The Macroeconomic Studies on the Benefits of Standards: A Summary, Assessment and Outlook

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Economic and social benefits of standards

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Background

- role of institutional infrastructures for economic growth difficult to assess
- impact of regulatory framework, incl. Intellectual Property Rights, and physical technological infrastructures, especially ICT, has been addressed
- a rather new aspect, the role of technical standards for economic growth, although the importance of technological infrastructure as an essential determinant of the economic performance of industrialized economies is generally acknowledged today.
- in contrast, the role of the patent system for economic growth received a higher interest.
- however, it is undisputed in the meantime that technical standards are very important for the fast and efficient diffusion of new technologies
- standard setting organizations and companies involved in standardization have to justify the resources they spent towards companies and policy makers

Background

- diffusion aspect covers only one macroeconomic impact dimension of standards
- furthermore, the standardization process itself is a platform especially for the exchange of knowledge relevant for the implementation of new technologies among its participants
- this dialogue enables the generation of new incremental and more application-related technological know how instead of radical breakthroughs in basic research.
- in addition, the interface between research and standardization deserves a special focus, since it is beneficial both for the fast diffusion of new technologies, i.e. for growth, and for research, but we face still serious inefficiencies at this interface

The basic macro econometric model

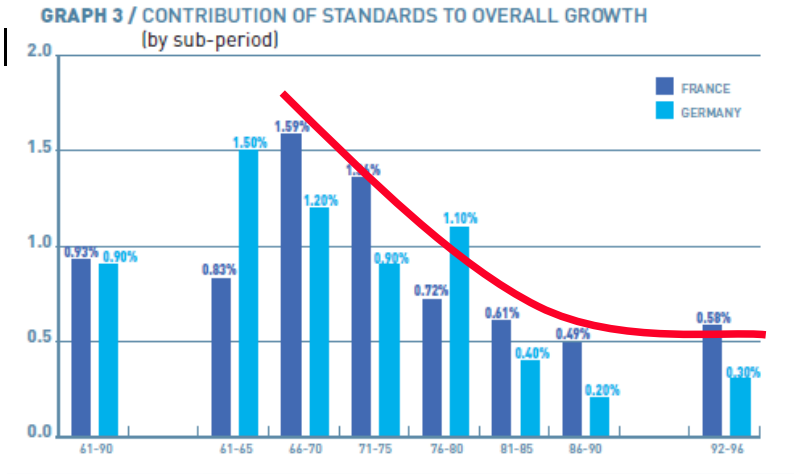
- **basic idea:** Economic growth is driven by the production factors capital K and labour L and the technical progress A
- Y(t) = A(t) [F(K(t),L(t)].
- A(t) = A[Z(t)].
- Jungmittag et al. (1999) distinguish here between
  - technical progress which stems from domestic innovative activity, the role of domestic diffusion of technology,
  - the import of technology from abroad,
  - the role of domestic diffusion of technology.
- $y(t) = a + \alpha k(t) + \beta l(t) + \gamma pat(t) + \delta lex(t) + \varepsilon std(t) + u(t)$.

Summary of macroeconomic studies

Country	Authors	Period	GDP growth rate	Contribution of standards
Germany	Jungmittag/Blind/Grupp (1999)	1960-1990	3.3%	0.9%
France	Hakima Miotti (2009)	1950-2007	3.4%	0.8%
United Kingdom	DTI (2005)	1948-2002	2.5%	0.3%
Canada	Haimowitz und Warren (2007)	1981-2004	2.7%	0.2%
Australia	Centre for International Economics Australia (2007)	1962-2003	3.6%	0.8%
China	Rengang Huang (2008)	1978-2007		Production elasticity 0.079
Denmark	CEBR (2007)	1966-2003		No significant contribution, only for selected industries with elasticity of 0.06 leading to 42% contribution to growth

Interpretation of results

- similar result of high impact for countries with comparable economic structure and size, but also significant national standardization activities (Germany and France)
- lower impacts in countries with lower national standardization activities (United Kingdom, Canada, Australia and Denmark) or emerging economies (China)
- trend towards l r Germany and France



