

Getting the Balance Right

R&D Funding and Horizon 2020 in a time of budget uncertainty

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Message: basic research is important, but to innovate well you have to **do** innovation

- The science lobby is on the march again, based on the idea that everything depends on basic research
- In Europe, our policy diagnosis is still the ‘European Paradox’, though it’s getting a bit more critical about the quality of EU research
- However, the facts contradict any claim that basic research drives development
- Meanwhile, China and the USA show the way with huge mission-driven efforts
- It’s time to focus effort into missions and worry less about science

The science lobby's argument starts with knowledge and ends with governance. The claims are ...

- New fundamental knowledge causes innovation
 - “We cannot programme scientific breakthroughs or order them from a menu...We can't foresee the consequences of what we discover.” [Helga Nowotny, ERC]
 - Hence we should not prioritise thematically
 - Using any other criterion than excellence means funding sub-optimal research
 - Only scientists can decide what excellent research is, therefore
 - *Fund investigator-initiated, 'blue skies' research*
 - *Only the scientific community should decide what to fund*
 - *The more money you give us the richer we'll all get*
 - We've been here before: *Science, the Endless Frontier* (Vannevar Bush, 1945)
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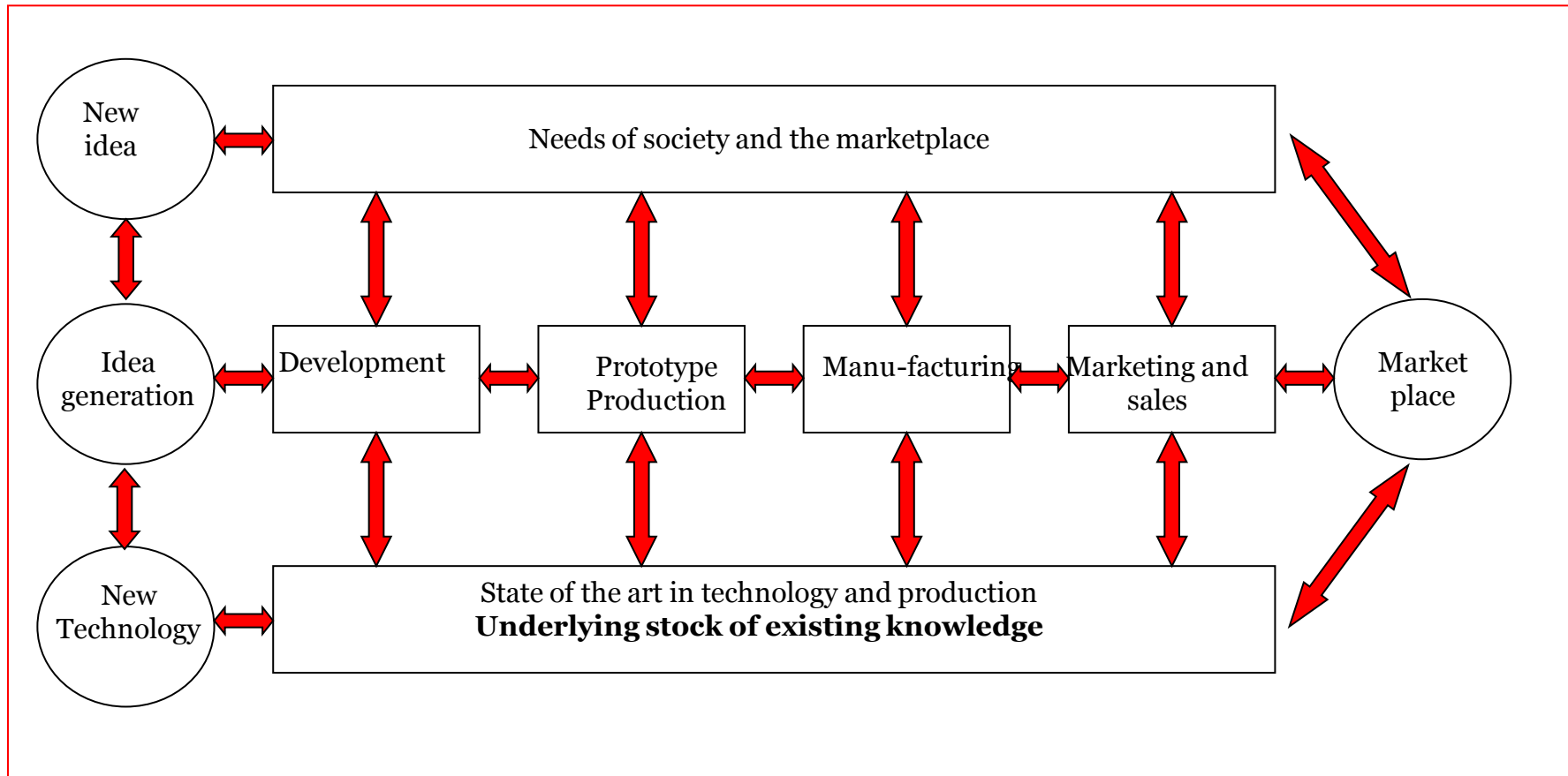
Paradox?

- The enduring diagnosis of Europe is that we do plenty of science but fail to get it to market
 - This was the key message of the Innovation Green Paper of 1997 and the diagnosis underlies Horizon 2020
 - The latest Innovation Union Competitiveness report (2011) stresses four major challenges for Europe
 1. *Under-investment in R&D in Europe – not only by the state but especially by business*
 2. *Weak knowledge exchange between science and industry*
 3. *Improving but still far from adequate quality in research*
 4. *Unfavourable framework conditions for innovation*
 - Welcome back to the Barcelona 3% Goal
 - *NB that is 2% from business and 1% from the state*
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What does the research evidence say?

