

Leveraging Public Research for Innovation and Growth: United Kingdom Country Study

Suma Athreye, Brunel University

Federica Rossi, Birkbeck College, London

Evolution of university Industry interactions

*The evolution of the current system of university-industry interaction is a product of :

- An **organic** expansion of a **differentiated** university sector
 - Policy intervention chiefly through the channelling of funds
 - A shrinking role of PSROs – the reasons for which are less clear
- *This evolution is reflected in a wide variety of knowledge transfer channels

Knowledge transfer channels

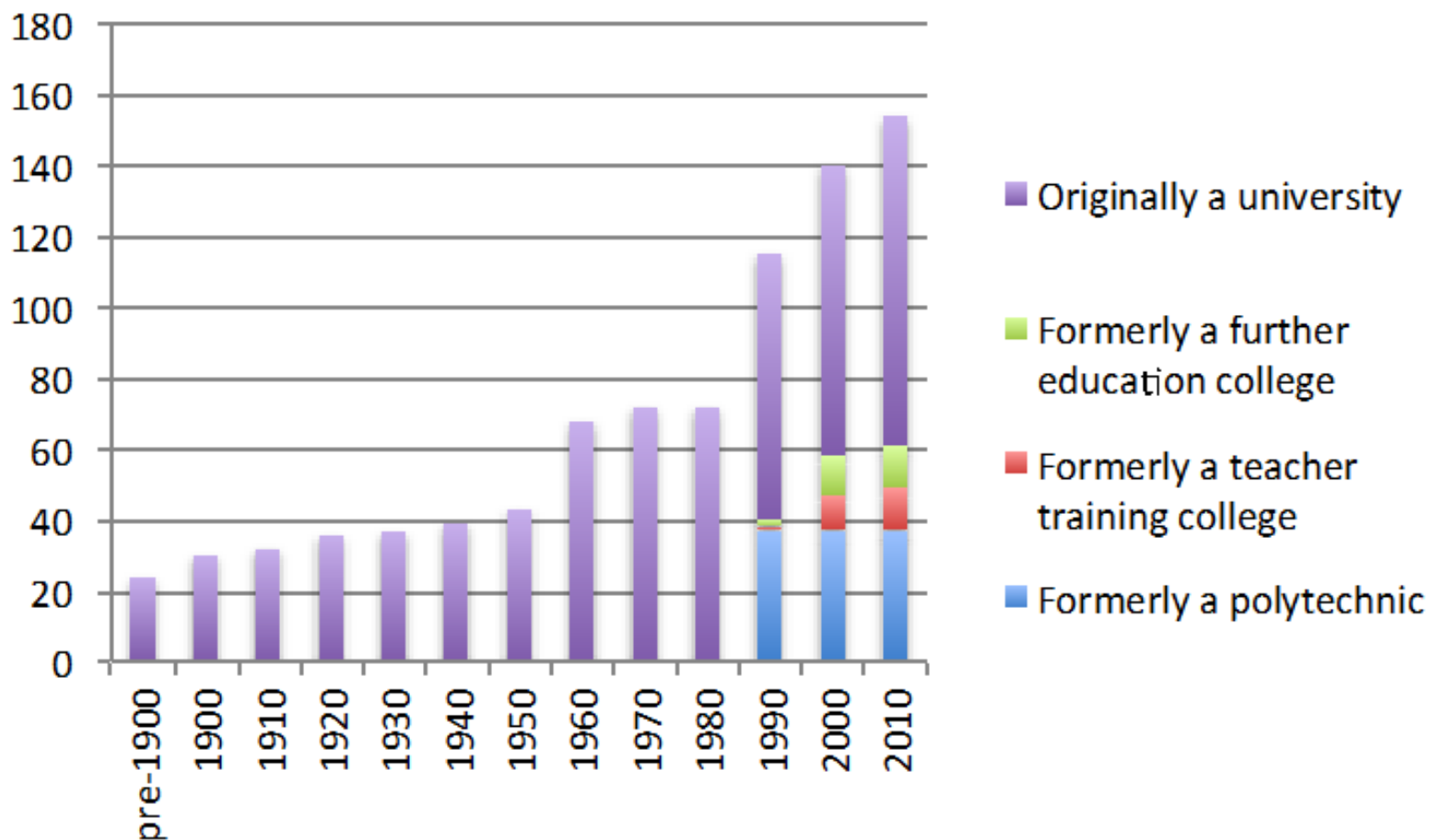
- * Channels of knowledge transfer vary by type of university and by industrial sector
- * PSROs have a smaller range of channels and closer to business
- * PSROs are more efficient than university in commercialising knowledge