Source: AFNOR 2008

- obviously differences between industries in the same economy

A differentiated macro econometric model

- extension of the macroeconomic approach of Jungmittag et al. to panel data for four European countries and twelve sectors over the period from 1990 to 2001 by Blind and Jungmittag in Journal of Productivity Analysis 2008 .
- due to data availability, the following panel data model is :
- $y_{ij}(t) = a_i + b_j + \alpha k_{ij}(t) + \beta l_{ij}(t) + \gamma pat_{ij}(t) + \delta totstd_{ij}(t) + u_{ij}(t)$
- where:
  - y(t) = added value at time t,
  - k(t) = capital stock at time t,
  - l(t) = employment input at time t,
  - pat (t) = domestic patent stock applied for at the European Patent Office at time t,
  - totstd (t) = effective total stock of standards at time t,
  - u(t) = error term,
  - i = country (UK, Germany, France, Italy),
  - j = sector

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List of sectors and their NACE codes

1.	Food products, beverages and tobacco	15-16
2.	Textiles, textile products, leather and footwear	17-19
3.	Wood and products of wood and cork	20
4.	Pulp, paper, paper products, printing and publishing	21-22
5.	Chemical, rubber, plastics and fuel products	23-25
6.	Other non-metallic mineral products	26
7.	Basic metals and fabricated metal products	27-28
8.	Machinery and equipment, n.e.c.	29
9.	Electrical and optical equipment	30-33
10.	Motor vehicles, trailers and semi-trailers	34
11.	Other transport equipment	35
12.	Manufacturing n.e.c.	36-37

Estimation results for all four countries and 12 industries (n=509)

	Model 1 LSDV	Model 2 LSDV	Model 3 Ridge Regression
Capital	0.104	0.118	0.230
	(3.998)[a)]	(4.490)	(11.639)
Labour	0.801	0.772	0.648
	(33.055)	(34.583)	(30.912)
Patent Stock	0.270	0.324	0.105
	(5.185)	(8.841)	(11.785)
Standards (total)	0.033	0.049	0.079
	(1.526)	(2.314)	(6.077)
F-Tests			
Country effects	47.990	51.650	Yes
	(0.000)[b)]	(0.000)	
Industry effects	21.447	28.395	Yes
	(0.000)	(0.000)	
Time effects	1.158	---	
	(0.314)		
Ridge parameter[c)]	---	---	0.015
$R^2_{adj.}$	0.976	0.976	0.965

i. e. 1% in the stock of standards increases growth by 0.079%

[a)] t-values in brackets, t=1.645 (or 2.325) for a significance level of 5 % (or 1 %) (one-sided test); White's heteroskedasticity consistent t-values for LSDV estimation.

[b)] Significance levels in brackets.

Source: Blind and Jungmittag 2008

Comparison of partial production elasticities by country: Results of ridge regressions

	Total Model	United Kingdom	Germany	France	Italy
Capital	0.230	0.344	0.227	0.518	0.291
	(11.639)	(26.767)	(10.704)	(12.488)	(33.989)
Labour	0.648	0.455	0.417	0.302	0.314
	(30.912)	(18.235)	(13.925)	(5.540)	(43.750)
Patent Stock	0.105	0.047	0.094	0.072	0.059
	(11.785)	(9.465)	(9.095)	(5.210)	(32.692)
Standards (total)	0.079	0.052	0.027	0.147	0.017
	(6.077)	(4.485)	(2.666)	(5.754)	(3.112)

Source: Blind and Jungmittag 2008

An first interim summary

- in summary, there are rather similar partial production elasticities of the patent and standards stocks in the four countries, but significant differences with respect to their relation between them
- explanation for these differences can be different industry structures, because the institutional settings both for the standardization and the patent system are rather similar due to the harmonisation efforts at the European level; therefore, we will have a look at the industry models