- When innovation is linked to research (often it isn't), the link is non-linear
- Basic and applied research are systemically interdependent
- Much basic research isn't 'blue skies'
- Excellent research doesn't have to be irrelevant
- Time constants in the research-innovation link are long
- Historically, technology often triggers science
 - *Thermodynamics, aerodynamics, materials science ...*

Linear innovation models have been rejected in favour of more complex, systemic ones



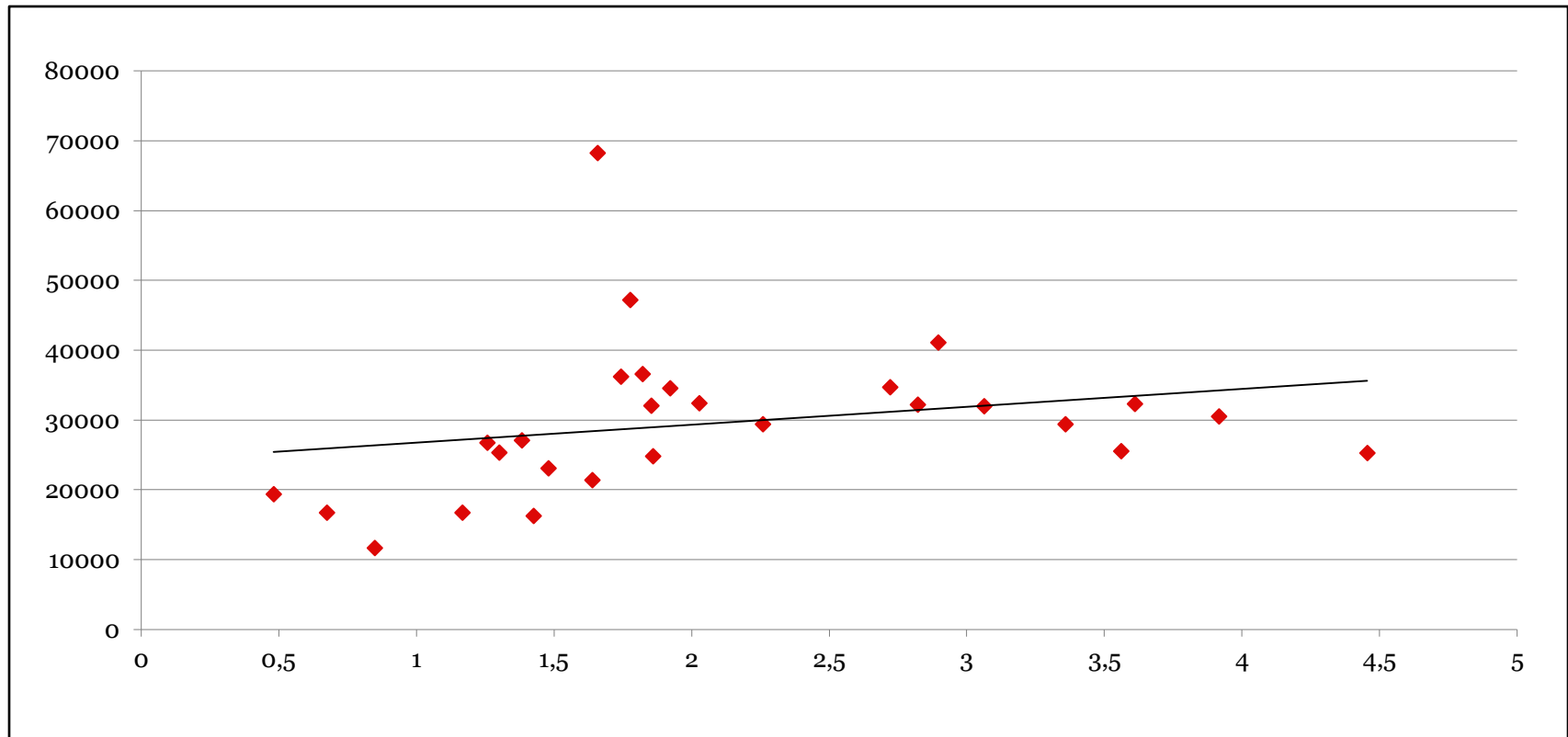
Research-innovation links at the micro level

- Increase in the stock of useful knowledge
- Supply of skilled graduates and researchers
- New instrumentation and methodologies
- Creation of networks and stimulation of social interaction
- Enhancement of problem-solving capability
- ‘Spin-off’ companies
- Provision of social knowledge