Evolution of the university sector and industry interactions

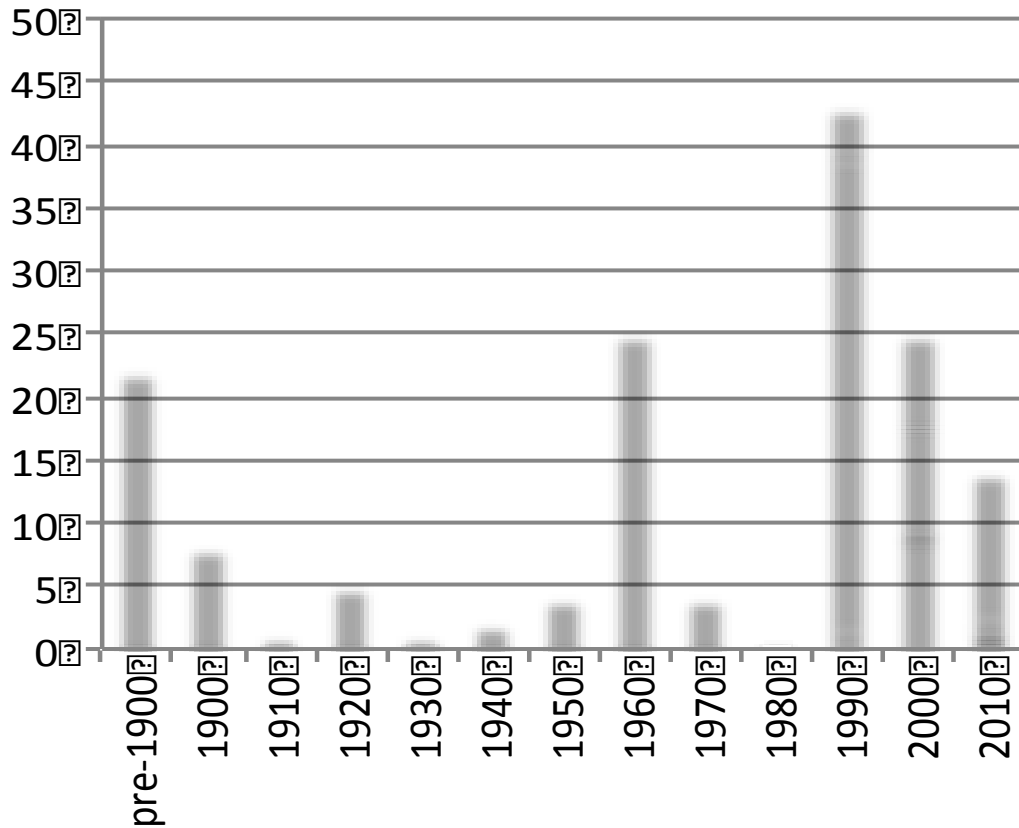
Overall picture: Universities

- * 161 institutions with degree awarding powers, of which 157 are university institutions
- * Not all universities have science departments.
- * 121 universities have reported filing of patent applications and/or the generation of income from IP licenses, and/or the creation of spinoff companies (2009-2014)
- * The university sector is very heterogeneous in size and quality of education and research

