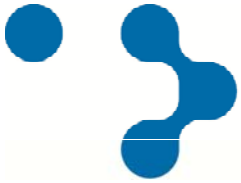

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Global Trends in Nanotech

Samhitha Udupa
Analyst, EMEA

December 2010

Lux Research profile

- Advisor to corporations, investors, and governments on science-driven innovation
- Offers subscription-based intelligence services as well as custom consulting
- Practices in 1) solar, 2) power, 3) water, 4) **nanomaterials**, 5) green buildings, 6) carbon, and 7) biosciences
- Diverse, 50-person team; Ph.D scientists and market researchers
- Primary research methodology: Focus on proprietary interviews and site visits
  - > 1,500 interviews last year
  - Site visits in 20 countries, China to Dubai
- Clients on five continents

Josh Wolfe,
Director, Lux Research

21st Century R&D Act signing in Oval Office

LR Chairman Peter Hebert on CNBC

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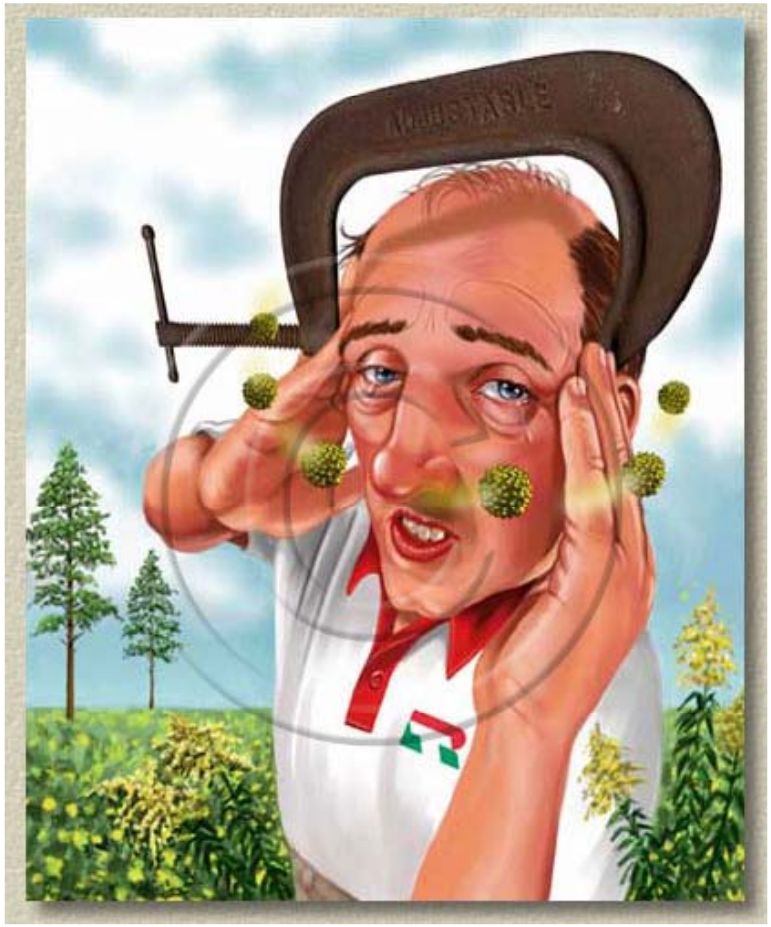
Nano-enabled allergy medicine?



LUNA INNOVATIONS NASDAQ:LUNA

Luna Awarded NIH Grant to Apply Nanotechnology to Allergy Treatment

Grant to Identify and Analyze Nanomedicine Prototypes for Treating Allergies and Other Inflammatory Diseases
ROANOKE, Va.--(BUSINESS WIRE)--July 22, 2008--Luna Innovations Incorporated (NASDAQ:LUNA) announces the award of a $1.6 million Research Project Grant (R01) from the National Institutes of Health (NIH) to investigate the use of fullerene-based nanomedicines as a pathway to treat allergies and other inflammatory diseases. ……

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Agenda

- What's the state of nanotech funding?
- Which nations are leading the race?
- Summary