Ben Martin and Puay Tang, The Benefits from Publicly Funded Research, SPRU, 2007

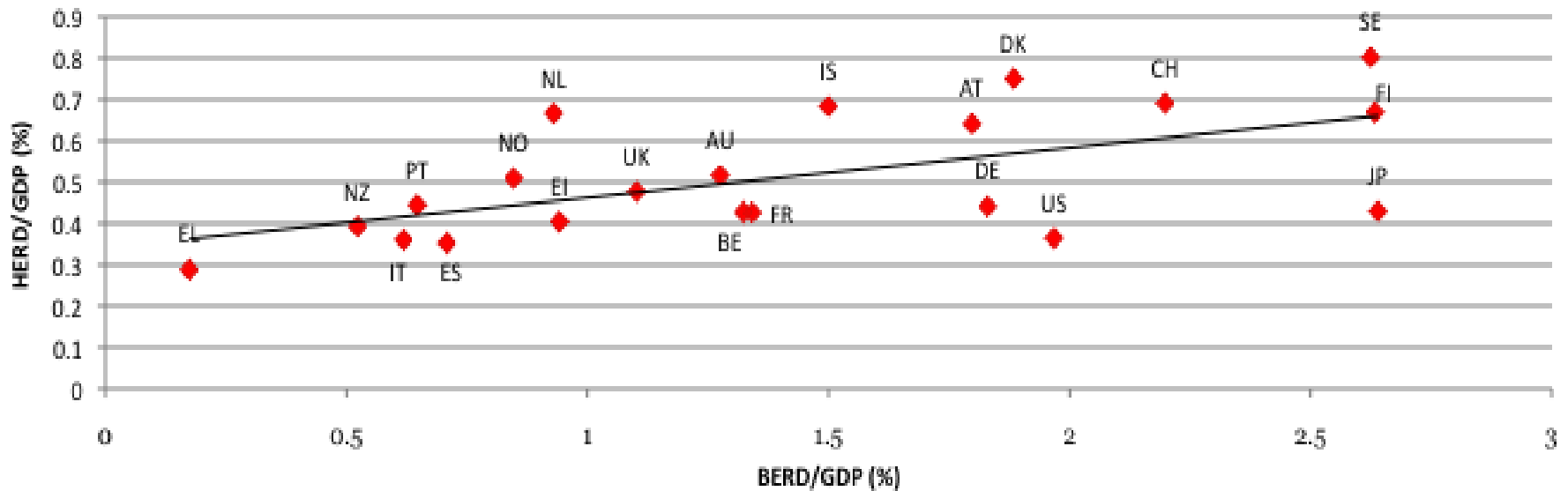
Doing more R&D goes along with getting richer

GERD/GDP vs. GDP per person (US \$, 2009. Source: OECD)



The innovation effort is driven by BERD, supported by HERD

Comparison between BERD/GDP and HERD/GDP by country (average ratio over the 2006-2009 period)



Basic research isn't a random activity: much of it is use-orientated

Quest for fundamental understanding	Yes	Pure basic research (Bohr)	Use inspired basic research (Pasteur)
	No		Pure applied research (Edison)
		No	Yes

Considerations of use

Which is better – basic or applied research?

- Some of the most interesting evidence about the importance of basic and applied research comes from the budget rivalry between the US National Science Foundation (NSF) and mission-orientated research in the 1960s
 - The US Department of Defence commissioned the Hindsight study, which traced the research antecedents of a number of weapons systems back for twenty years or so and concluded that the underpinning research was largely mission-orientated in nature
 - NSF retorted with the TRACES study, which traced backwards for up to fifty years from five important civil innovations and found critical connections to basic research
 - The unsurprising implication is that both sorts of research are at various times needed
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Recent research, funded by VINNOVA

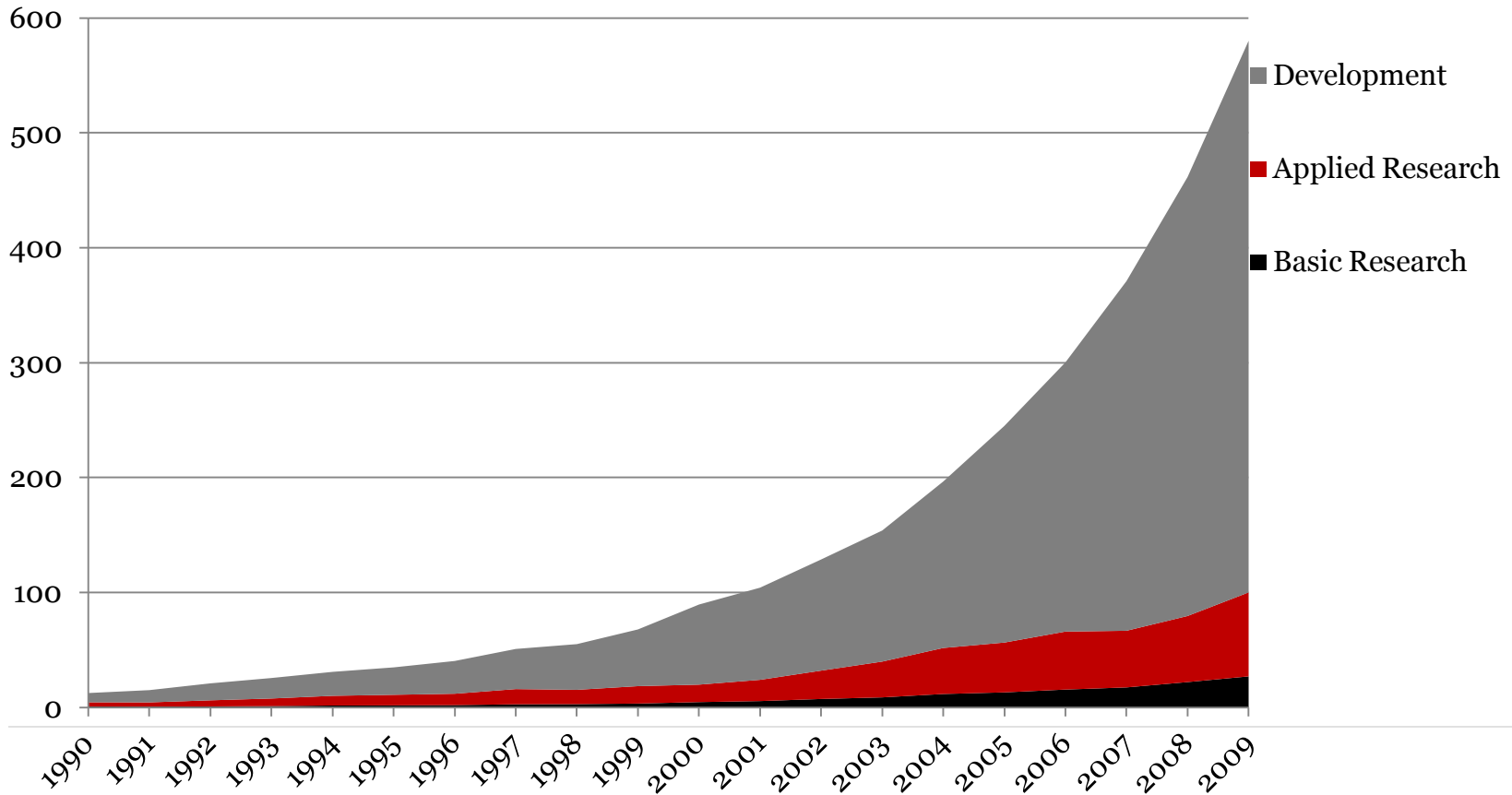
- VINNOVA and its predecessors have played important roles in identifying, defining and growing new areas of needs-driven R&D. This would not have been achieved had the funding been under the unique control of either the research or the industrial community
- It was done through a combination of ‘bottom-up’, responsive mode funding and programming
- Time constants are constantly under-estimated in R&D funding. It is not uncommon for 10-20 years to elapse before socio-economic effects of any size are visible
- Key effects of funding have been the development of new clusters of human capital and organisational learning – system development, not just to underpinning individual innovations
- Where R&D programmes address societal needs, they have to connect with effective demand (ie users willing and able to pay)