Cumulative number of degree-awarding institutions active since 1900



Number of degree-awarding institutions created in each decade



originally a university

Teacher training college

Polytechnic

Other further education college

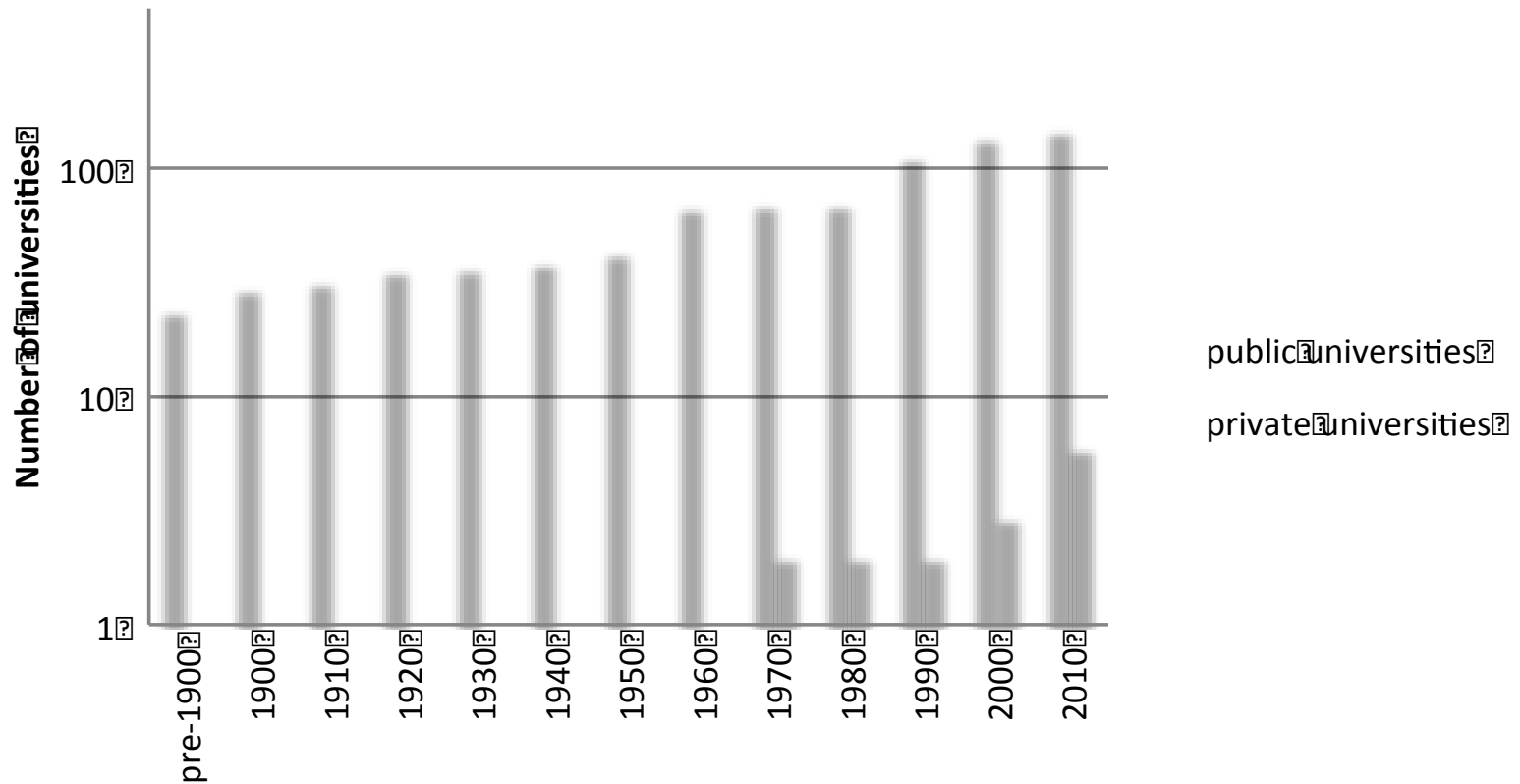
Funding structure of public universities

- * Funded by the government for their teaching and research activities through separate funding streams
- * Since the mid-1980s, recurrent research funding is distributed on a quality-related basis, based on a nationwide assessment of the quality of the research at universities
- * Recurrent funding for teaching is distributed to universities according to a formula based on student numbers, weighted according to field of study and other cost factors

Funding structure of public universities

- * Changes to teaching funding:
 - Since 2012/13, a high proportion of public funding for teaching is channeled through repayable loans to students
 - At the same time, universities have been allowed to raise their yearly tuition fees to up to £9,000 per year
 - Proposals to introduce a teaching quality metric

The distribution of public and private UK universities since 1900



Evolution of policy thinking about universities in knowledge transfer

Source: Rossi and Rosli (2016)

Period	Early 1990s - early 2000s	Early 2000s - 2010s	Early 2010s onwards
Conceptualisation of third mission engagement	Technology transfer	Knowledge transfer	Knowledge exchange
Model of innovation	Linear model: universities seen as transfer agents	“Enhanced” linear model: universities still seen as transfer agents, but it is acknowledged that many types of knowledge can be transferred and that interactions are crucial for transfer to occur	Systemic approach: emphasis on joint actions between universities and other stakeholders and on positive feedback processes for all involved
Subject-related focus	Science and engineering primarily	All academic subjects, including not only science and engineering but also the arts and humanities and the social sciences	All academic subjects, with interdisciplinarity as a key theme

Evolution of policy thinking about universities in knowledge transfer (contd)