Estimation results for the individual industries

	Industry 15-16	Industry 17-19	Industry 20	Industry 21-22	Industry 23-25	Industry 26	Industry 27-28	Industry 29	Industry 30-33	Industry 34	Industry 35	Industry 36-37
						LSDV Estimation						
Capital	-0.135	0.157	0.931	0.081	0.369	0.663	0.051	0.570	-2.280	0.759	-1.060	-0.586
	(-0.898)[a)]	(0.923)	(3.022)	(0.527)	(2.305)	(11.862)	(0.432)	(3.288)	(-4.447)	(3.318)	(-2.272)	(-1.222)
Labour	-0.224	0.766	0.788	0.521	0.245	-0.069	0.670	0.686	1.141	-0.157	0.837	0.712
	(-1.750)	(10.277)	(3.727)	(5.063)	(2.268)	(-0.928)	(8.447)	(2.812)	(3.148)	(-0.604)	(4.764)	(3.794)
Patent Stock	0.006	0.335	0.503	0.204	0.821	0.119	0.271	0.023	-2.852	-1.147	1.057	0.602
	(0.119)	(2.354)	(4.307)	(1.582)	(2.041)	(4.318)	(3.969)	(0.233)	(-4.555)	(-3.997)	(3.963)	(1.594)
Standards	0.054	-0.006	0.172	-0.034	-0.348	0.128	-0.026	-0.295	0.609	-0.768	0.292	0.507
(total)	(1.822)	(-0.080)	(1.230)	(-0.724)	(-4.182)	(2.999)	(-0.558)	(-3.717)	(2.991)	(-2.280)	(1.685)	(2.666)
$R^2_{adj.}$	0.982	0.992	0.997	0.996	0.991	0.985	0.995	0.994	0.968	0.987	0.780	0.943
						Ridge Regression						
Capital	0.110	0.181	0.358	0.197	0.315	0.461	0.314	0.354	0.131	0.846	0.523	0.060
	(4.410)[b)]	(6.763)	(7.209)	(7.628)	(5.394)	(13.045)	(6.105)	(13.152)	(0.895)	(6.223)	(1.708)	(5.354)
Labour	0.158	0.509	0.353	0.365	0.070	0.179	0.301	0.317	0.528	0.062	0.504	0.122
	(9.057)	(15.059)	(6.147)	(12.168)	(1.401)	(4.063)	(9.906)	(11.174)	(4.190)	(0.744)	(2.907)	(3.587)
Patent Stock	0.046	-0.063	0.265	0.075	0.171	0.092	0.132	0.144	0.007	-0.083	0.243	0.070
	(4.211)	(-2.685)	(10.604)	(6.955)	(13.137)	(4.461)	(9.032)	(4.801)	(0.112)	(-0.934)	(3.301)	(7.420)
Standards	0.043	0.101	0.088	0.013	-0.095	0.153	0.077	-0.057	0.052	0.065	0.140	0.110
(total)	(4.683)	(2.380)	(1.435)	(0.589)	(-2.547)	(4.738)	(2.722)	(-1.078)	(0.754)	(0.348)	(1.273)	(5.274)
Ridge parameter	0.1	0.02	0.015	0.015	0.015	0.02	0.015	0.02	0.015	0.015	0.04	0.4
$R^2_{adj.}$	0.931	0.974	0.970	0.990	0.972	0.959	0.985	0.980	0.907	0.954	0.653	0.571
Fixed Effects	Country	Country	Country Time	Country	Country Time	Time	Country Time	Country Time	Country Time	Country Time	Country	Country Time
NOBS	46	46	34	45	46	46	45	45	45	33	33	45

[a)] White heteroskedasticity consistent t-values in brackets. [b)] t-values in brackets.

Source: Blind and Jungmittag 2008

A second interim summary

- signs or sizes of the coefficients of the partial production elasticities not always realistic, but rough pattern regarding the impacts of the stock of patents and the stock of standards.
- mostly significant impacts of the stocks of standards in the sectors, characterised by low and medium R&D and technology intensity, whereas the stocks of patents have higher impacts the increasing R&D intensity of sectors.
- very rough structure of a stronger importance of the knowledge base measured by patents in high-tech sectors and a dominance of standards in low- and medium-tech sectors can be explained by the economics of innovation and technology:
  - in dynamic R&D intensive sectors, short technology life cycles make production of standards difficult and lead to relatively low impacts
  - sectors with low R&D benefit more from standards due to their cost saving effects

Focus: Impact of ICT standards on growth in sector "Manufacture of office and electrical machinery and of radio, television equipment" in Germany and UK