Excellent research doesn't have to be irrelevant

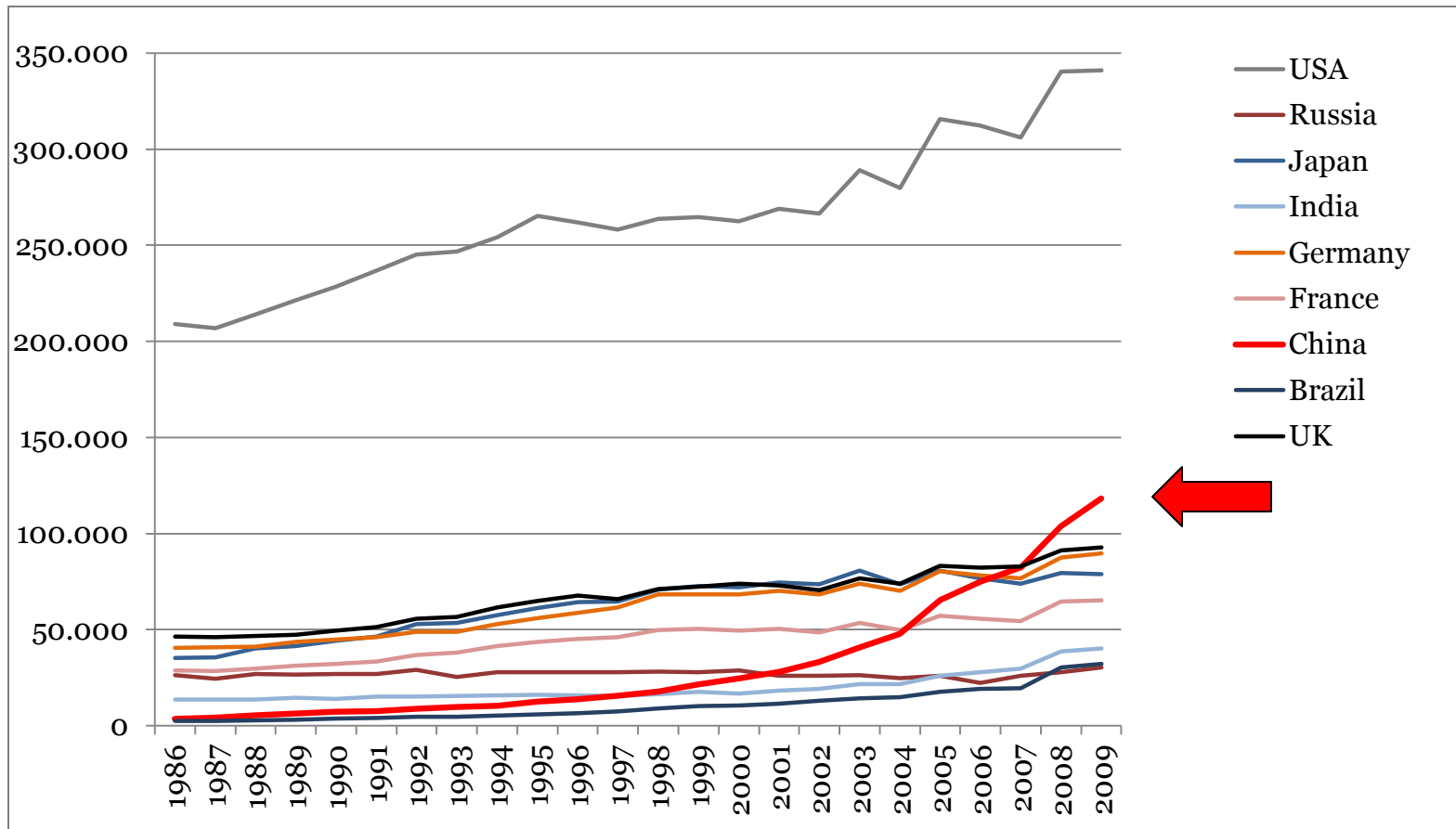
- Most UK academics cooperate with industry to further their research rather than commercialise knowledge
 - Italian researchers who patent also publish the most
 - Norwegian academics receiving industrial funding publish more than those who don't
 - Crespi finds patenting and scientific publication correlate
 - Italian studies show copublications with industry have higher than normal citation rates
 - British studies show the researchers from the highest-ranked university collaborate the most with industry
 - Peer reviews of Competence Centres schemes, eg in Sweden, find very high levels of scientific quality
 - And so on
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You don't need much fundamental research to do catch-up