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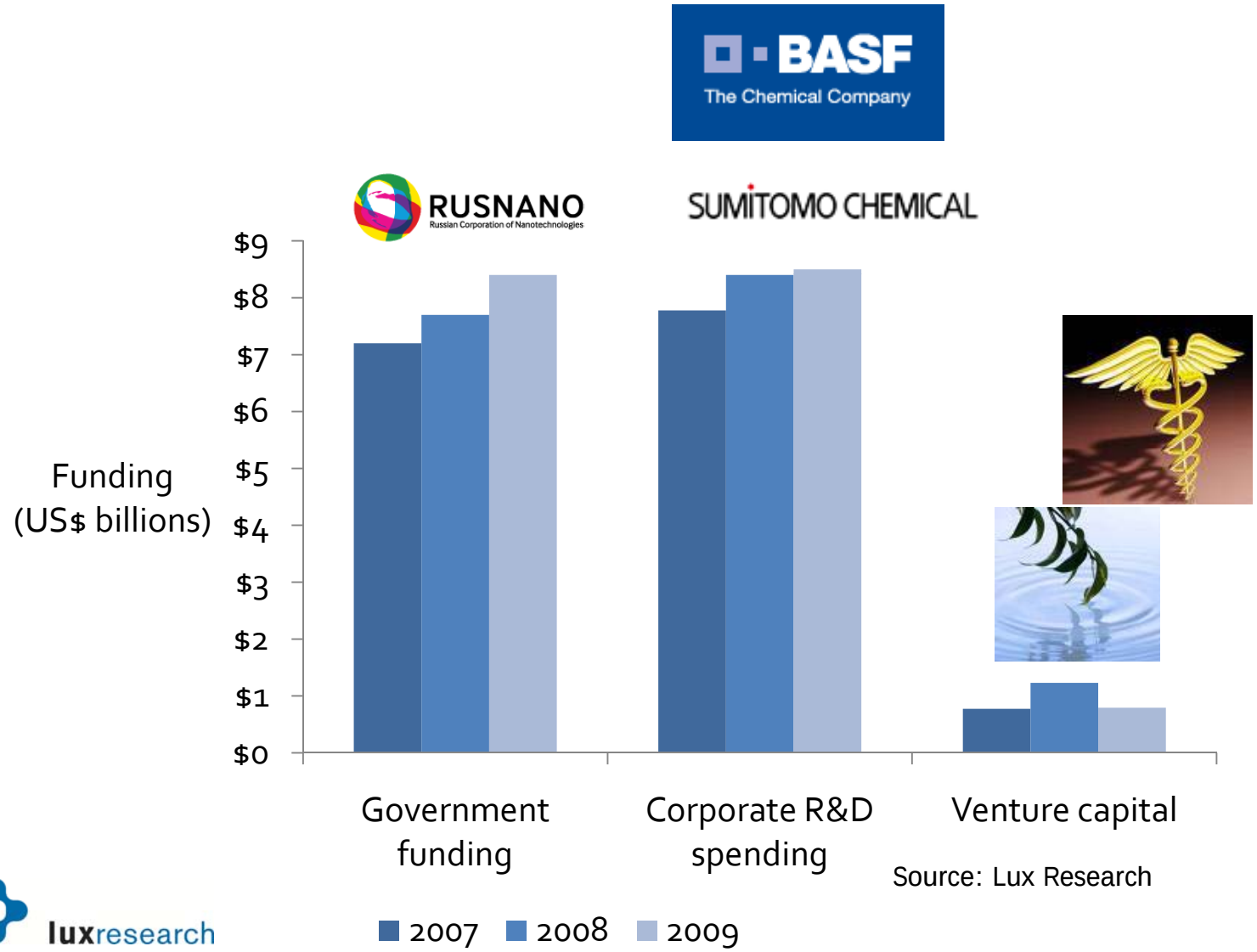
$18 billion in 2009 propels nanotech forward



Source: Lux Research

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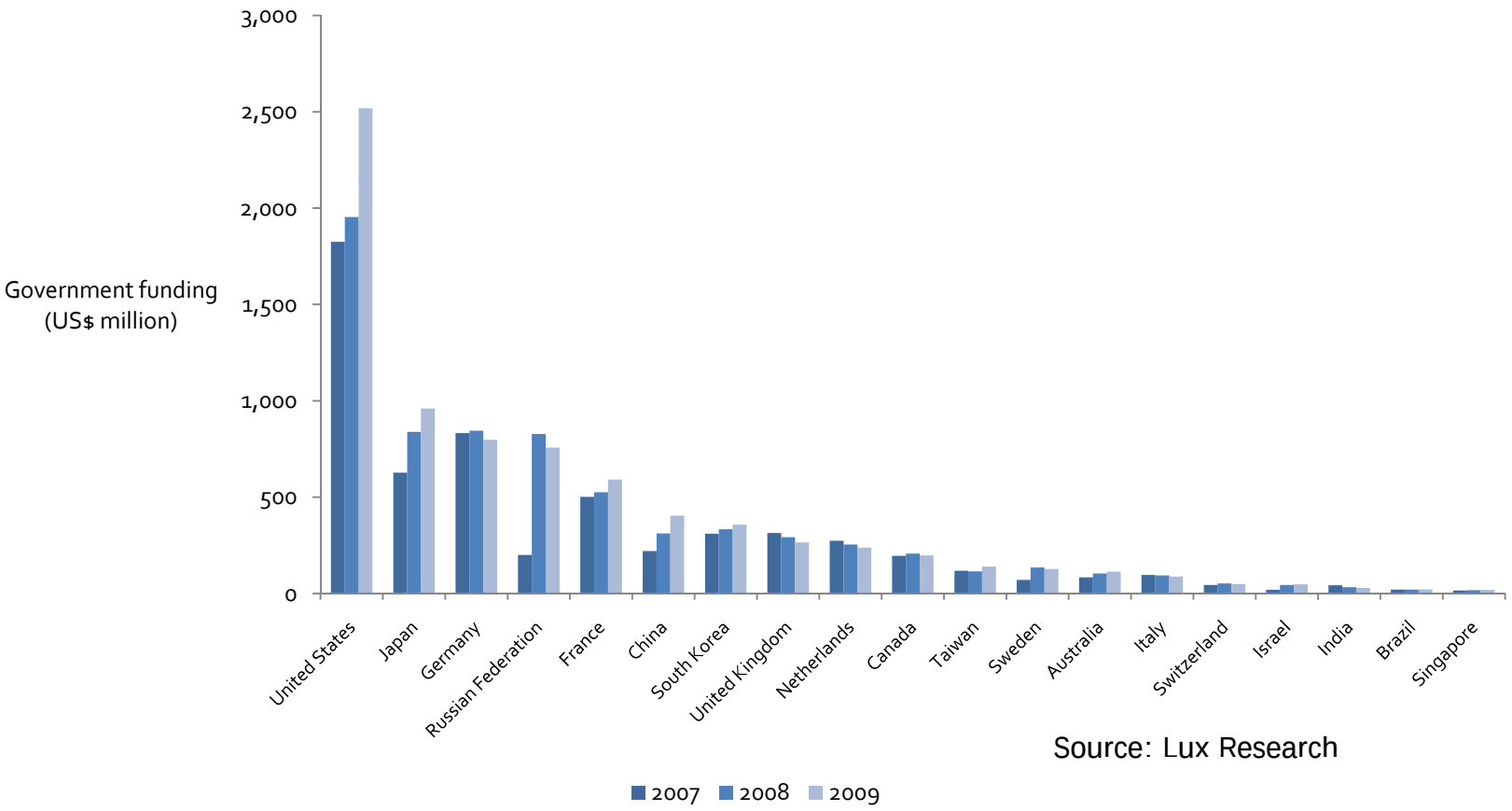
US, Japan, and Germany lead in government funding…