Variables	ICT UK-Germany Model (n= 63)	Variables	Total UK-Germany Model (n=272)
Capital	0.133 (0.931)	Capital	0.170 (4.460)
Labour	0.617 (5.875)	Labour	0.797 (31.732)
Patent Stock	0.622 (3.357)	Patent Stock	0.682 (8.735)
Standards (total)	0.636 (7.354)	Standards (total)	0.092 (2.400)
Dummies		F-Tests	
UK	0.608 (3.077)	Country effects	147.473 (0.000)[b)]
NACE 31	-0.016 (-0.058)	Industry effects	35.276 (0.000)
NACE 32	-1.042 (-9.268)	Time effects	4.375 (0.000)
$R^2_{adj.}$	0.951	$R^2_{adj.}$	0.989

Source: Blind and Jungmittag 2008

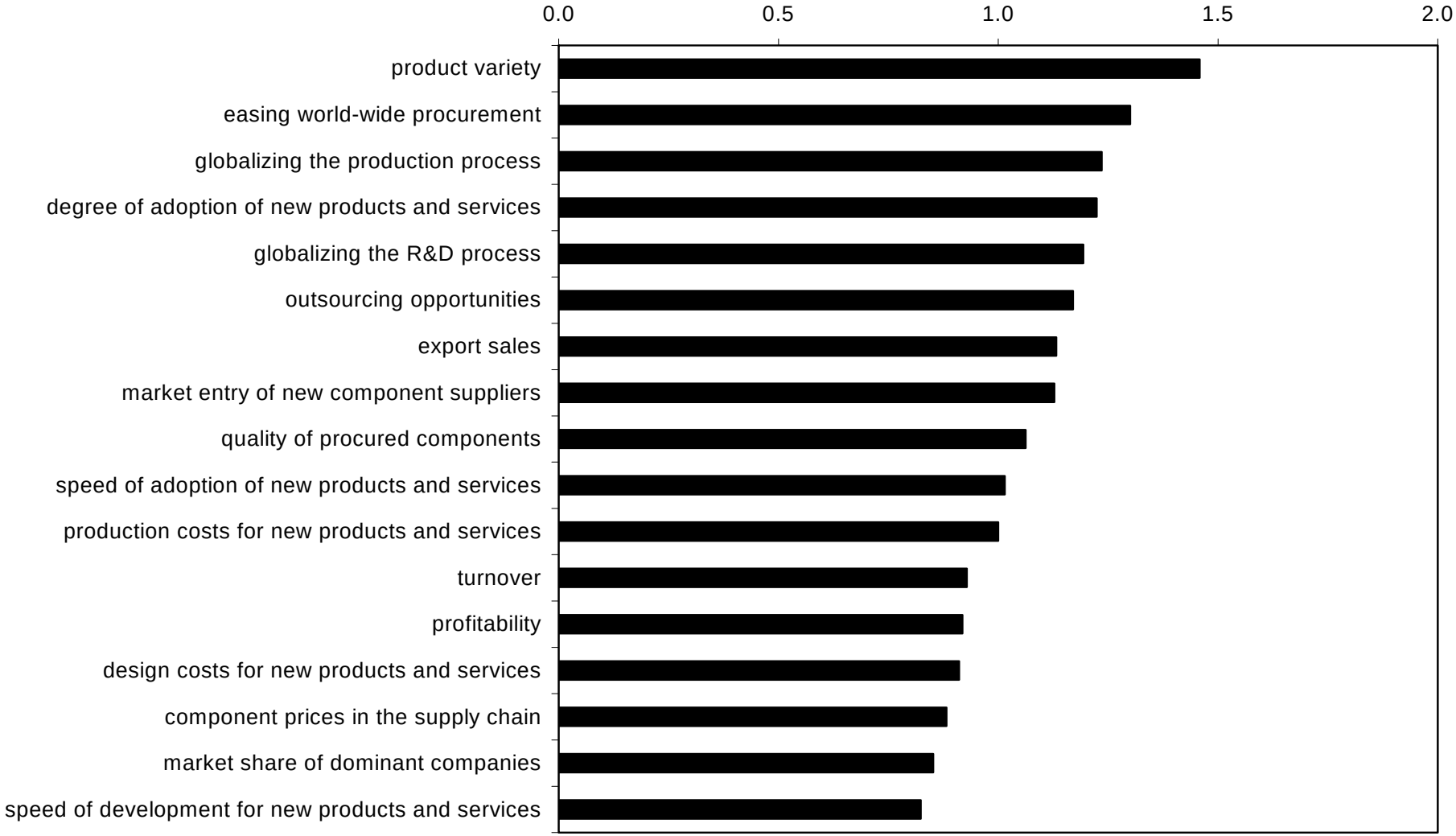
Summary of the industry based macro analysis