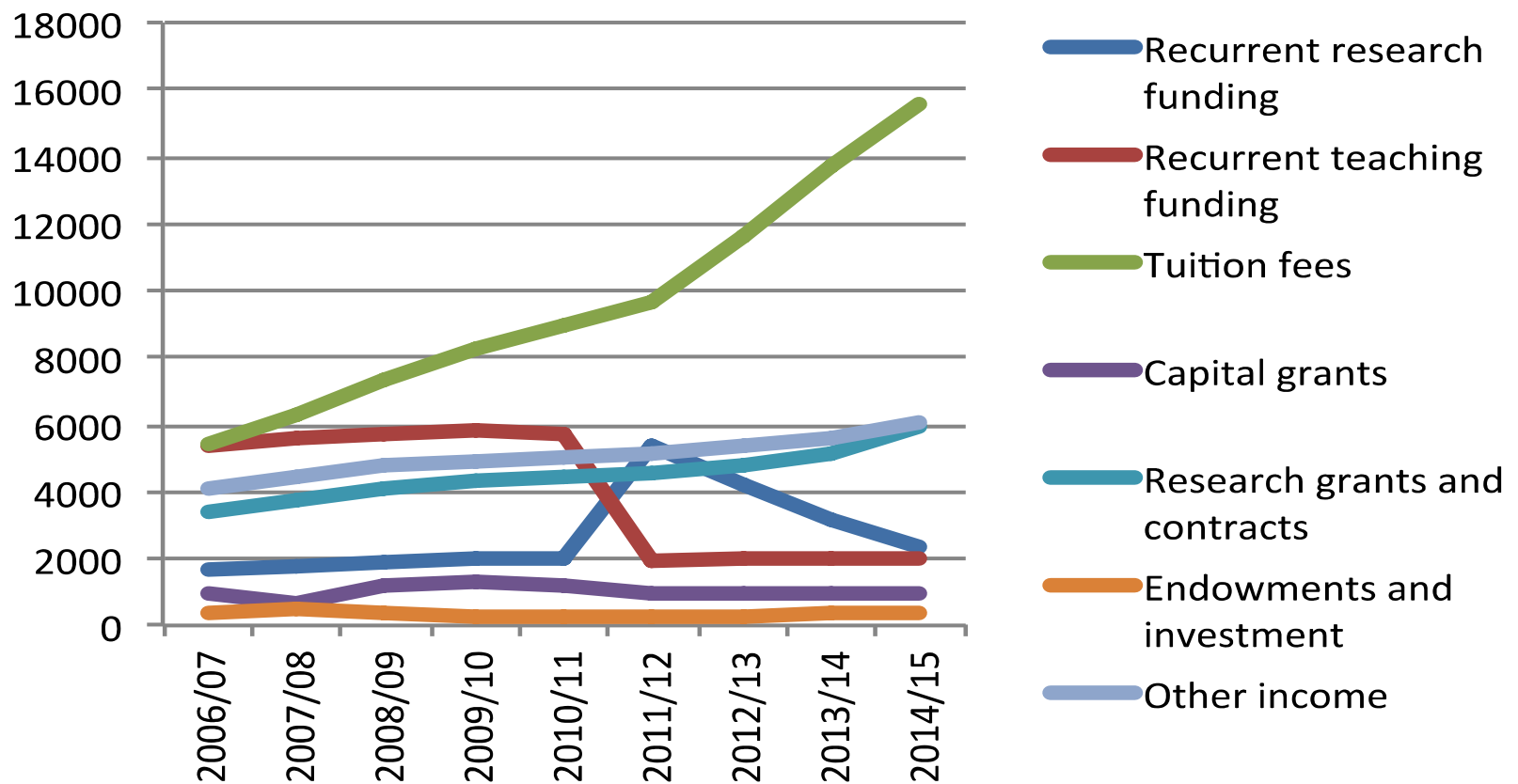
Period	Early 1990s - early 2000s	Early 2000s - 2010s	Early 2010s onwards
Institutional focus	Research-intensive universities	All types of universities: potential contribution of universities with diverse institutional missions is acknowledged	All types of universities: importance of coordinating resources and scale up responses to complex challenges in all fields
Spatial focus	Not mentioned explicitly: focus is on disembodied knowledge which can be transmitted easily	Regional focus: importance of co-localisation to promote interactions	Flexible focus (local, national or global) depending on the challenges to be addressed
Key policy goals	Increase universities' ability to respond to industry needs	Increase universities' ability to build ongoing relationships with stakeholders in business, policy, communities,	Help universities to work with other partners to build effective ecosystems of innovation able to tackle complex challenges