Source: Lux Research

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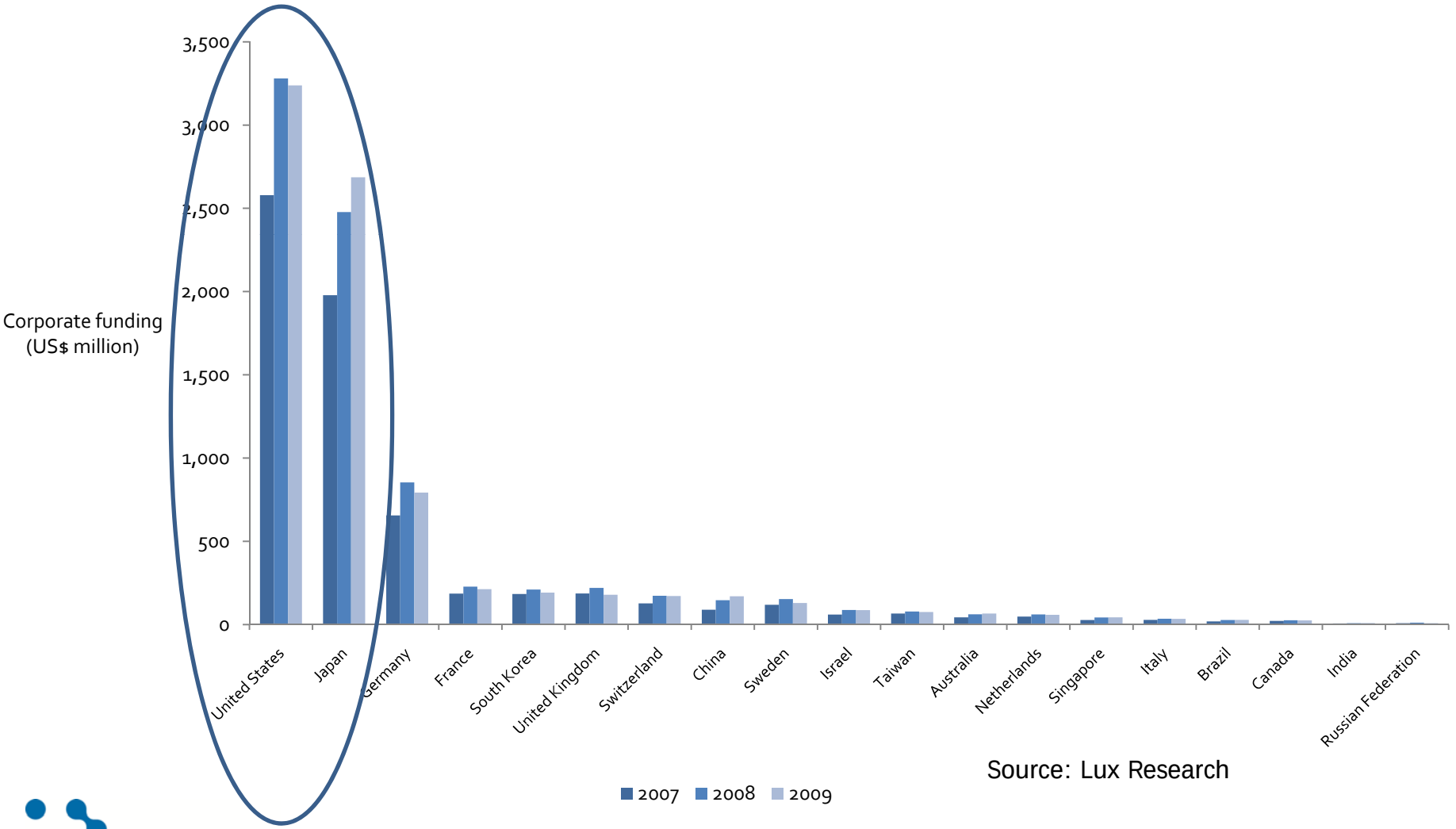
…and overshadow the rest of the world in corporate funding