- total model covering all four countries, but also the four separate country models, confirm the significant influence not only of the patent stock as important knowledge pool for economic growth, but also of the stock of formal standards (production elasticity of the patent stock slightly higher for the stock of standards)
- sector models are only partly satisfying
- however, in the more mature and less R&D-intensive sectors higher impacts of the stocks of standards, whereas the knowledge pool measured by patent applications more relevant for those sectors with high R&D intensity and a stronger use of high technology
- exception: in ICT sectors, very strong impact of ICT standards on growth

Survey on the impact of ICT standards on the micro level within the FP6 Project NO-REST (Networking Organisation – Research into Standardization)

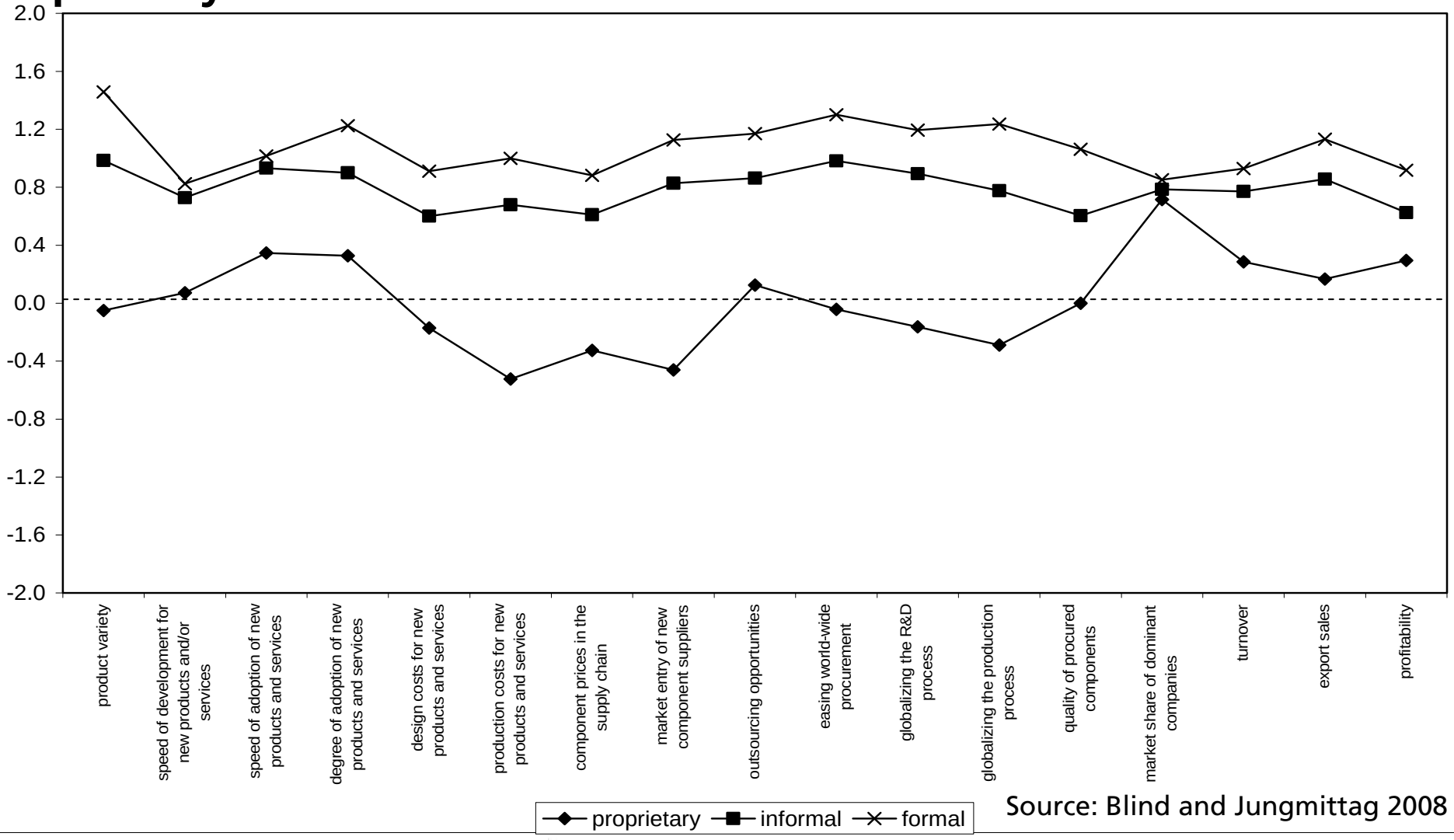
- Online survey among ETSI, CEN/ISSS and ITU members between February and November 2005
- more than 100 responses
- qualitative assessment of various impact dimensions of ICT standards distinguishing into formal, consortia and proprietary standards
- mostly descriptive statistics and some selected correlations