Evolution of policy in support of knowledge transfer

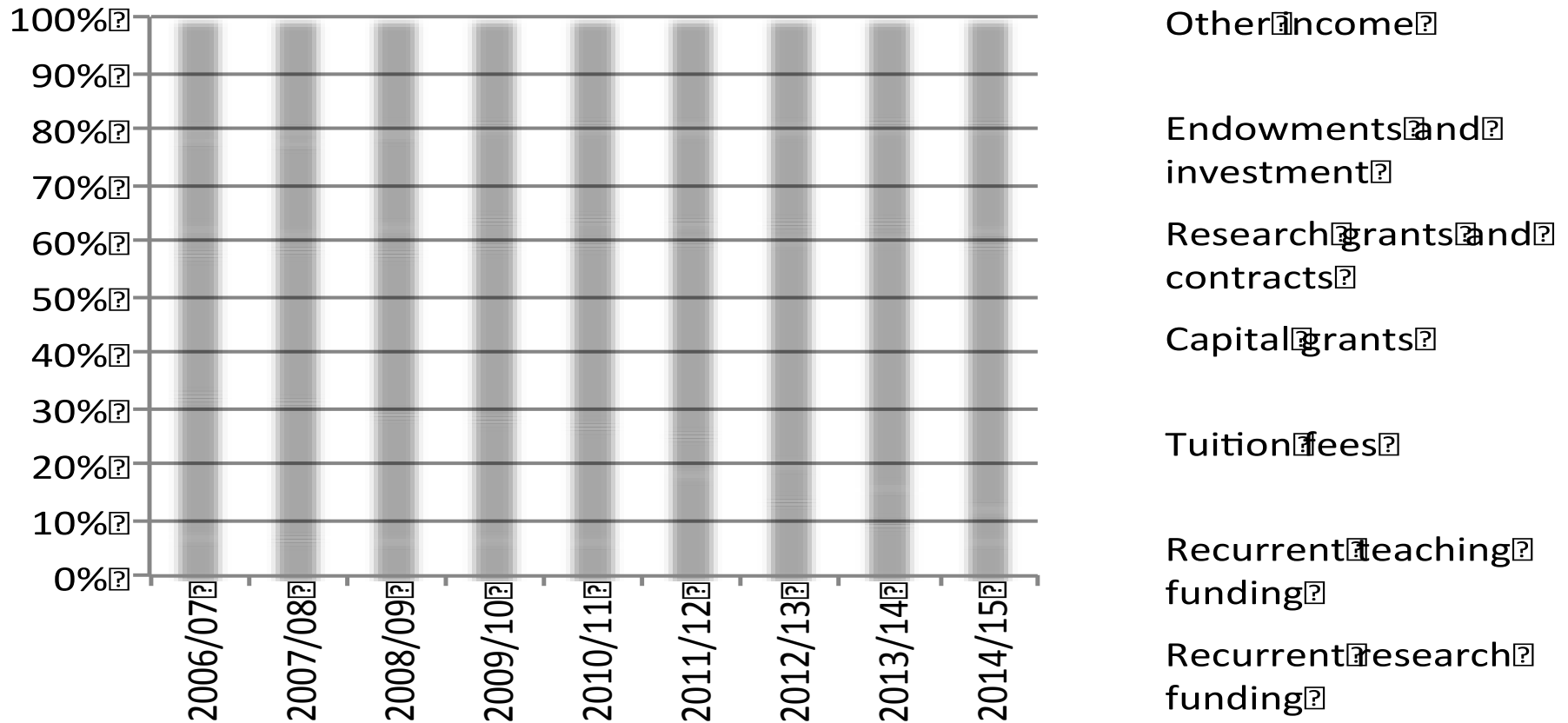
- * Policy instruments have only marginally kept pace with the evolution in policy thinking
- * Higher Education Innovation Fund to support knowledge transfer activities mainly relies on quantitative indicators of universities' performance in a few activities close to the technology transfer model
- * Research Funds are concentrated in research-intensive institutions
- * Only recently, Research Evaluation Framework has introduced evaluation of impact case studies which allow for a broader view of what constitutes knowledge transfer and its impact