Source: Lux Research

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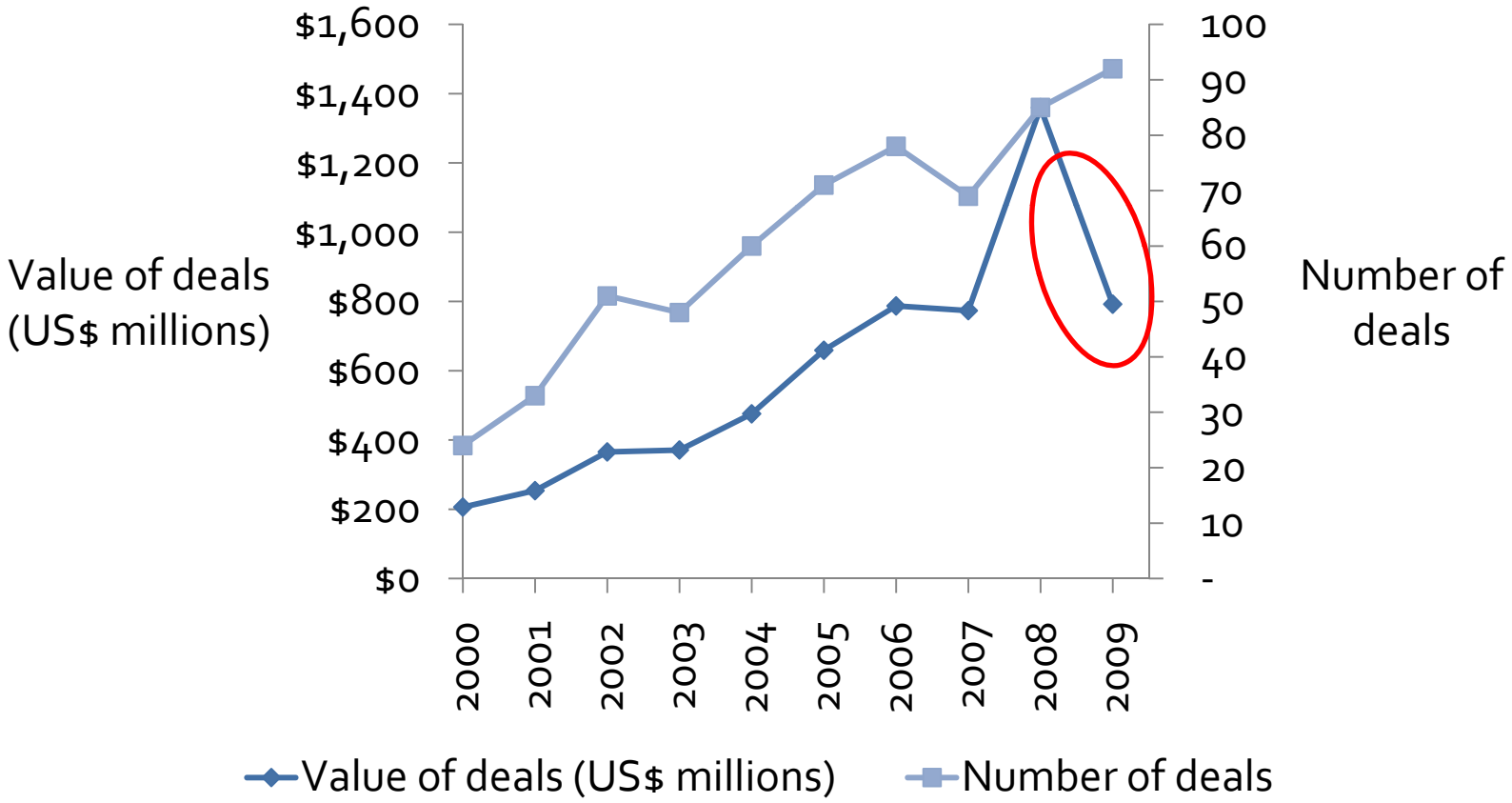
Global corporations drive spending, as nanotech becomes commonplace in R&D departments

- U.S.
  - General Electric (GE): anti-ice coatings
  - Hewlett-Packard (HP): nanowire nanoelectronics

- Japan
  - Despite its economy only being about one-third the size of the U.S.'s, its corporations give the U.S. a run for its money
  - On average, firms like Showa Denko (MWNT-based batteries) and Mitsui (MWNT-based composites) spent 37% more on R&D than their U.S. counterparts in 2009

- ...but in the case of China and Russia
  - Governments are putting a lot of money on the table, but their businesses don't approach nanotech with the same intensity
  - Chinese and Russian corporations devoted just $170 million and $8 million, respectively, in 2009

VC funding plummeted 42% to $792 million in 2009



Source: Lux Research

So, what are the implications?

- Start-ups feel the pressure
  - We've heard the cries of desperation – many coming from well-regarded specialists – during our 1,000-plus primary interviews
  - Many companies have gone bust these past few years:
  - **NanoDynamic**s– closed in July 2009
  - **Evident Technologies** filed for Chapter 11 bankruptcy
  - Nanoscale catalyst provider **Nanox**
  - Printed optoelectronics sensor developer **Nanoident**
  - Nanostructured coating developer **Hyperion Technologies**

- ..but their pains equal opportunities for larger firms
  - M&A and activity likely to increase as large firms seeks deals
  - For example, **Cabot** recently purchased ceramic nanoparticle developer **Oxonica Materials** and **Teijin** recently acquired silicon nanoparticle ink developer **Nanogram**

- Overall, the importance of government funding and incentives and corporate partnerships will rise
  - VP of leading VC firm told us, "Start-ups shouldn't limit themselves to VC; instead, they should seek out other sources and partner early, with the expectation of leaving some value on the table. They should also be prepared for less leeway in not hitting milestones."