Survey results: Impacts of formal standards for companies



Source: Blind et al. 2010 in Telecommunications Policy

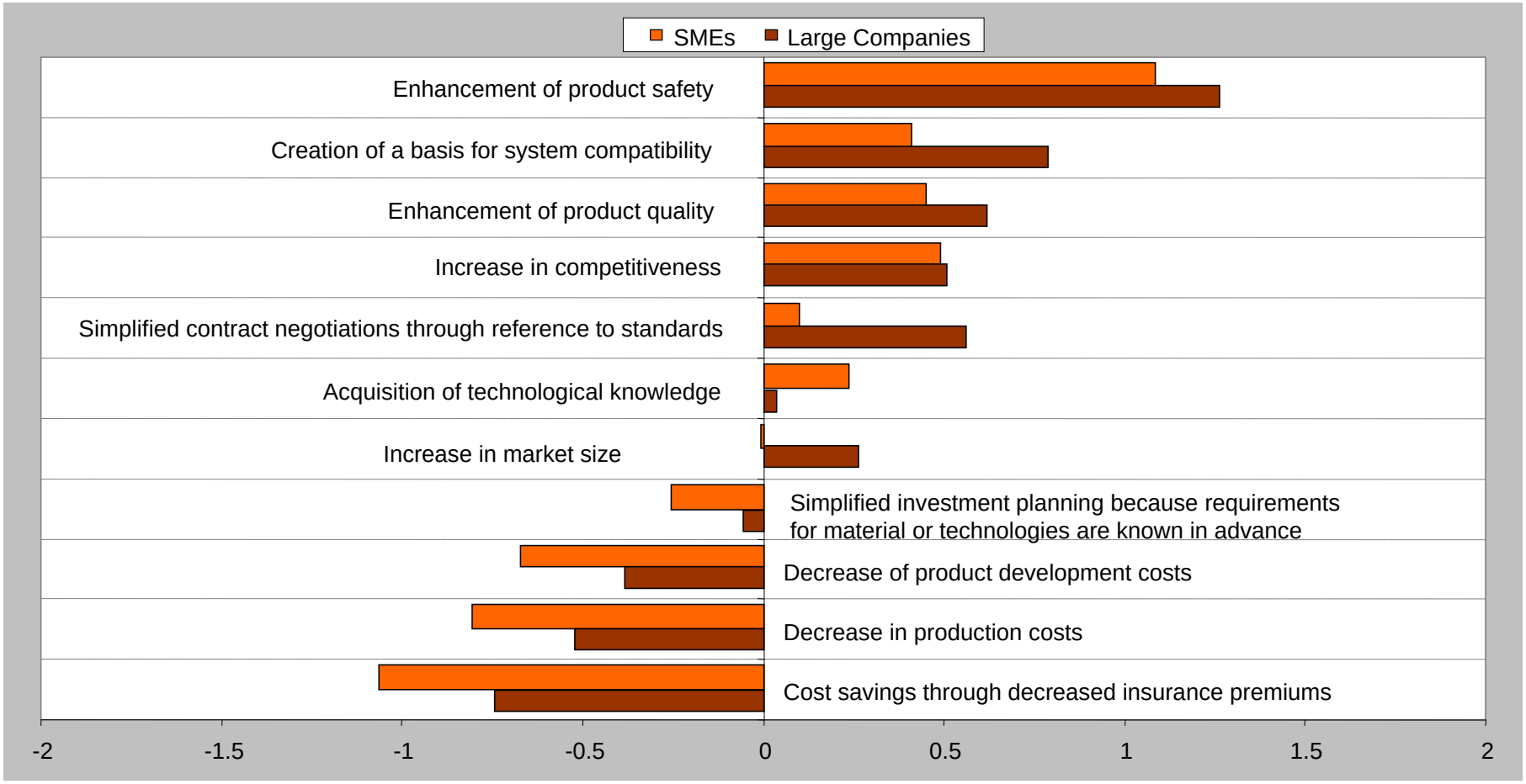
Survey results: Impacts of formal standards vs. consortia and proprietary standards