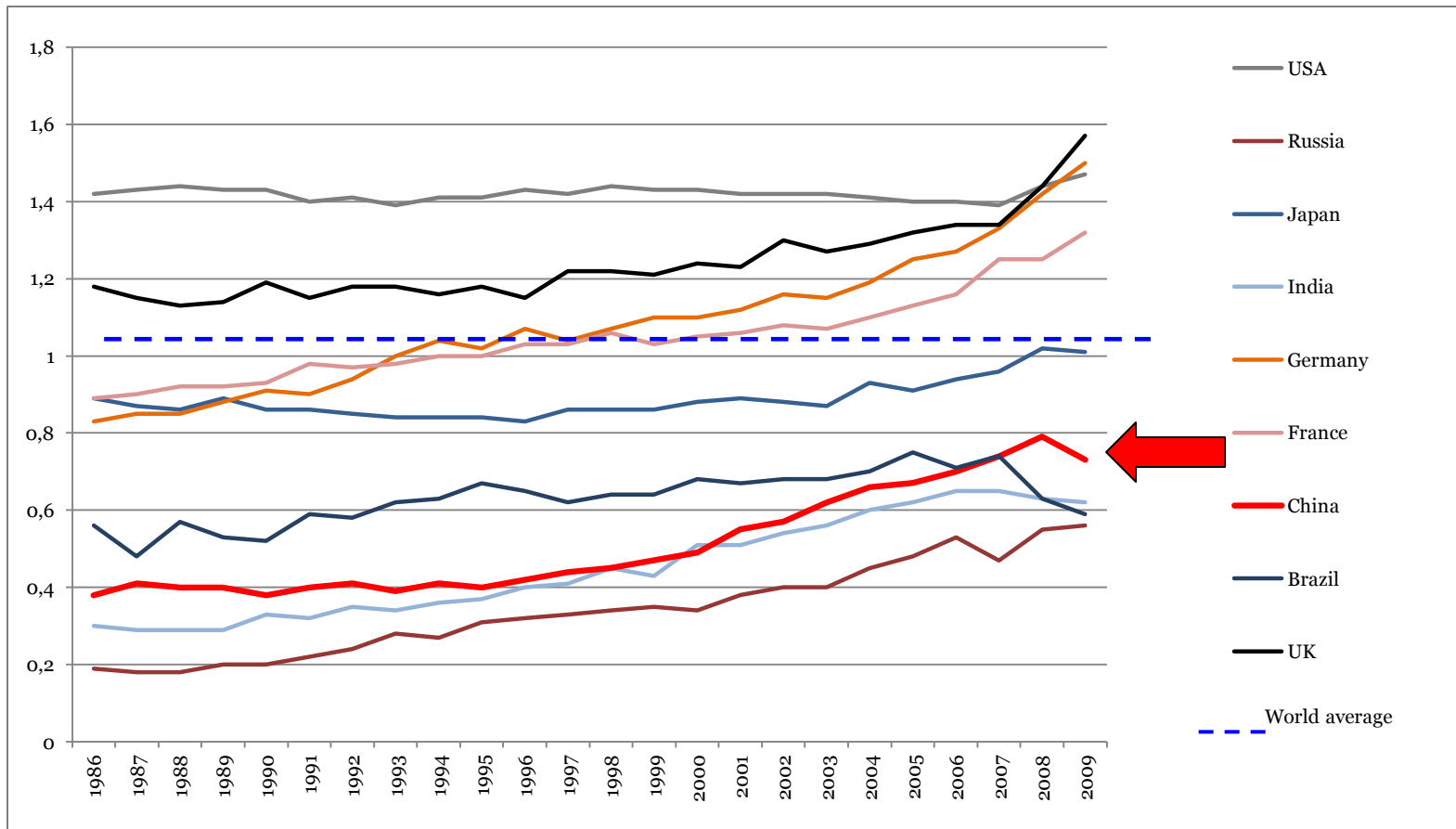
China: GERD. Basic share constant at 5% (RMB billions)



But it's amazing what you can do with just a little. Chinese publications in the WoS