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Evaluated 19 countries on two axes: Nanotech Activity and Technology Development Strength

Evaluated 19 countries on two axes: Nanotech Activity

Criterion	Weight	Description
Nanotech initiatives	15%	Qualitative measure of effectiveness and coordination of nanotech initiatives at national, regional, and local levels in most recent year
Nanotech centers	15%	Measure of number and quality of dedicated government and university nanotech facilities with either R&D or commercialization focus in most recent year
Government funding	10%	Amount of funding at regional and national levels specifically allocated to nanotech during most recent year in US$ by PPP
Risk capital	10%	Qualitative assessment of availability of risk capital to fund new ventures in most recent year; includes venture capital, government grants, and subsidized loans
Corporate spending	10%	Estimated spending on nanotech R&D by corporations during most recent year in US$ by PPP
Nanotech publications	15%	Number of nanotech articles in scientific journals submitted from that country globally in most recent year
Nanotech patents	15%	Number of nanotech patents from that country issued globally in most recent year
Active companies	10%	Qualitative measure of strength and volume of companies active in nanotech in most recent year; includes large corporations, small and mid-size companies, and start-ups

- Nanotech Activity is the measure of absolute amount of nanotech development
- The metrics are specific to nanotechnology, and are compared on an absolute basis, meaning that smaller countries tend to rate lower

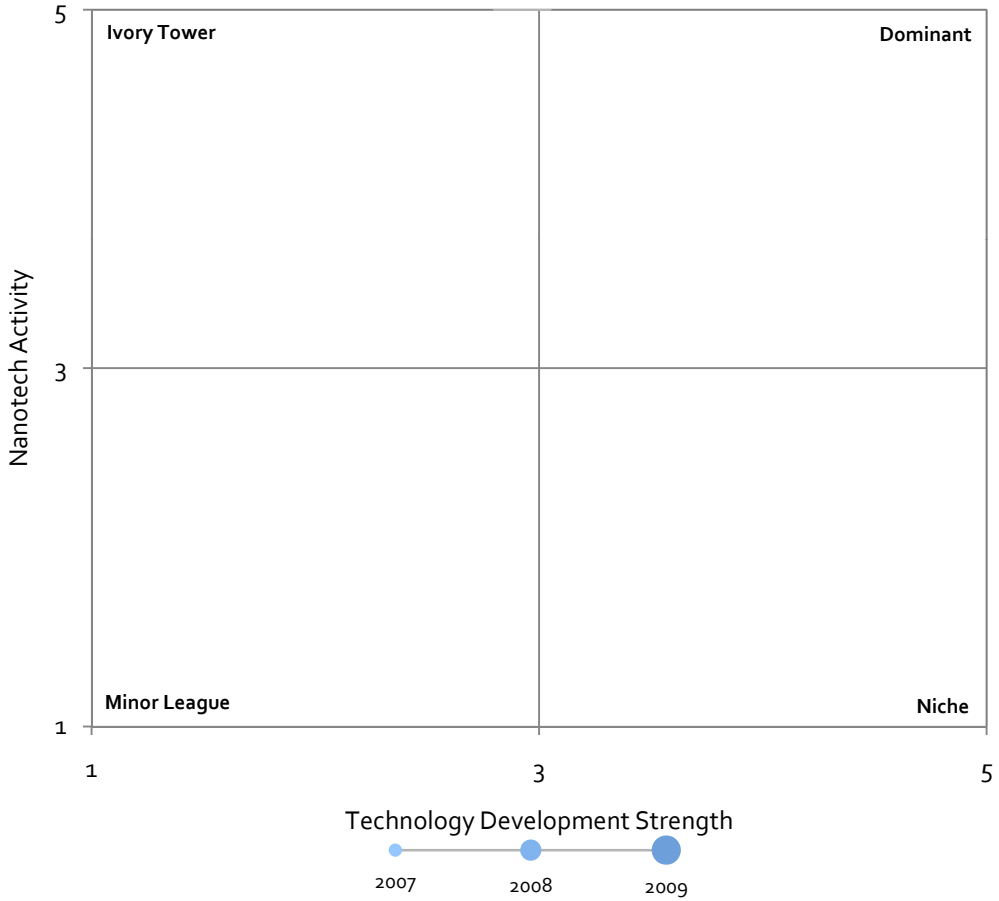
Evaluated 19 countries on two axes: Technology Development Strength

Criterion	Weight	Description
High- or medium-high tech (HMHT) manufacturing	20%	Share of GDP coming from high- or medium-high tech products
R&D spending	25%	Gross expenditures on research and development (GERD) as a percentage of GDP from both public and private sources
Intellectual capital	15%	Number of tertiary science and engineering (S&E) degrees granted during most recent year per capita
Technology and science (T&S) workforce	20%	Number of researchers active in most recent year per $ billion of GDP
Knowledge emigration	10%	Fraction of graduates of tertiary education that leave country
Infrastructure	10%	Composite metric composed of: electricity production per capita (20%), mobile phones per capita (20%), internet hosts per capita (20%), internet users per capital (20%), and percent roads paved (20%)