Income Sources of Universities

Authors' elaboration on data from Higher Education Statistics Agency



Universities' income composition by source



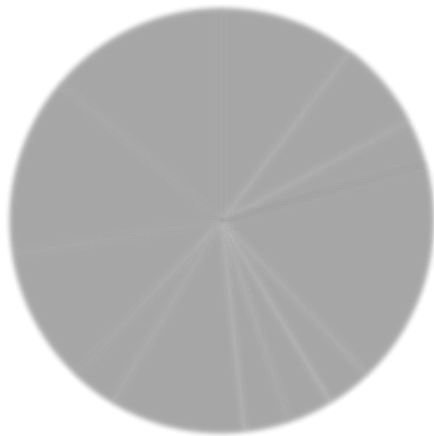
Overall picture: PSROs

- * 29 Public Sector Research Organizations,
- * 32 Institutes of the Medical research Council and the Institute of Cancer Research.
- * The number of PSROs has decreased since 2000 due to mergers, closures and privatisations
- * Data on PSROs are more limited than for Universities in the UK

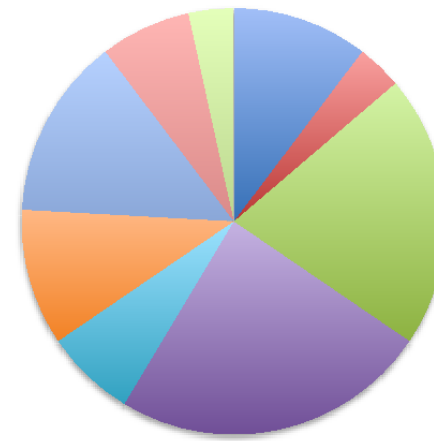
Overall picture: PSROs

Distribution by ownership

Distribution by ownership



Department for Business, Innovation and Skills
Department for Culture, Media and Sport
Department for Energy and Climate Change
Department for Environment, Food and Rural Affairs
Department of Health
Forestry Commission
Health and Safety Executive
Ministry of Defence
BBSRC
MRC
NERC
STFC



- Trading fund
- Government Owned Contractor Operated (GoCo)
- NDPB
- Executive Agency
- Government Owned Company
- MRC wholly owned Research Centre
- NERC wholly owned Research Centre
- National Laboratory
- Joint venture company

Evolution of University-Industry interactions: thorny questions

*Did policies push university engagement with industry? Or, did policies ratify what was happening anyway as firms started drawing on universities for basic science research? (Mazzoleni, 2011)

*Is the knowledge transfer income of the universities a reflection of society's willingness to pay for scientific research? Or, does it represent the overall crisis in public funding of educational services?

Careful case studies may shed useful light on both issues

Knowledge transfer channels

A brief history of institutional mutation

- *From 1948, academic property rights managed collectively by the National Research Development Corporation (NRDC).
- *In 1981, NRDC merged with the National Enterprise Board to form the British Technology Group (BTG) which had exclusive rights to commercialize the results of publicly funded research.
- *In 1985, universities were given the rights to own and commercialize academic inventions-- independently or using the services provided by BTG.

A brief history of institutional mutation

- * In 1992, BTG was privatized and became a private supplier of IPR brokerage services to universities and other companies.
- * Today the UK has a system of “automatic ownership”, such that the university is the first owner of the IPR, which usually cannot revert to the inventor.
- * Other European countries (such as Austria, Czech Republic, Denmark, Finland, Germany, Greece, Hungary and Norway) apply the “pre-emption rights” principle, whereby the researcher is the first owner of the invention

Indicators of IPR activities in UK universities

Source: Presented in Geuna and Rossi (2011), updated using HESA data

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09*	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
A) Patent applications	1,308	1,648	1,536	1,913	1,898	2,097	1,994	2,256	2,274	1,936	2,076	2,156
B) Patents granted	463	711	577	647	590	653	820	757	826	951	969	953
C) Formal spin-offs established	167	148	187	226	219	191	207	236	170	131	130	129
D) Formal spin-offs still active after 3 years	688	661	746	844	923	982	806	825	818	793	802	836
E) IP income (£million)	43	63	63	61	68	124 [§]	56	69	79	61	95	102
F) Other knowledge transfer income (million GBP)**	1,508	1,518	1,612	1,829	1,910	2,001	2,975	2,209	2,269	3,395	3,720	3,936

IP-backed activities in UK universities

- * Bulk of IP activity in a subset of research-intensive universities with a substantial presence in only five subjects
- * In 2014-15, six institutions (5%) produced 40% of patent applications, and 25 institutions (21%) produced 80% of patent applications.
- * The distribution of IP income is even more skewed: just three institutions (2.5%) produced 41% of IP income, and 17 (14%) institutions produced 80% of IP income.