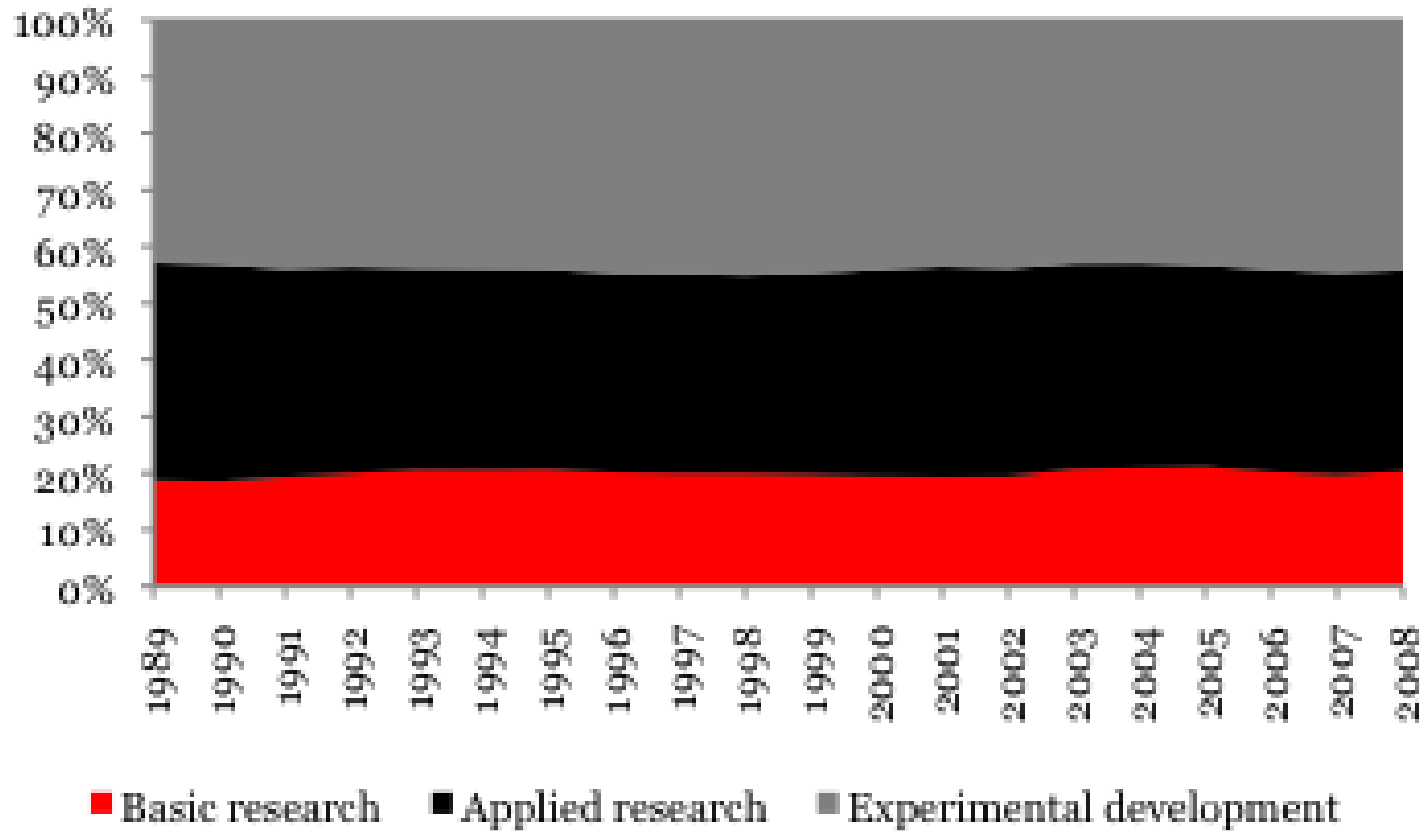


Impacts of Chinese publications relative to the World



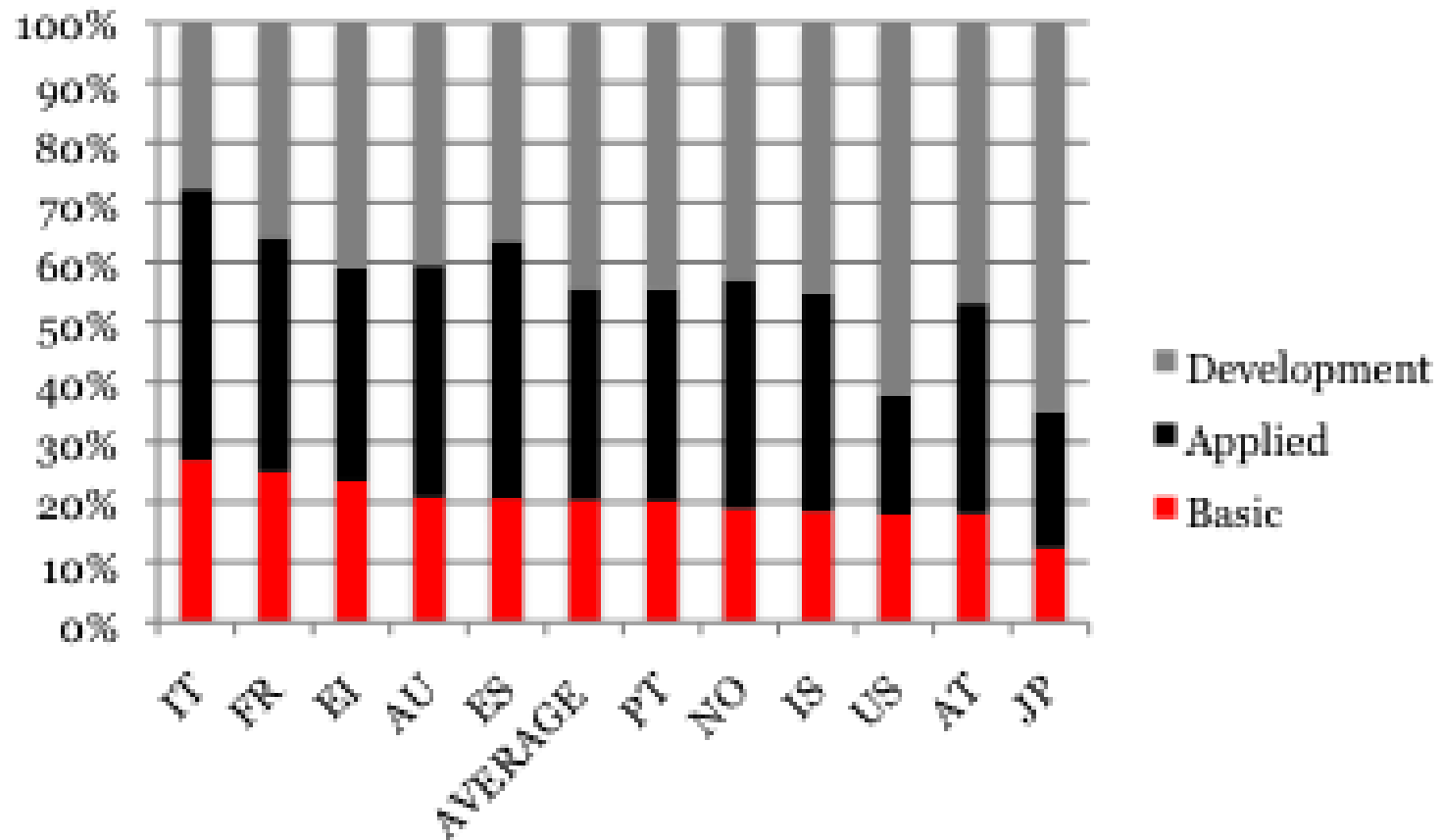
As you approach the technology frontier, you need more fundamental research