- Technology Development Strength is a measure of technology commercialization prowess
- This factor measures the ability of a country to grow its economy through technological innovation – not specific to nanotech – by looking at the economy's relative technology intensity
- Factors for Technology Development Strength are calibrated relative to each country's population or GDP, so that small countries are at no disadvantage compared to larger ones

…then placed them in one of four quadrants

- Dominant
  - High *Nanotech Activity* and *Technology Development Strength* needed to commercialize it
- Niche
  - High *Technology Development Strength*, but few resources to compete on *Nanotech Activity* – so they focus on a niche
- Minor league
  - Low *Nanotech Activity* and *Technology Development Strength*
- Ivory tower
  - High *Nanotech Activity*, but less likely to develop economies based on it because of relatively low *Technology Development Strength*



Source: Lux Research

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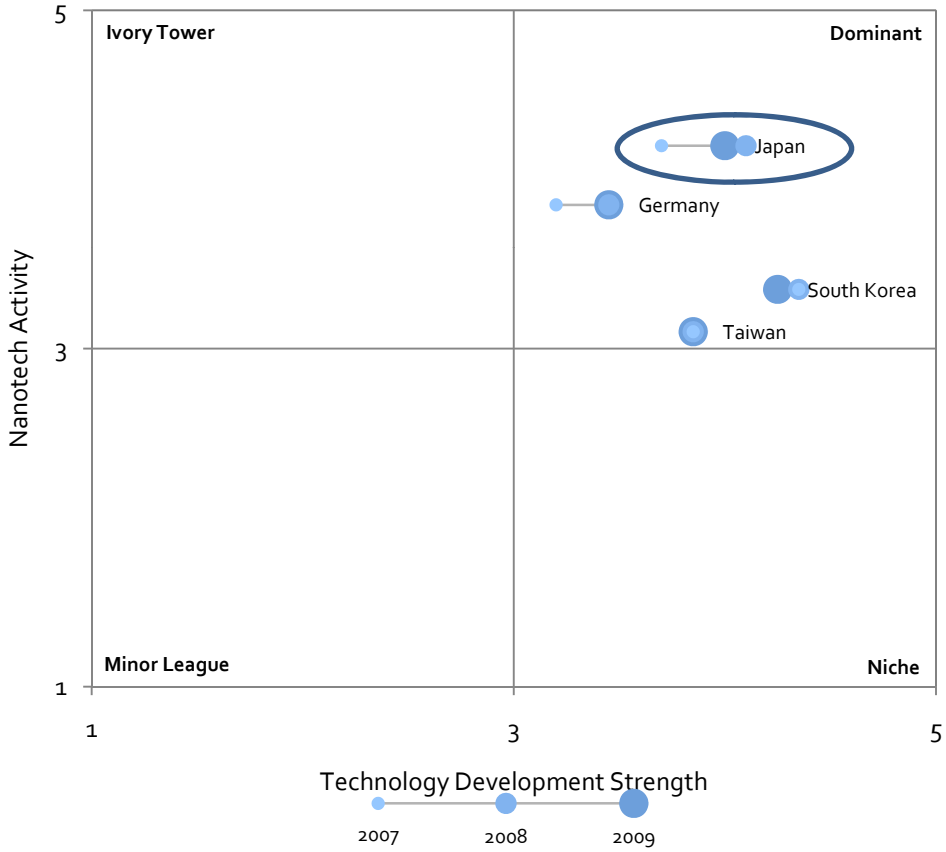
Japan and Germany dominates, as U.S. slips (slightly)

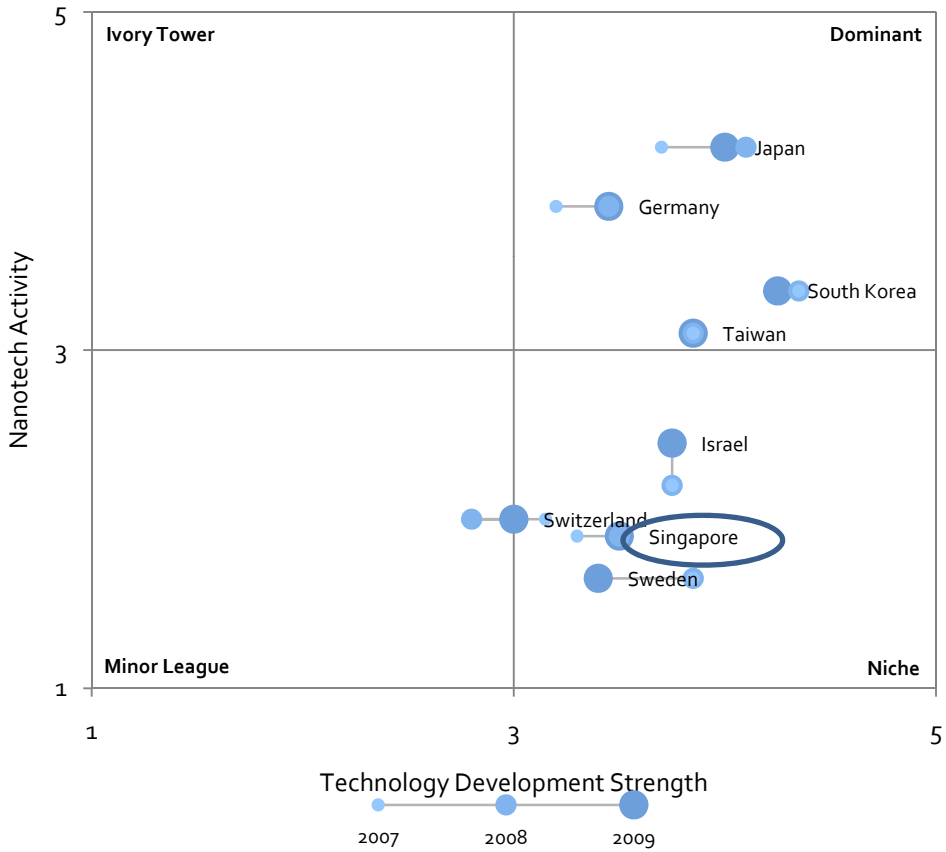
- Japan has the second highest *Nanotech Activity* score
- Though not as well coordinated or as well funded as the U.S., Japan has a healthy government program and network of research centers
- Plus, its technology-oriented private sector helps to make up the funding gap
  - Examples include conglomerates like Toray and Sumitomo Chemical
- Like the U.S., Japan has a large technical workforce and a very low emigration rate.