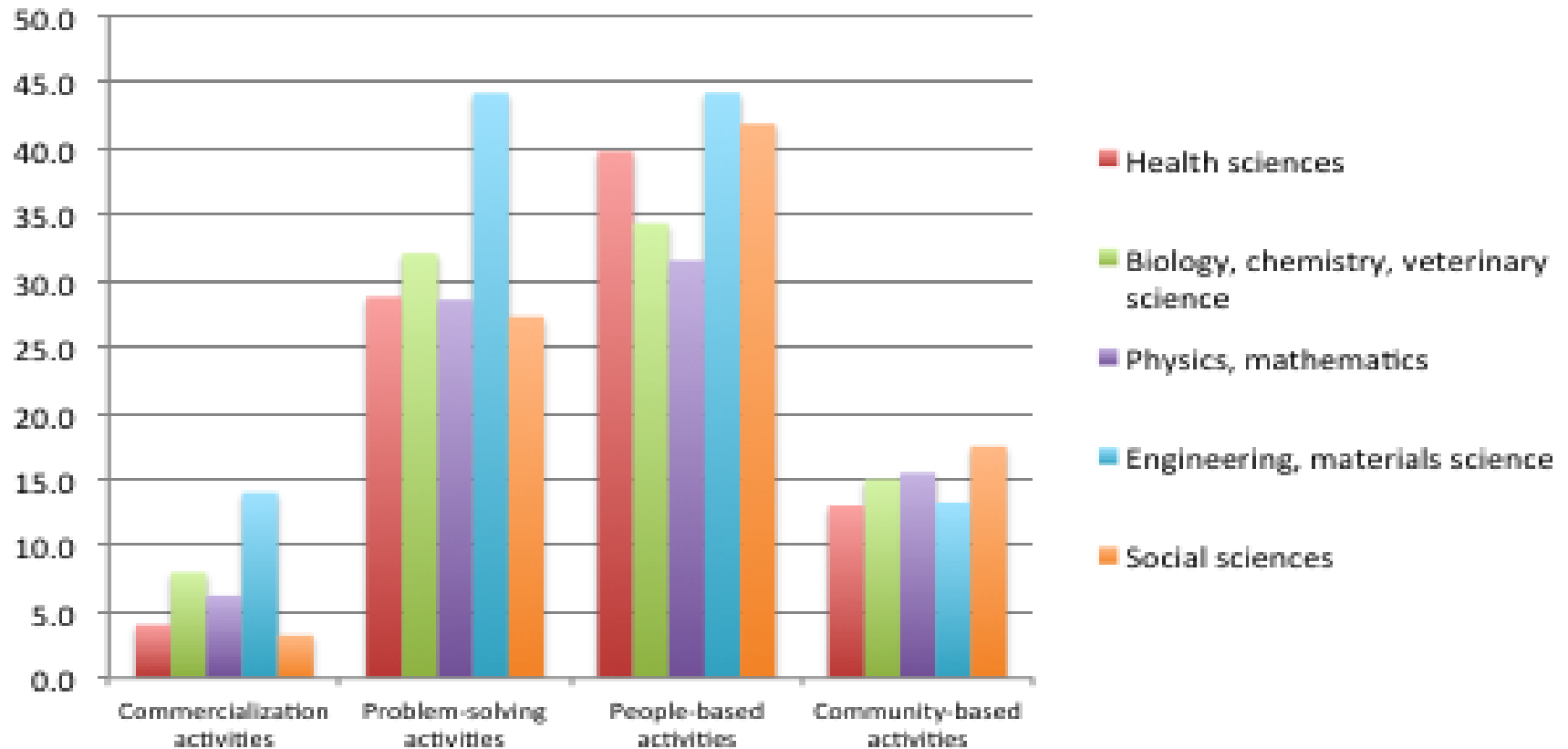
Knowledge transfer activities

- * Wide variety of channels in the sector as a whole
- * Several studies show the presence of at least two clusters of university
 - a research intensive cluster
 - a teaching intensive cluster
- * IP-based activities very concentrated in a small number of universities
- * PSROs outperform Universities in IP-based knowledge transfer

