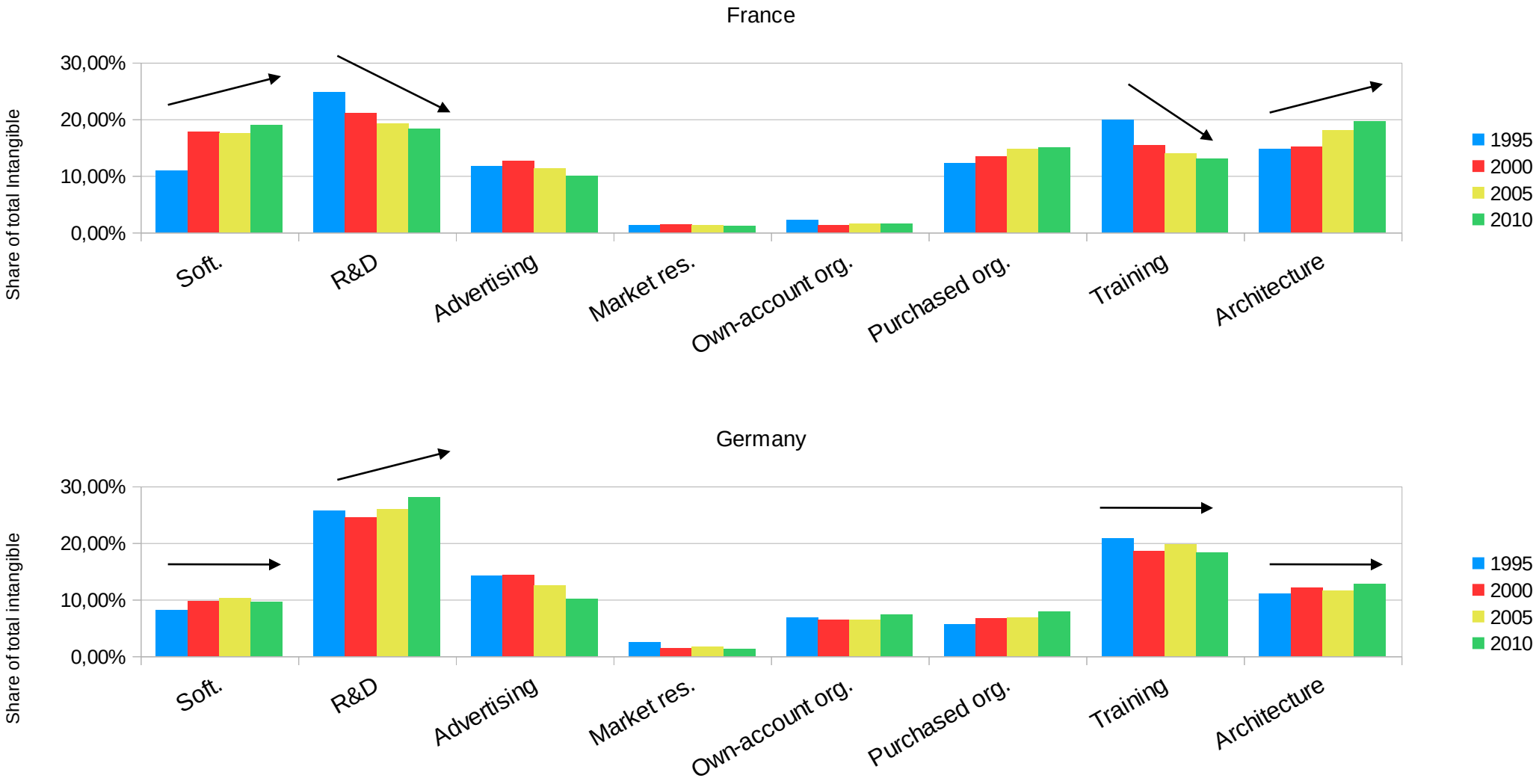

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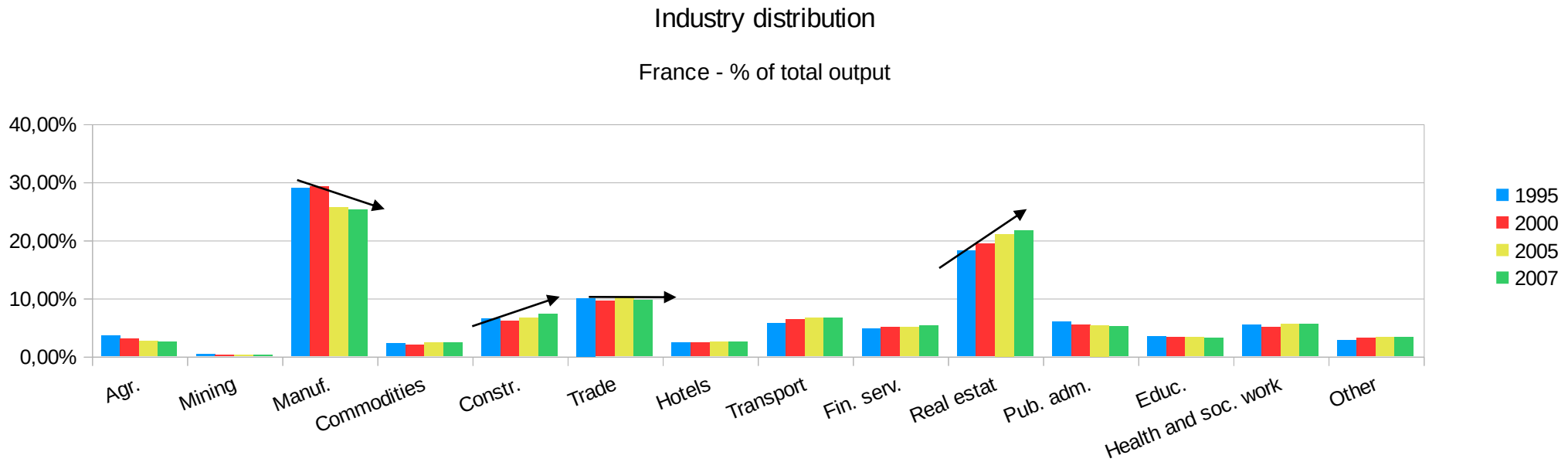

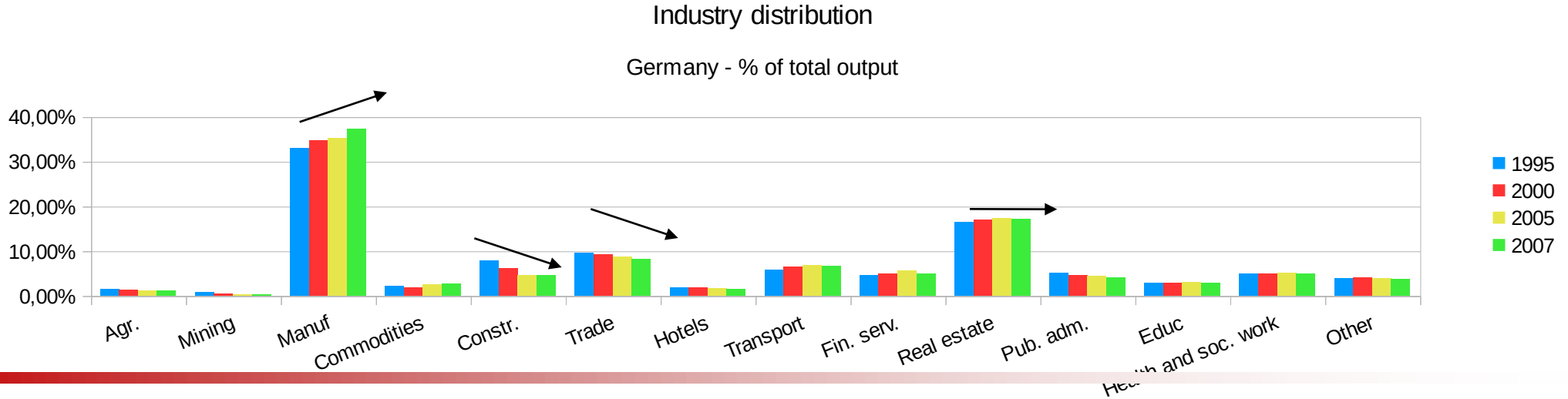

Main findings

- Overall intangible investment has a positive impact on production
- Intangible asset complementarity is not straightforward
- Intangible investment is highly industry-specific
- Need for industry-level innovation policy
- Structures and trends differ between France and Germany
- No “one-fits-all” innovation policy

Interim Concluding points

- Policies must promote innovation
- Multi-level heterogeneity: need for specific innovation policies (country, industry)
- Deepen the asset complementarity analysis
- Determine industry-level investment strategies
- Include other forms of intangible investment

Thank you for your attention