Source: Lux Research

Singapore thrives in niche quadrant

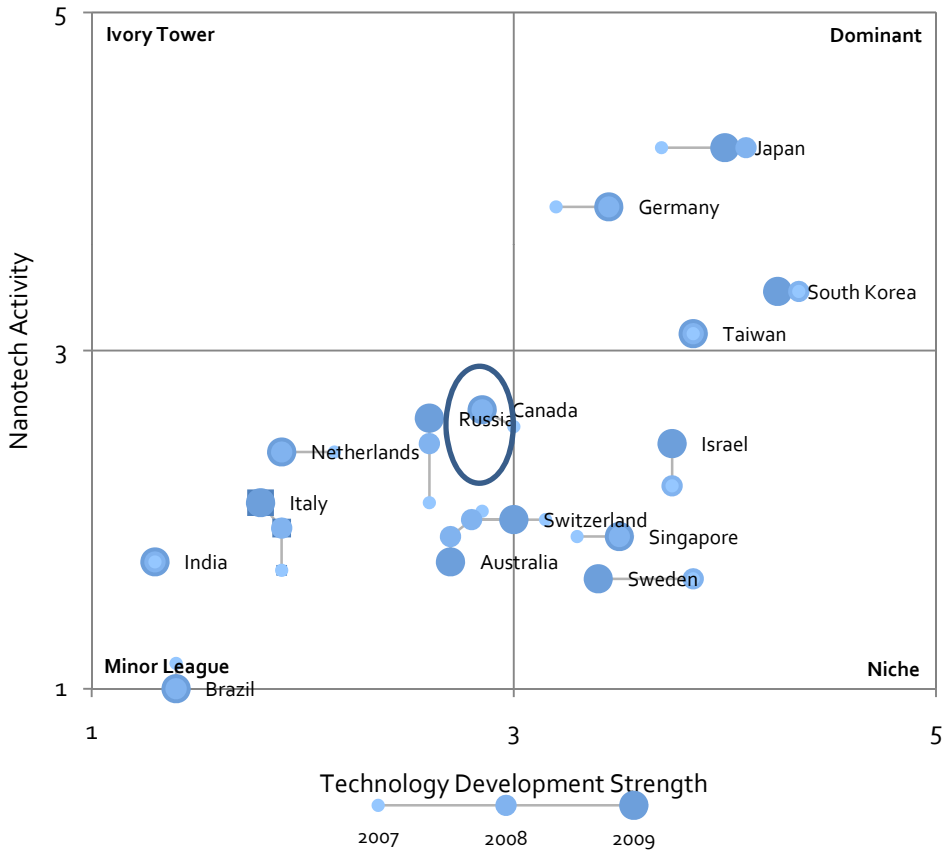
- Despite it's small size, Singapore excels with strong support from the government and from knowing it strengths
- The government of Singapore has called for strategic research programs on nanoscale manufacturing as well as molecular and polymer electronics
- It's no coincidence BASF chose Singapore as the location for a research and development center for organic electronics to complement the Singapore-based BASF Competence Center for Nanostructured Surfaces