Type of activity	Activity	All	Health sciences	Biology, chemistry, veterinary science	Physics, mathematics	Engineering, materials science	Social sciences
Commercialization	Patenting	6	5	15	7	22	1
	Licensed research	3	3	6	6	12	1
	Forced-run consultancy	7	6	7	8	14	9
	Spun out company	3	2	4	4	8	2
Problem-solving	Joint publications	48	54	61	52	69	42
	Joint research	44	50	59	49	66	38
	Consultancy services	31	31	25	25	44	37
	Prototyping and testing	9	8	12	12	27	5
	Research consortia	29	27	34	33	52	27
	Contract research	27	27	26	24	45	30
	Hosting personnel	29	28	36	30	45	27
	Informal advice	47	46	43	38	51	52
	External secondment	10	9	11	12	18	9
	Setting of physical facilities	10	8	14	11	25	6
People-based	Standard setting forums	25	30	20	18	31	28
	Participating in networks	63	65	57	52	72	69
	Attending conferences	81	83	83	77	85	83
	Student placements	31	27	29	29	47	32
	Giving invited lectures	55	57	50	45	58	59
	Curriculum development	22	25	14	15	25	27
	Sitting on advisory boards	33	36	27	23	31	37
	Employee training	27	30	24	20	40	32
	Enterprise education	7	5	5	5	9	10
Community-based	Social enterprises	13	11	6	7	7	21
	Museums and art galleries	17	8	13	15	10	14
	Public exhibitions	13	10	10	14	13	8
	Heritage and tourism	10	2	4	6	5	11
	Community-based sports	3	3	2	2	3	4
	Performing arts	18	11	10	12	8	16
	School projects	29	23	35	29	28	26

Knowledge transfer activities: % of academics in each type of activity

Source: NCUB (2016)



Summary indicators of IPR related activities in UK PSROs

Source: BIS (2014)

	1 st annual survey 2003-4 (n=107)	2 nd annual survey 2004-5 (n=116)	3 rd annual survey 2005-6 (n=135)	4 th annual survey 2006-7 (n=138)	5 th annual survey 2007-8 (n=138)	6 th annual survey 2008-9 (n=143)	7 th annual survey 2012-13 – Grossed up values	Change 2008-9 to 2012-13
Business representatives on governing bodies (%)	175	214	247	207	209	231	405	75%
FTE staff employed in commercialisation offices	385	368	513	669	486	448	611	36%
Number of patent applications	316	335	290	316	379	392	322	-18%
Number of patents granted	228	148	193	172	188	230	342	49%
Number of licensing agreements	621	352	286	604	1,136	2,579	1,164	-55%
Income from IP licensing	£33m	£46m	£186m	£116m	£146m	£198m	£195m	0%
Number of spin-outs	69	84	74	101	89	83	143	72%
Income from business consultancy	£36m	£31m	£26m	£43m	£37m	£100m	£166m	66%
Incl. income from Use of Facilities and Equipment and Training							£133m	199%

Knowledge transfer from UK PSROs

- * Business representation on PSRO Governing Bodies has increased over time.
- * Full-time staff in commercialisation offices has increased (by 36%), since 2008-09.
- * The number of patent applications has remained relatively unchanged, the number of patents granted has increased.
- * The number of spinouts has doubled between 2008-09 and 2012-13 – with PSROs holding some ownership of the spinouts in 93% of the cases.

Knowledge transfer from UK PSROs

- * Income from commercialization activities including business consultancy has increased dramatically (66%) since 2008-09.
- * A steady increase in licensing agreements in the early years – nearly double between the 4th and 5th and 5th and 6th surveys – has been replaced by a reduction in the last three years.
- * Income from IP licensing increased between 2007 and 2009 but it has remained the same since then.

Questions about knowledge transfer

- * What has been the impact of 2005 Bayh-dole type patenting legislation in the UK?
- * Has it made more universities patent or has it simply increased the intensity of patenting in existing universities?
- * What is the counterfactual to patenting?
- * Should more funding go to PSROs if they are more efficient at knowledge transfer?

References

- * Rossi and Rosli (2016) 'Third mission policy goals and incentives from performance-based funding: are they aligned?' *Research Evaluation*, doi: 10.1093/reseval/rvw012
- * Geuna and Rossi (2011) 'Changes to university IPR regulations in Europe and the impact on academic patenting' *Research Policy*, 41: 1068-1076
- * Mazzoleni (2011) Before Bayh–Dole: public research funding, patents, and pharmaceutical innovation (1945–1965), *Industrial and Corporate Change* 20 : 721-749.
- * Business, Innovation & Skills (2014) '7th Survey of Knowledge Transfer Activities in Public Sector Research Establishments (PSREs) and Research Councils'