Source: Blind and Jungmittag 2008

Influence of formal standards on business factors for German machinery and electro-technical companies

(-2 = low significance; +2 = high significance)



Source: Blind and Mangelsdorf 2009

Summary of micro studies

- impacts of standards on companies differ depending on
  - type of standards (formal, consortia, company-specific)
  - type of sector and technology
  - type of company
  - active involvement in standardization
- **important:** active participation increases the benefits of standards for companies and reduces their implementation costs
- macroeconomic studies also show stronger growth impacts for countries with significant national standardization activities

Assessment of macroeconomic studies

- all studies do not reflect the fact that standards just like patents are endogenously determined by research and development activities and innovation, but also some social demand regarding health, environmental and safety issues; this endogeneity has to be taken into account in multistage regression approaches also reflecting the virtuous circle between innovation and standardisation
- trade enhancing effect of standards has to be acknowledged, especially the market integration effect of European standards for the completion of the single market in Europe
- studies just rely on formal standards, whereas especially in the information and communication technologies informal consortia standards, but also some de facto standards are more relevant than formal standards (Blind, Gauch 2008)
- studies are based on the publications or the active number of standards (not even differentiating the amount of their content), whereas their diffusion and implementation is not taken into consideration

Assessment of macroeconomic studies

- microeconomic studies show a large variety of economic impacts of standards and differences in the impacts of different types of standards, which is not taken into account
- macroeconomic studies indicate (and microeconomic studies prove) that the level of contribution to the production of standards is very relevant for their impacts, but due to larger activities at European and international level decreasing engagement in purely national standards
- finally, conceptual framework (i.e. general equilibrium model) between the impacts of standards on the microeconomic level and the impacts on the macroeconomic level is missing

Outlook

- time series should be meanwhile so long to conduct multistage analyses taking the endogeneity of standards into account, especially the impulses from research and innovation
- methodologies to differentiate the amount of content in standards (e.g. page counts) should be included in the construction of the stocks of standards
- data for the construction of indicators for diffusion and implementation could be delivered by standardisation bodies
- development of comprehensive standards databases including consortia standards
- pooling industry data from different countries taking the industry specific impacts of standards into account since differentiating between different types of standards and their economic function is not promising due to large overlap of economic functions of standards
- special focus on the economic impact of the still small share of standards in the service industries, but also new emerging industries

Outlook

- degree of national involvement in the development of supranational standards should be documented in standards databases
- studies covering whole regions reflecting the integration of national standardization activities and national markets (e.g. in Europe) are required
- complementary microeconomic studies to generate more sound evidence on the impacts of different types of standards (e.g. via the ISO methodology)
- development of conceptual framework (i.e. general equilibrium model) between the impacts of standards on the microeconomic level and the impacts on the macroeconomic level both for rather mature, but also emerging industries

➢ **still a lot of work to do and support needed by standardization organizations!**

Thank you for your attention!

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