Source: Lux Research

Russia makes a big push but remains in the Minor League

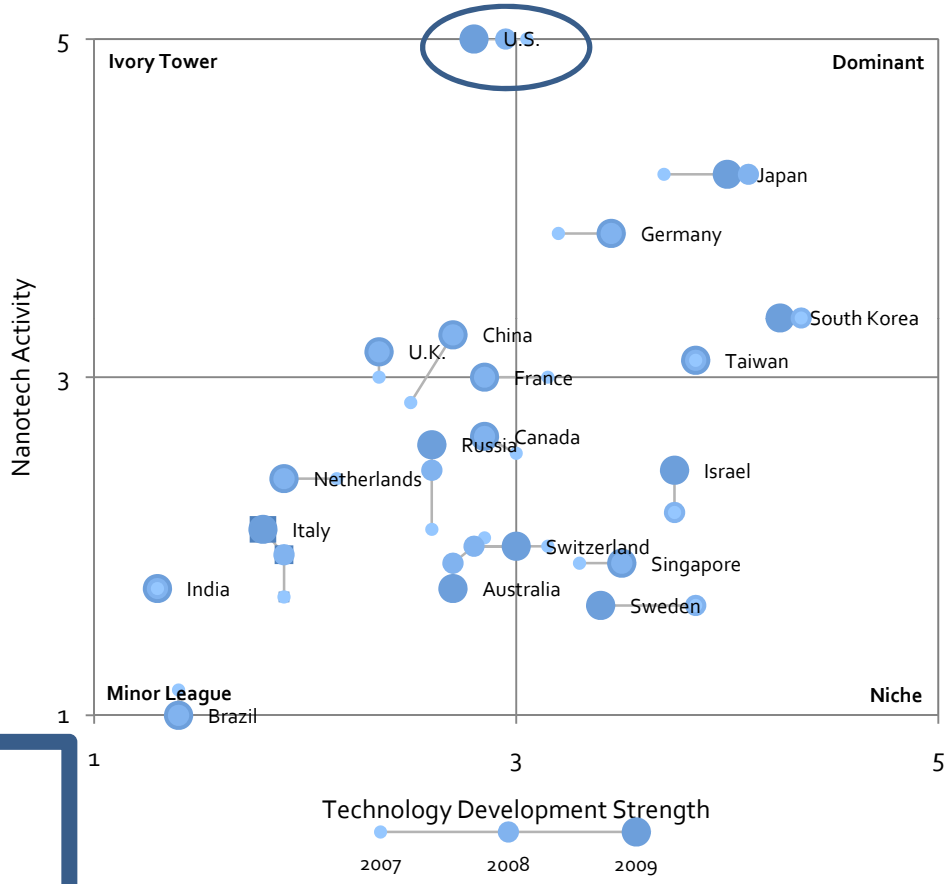
- Russia has drastically improved its government funding, nanotech initiative, nanotech R&D center scores, and publication counts
- However, its economy is still heavily dependent on revenue from oil, and technological innovation has historically taken a back seat
- Russia is home to a surplus of researchers and S&E graduates, but their talents aren't utilized
  - Many of the country's most educated to move to other countries
- As a result, Russia scores fairly poorly on *Technology Development Strength,* maintaining a score of 2.6 in 2009



Source: Lux Research

U.S. crosses into Ivory Tower territory, but it's still a powerhouse

- The U.S. dominates *Nanotech Activity*
  - Strong government and corporate support
  - Vibrant VC and start-up community
  - Leading universities and research institutions
  - Thousands of patents and publications
- BUT, the U.S.'s *Technology Development Strength* is below average, sitting at 2.8
- The economy in the U.S. is very diverse, with substantial service industries, and its HMHT manufacturing output is fairly low
  - Even if individual sectors are among the largest in the world by absolute measure
- The same pattern is evident in normalized R&D spending and T&S workforce – mediocre scores, even with large absolute numbers
- A grave concern: The number of graduates with tertiary S&E degrees per capita is among the lowest
  - Less than half that of Taiwan, South Korea, and Singapore
  - Less than one-third the amount in Russia



Source: Lux Research

So, what are the implications?

- It's not enough to throw billions into pure research
  - The U.S., Germany, and Singapore has shown us that countries need to give support to researchers and companies from lab to marketplace
- Emphasizing nanotech alone to build a tech-focused economy is ill-advised
  - It's now widely acknowledged that nanotech does not constitute an industry of its own
  - It needs to piggyback off products and industries to deliver the most value
- Private sector involvement is essential for effective commercialization
  - The countries that lead nanotech development and commercialization would not have gotten there without significant participation from VCs and industry – corporations in Japan, Germany, and the U.S. spend the same or more on nanotech research than their governments
- Strong intellectual property protection promotes partnerships
  - Governments must devote resources to strengthening their IP protection systems if they want nanotech development to flourish

So, what are the implications?

- Countries and the companies within them should reach across quadrants for synergistic collaborations
  - Germany's **BASF** is an exemplary practitioner, having linked itself to research at **Harvard University** in the U.S. and **Louis Pasteur University** in France and having built R&D facilities in Singapore
  - Korea's **Samsung** has partnered with U.S. start-ups like **Unidym**, **UniPixel**, and **Nanosys**
  - **Cornell University** received a $25 million dollar grant from the **King Abdullah University of Science and Technology** (KAUST) Global Research Partnership program
  - The **China-Korea Nanotechnology Center**, located in Beijing, is focused on bringing scientists from the two countries together for collaborative research

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Summary

- Global funding totaled $18 billion in 2009
  - government: increased 9%
  - corporate: flat
  - VC: fell 42%
- The economic downturn has impacted start-ups, as notable ones have closed
- Government funding and initiatives and corporate support are critical going forward

- The “Big Three“ – U.S., Japan, Germany – are still leaders in nanotech development
- Small countries like Israel and Singapore are thriving by focusing on core competencies
- China and Russia are on the upswing, but they are still no match for the Big Three

Thank you

Samhitha Udupa
Analyst, EMEA
Samhitha.udupa@luxresearchinc.com