Basic share of GERD in a basket of Western countries: from 18.6% in 1989 to 20.2% in 2009

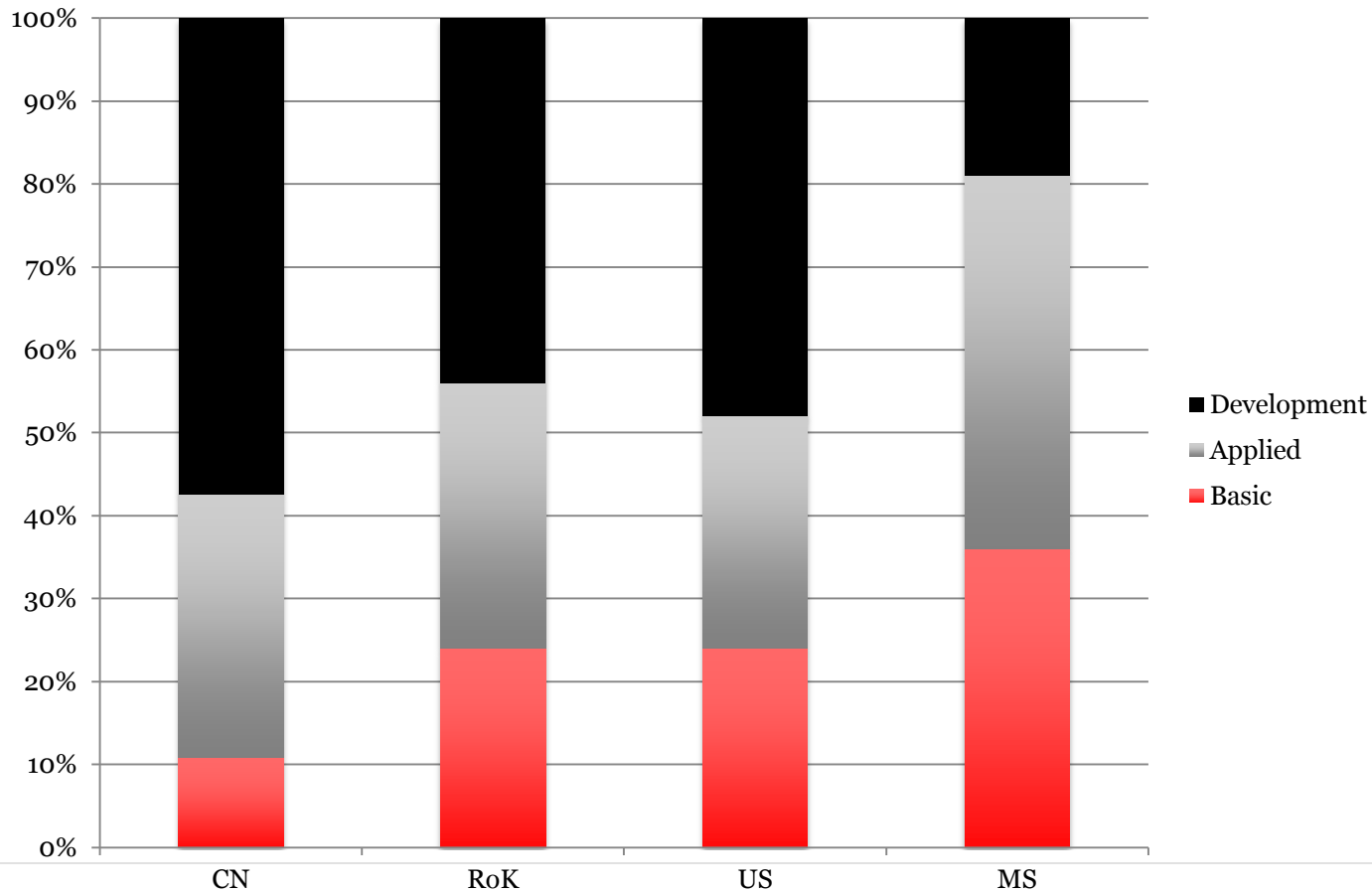


The greater share of **development** in GERD in US and Japan is striking

GERD by type: 2006-9. Source: OECD



It's even more striking if you look at government expenditures



Source: NSF, 2010

China's Medium- and Long Term Plan for National Science and Technology Development, 2006-2020

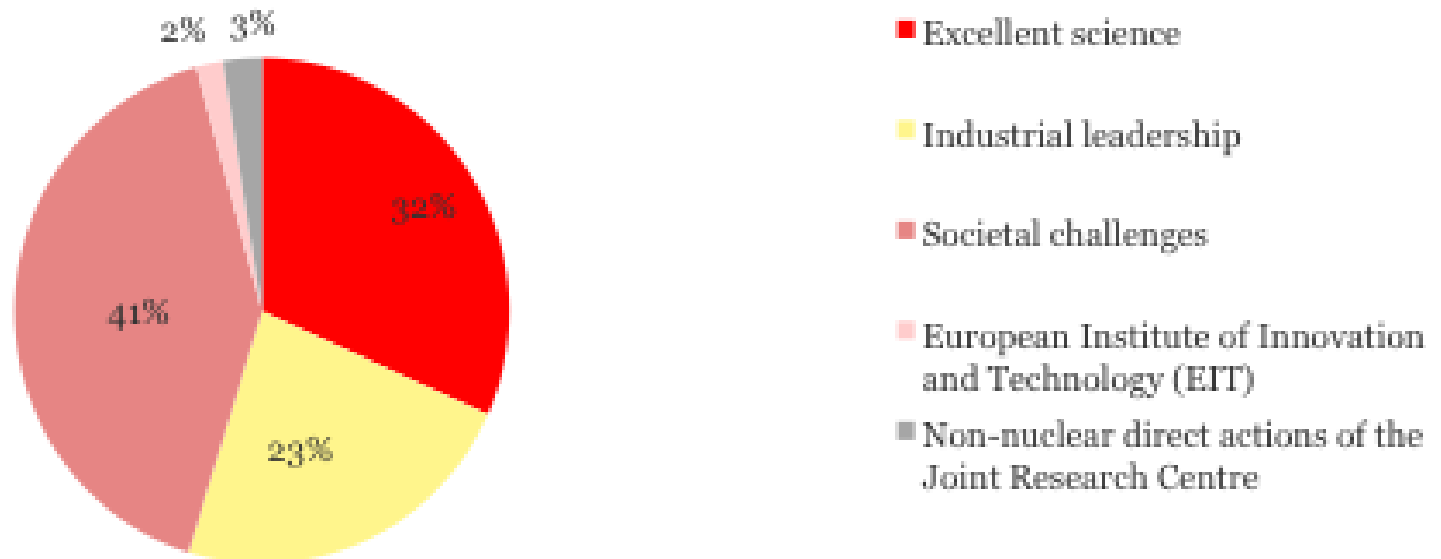
- Goal: to make China an innovation-driven economy by 2020
- High-priority clusters
 - *Technologies for water, energy and environmental protection*
 - *IT, advanced materials and manufacturing*
 - *Biotechnologies and their applications*
 - *Space and marine technology*
 - *Basic sciences and frontier technology - Raise basic research to 15% of GERD by 2020*
- 16 mission-driven megaprojects
 - *Mixing basic research and missions*

There's heavy emphasis on mission research in the USA – which includes a big basic component

Agency	Type	1986	1990	1995	2000	2005	2009	Trend 1986-2009
Department of Agriculture	<i>Basic</i>	48%	49%	46%	50%	48%	44%	Stable (+/-4%)
	<i>Applied</i>	52%	51%	54%	50%	52%	56%	
Department of Defense	<i>Basic</i>	29%	27%	30%	25%	23%	25%	Stable (+/-4%)
	<i>Applied</i>	71%	73%	70%	75%	77%	75%	
Department of Energy	<i>Basic</i>	47%	59%	47%	53%	50%	56%	Increase in Basic Research(+9%)
	<i>Applied</i>	53%	41%	53%	47%	50%	44%	
Department of Health and Human services	<i>Basic</i>	64%	62%	60%	56%	53%	53%	Increase in Applied Research (+11%)
	<i>Applied</i>	36%	38%	40%	44%	47%	47%	
NASA	<i>Basic</i>	44%	53%	49%	58%	48%	60%	Increase in Basic Research (+16%)
	<i>Applied</i>	56%	47%	51%	42%	52%	40%	
NSF	<i>Basic</i>	94%	94%	92%	93%	92%	92%	Stable (+/-2%) ²¹
	<i>Applied</i>	6%	6%	8%	7%	8%	8%	

So what are **we** doing? Horizon 2020: upwards of 32% largely bottom-up basic research?

Horizon 2020 (2014-2008)



Will more basic research fix our problems?

- Successful innovation relies on ‘coupling’ needs and opportunities
- In Europe, we have largely abandoned the historical role of the state in supplementing market coupling through ‘development pairs’
- Others – notably the USA but also China – have maintained a more developmental policy
- That’s why we need the bridging pillars for the KETs
- As well as much stronger effort on user-driven innovation at all levels
- By implication, we have to grow mission-driven research and complement it with downstream mechanisms like test beds and demonstrators

We need growth in the Industry and Challenge parts of Horizon 2020 plus more 'downstream' intervention

- There's a long history that shows the effectiveness of the parts of the FP corresponding to Industry and Challenge
- The time constants are long in this kind of activity – we need sustained efforts that engage the whole R&D community
- On the evidence so far, the ERC has done a good job in invigorating basic research in Europe – especially by influencing the behaviour of national funders and leveraging their resources. This should help tackle the quality deficit in EU science
- **The weaknesses of the EU system are in delivering missions to society and the market – that's where the effort needs to focus**

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Thank you

technopolis |group| has offices in Amsterdam, Ankara, Brighton, Brussels, Frankfurt/Main, Paris, Stockholm, Tallinn and Vienna
