

**China drives into the future:**

**Automotive upgrading in a global industry**

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# China has surpassed the US as world's biggest producer and consumer of cars

Country	2001 Production	2013 Production	% Change 2013 over 2012
<b>China</b>	<b>2,334,440</b>	<b>22,116,825</b>	<b>14.8%</b>
United States	11,424,689	11,045,902	6.9%
Japan	9,777,191	9,630,070	-3.1%
Germany	5,691,677	5,718,222	1.2%
South Korea	2,946,329	4,521,429	-0.9%
Thailand	459,418	2,532,577	4.3%
Indonesia	279,187	1,208,211	13.4%
Malaysia	358,785	596,170	4.7%
Taiwan	271,704	338,720	-0.1%

# Warren Buffet buys 10% share in BYD, 2008



# As Bill Gates smiles approvingly



“Chinese cars are nothing but ‘China-crap’”:  
foreigners test Chinese cars for safety



And aren't all those cars just adding to China's terrible air pollution?





# Beijing Auto Show 2014

Foreign cars command most of the attention



# Beijing Auto Show 2014

## Audi rules the roost in China





While Chinese brands lose market share



Foreigners smugly rejoice as China gives ground in the “battle for the middle”

“China’s own automakers have gone from feared to hapless” (*New York Times*, April 9, 2014)

“Chinese-brand cars lose traction at home” (*Financial Times*, March 13, 2014)

# Today's argument

Excessive optimism and fear have given way to unwarranted pessimism and contempt

1. China's auto industry has improved a great deal, and continues to mature
2. Method
  - a. Compare China to other developing countries in Asia
  - b. Make an argument about the importance for industrial development of institutions and the political support behind them
3. Briefly conclude with a review of the very real obstacles to further development in China, especially
  - a. Overcapacity and barriers to market consolidation or exit
  - b. Government (Party) preference for State-owned enterprises

# Chinese accomplishments

1. Massive expansion of sales required impressive improvements in infrastructure, etc.
2. Safety: steady but unheralded improvements, notably Qoros 3 in 2013:  
Top-ranked of 33 models tested in Euro NCAP
3. Emissions and fuel efficiency: rapidly catching up to European standards



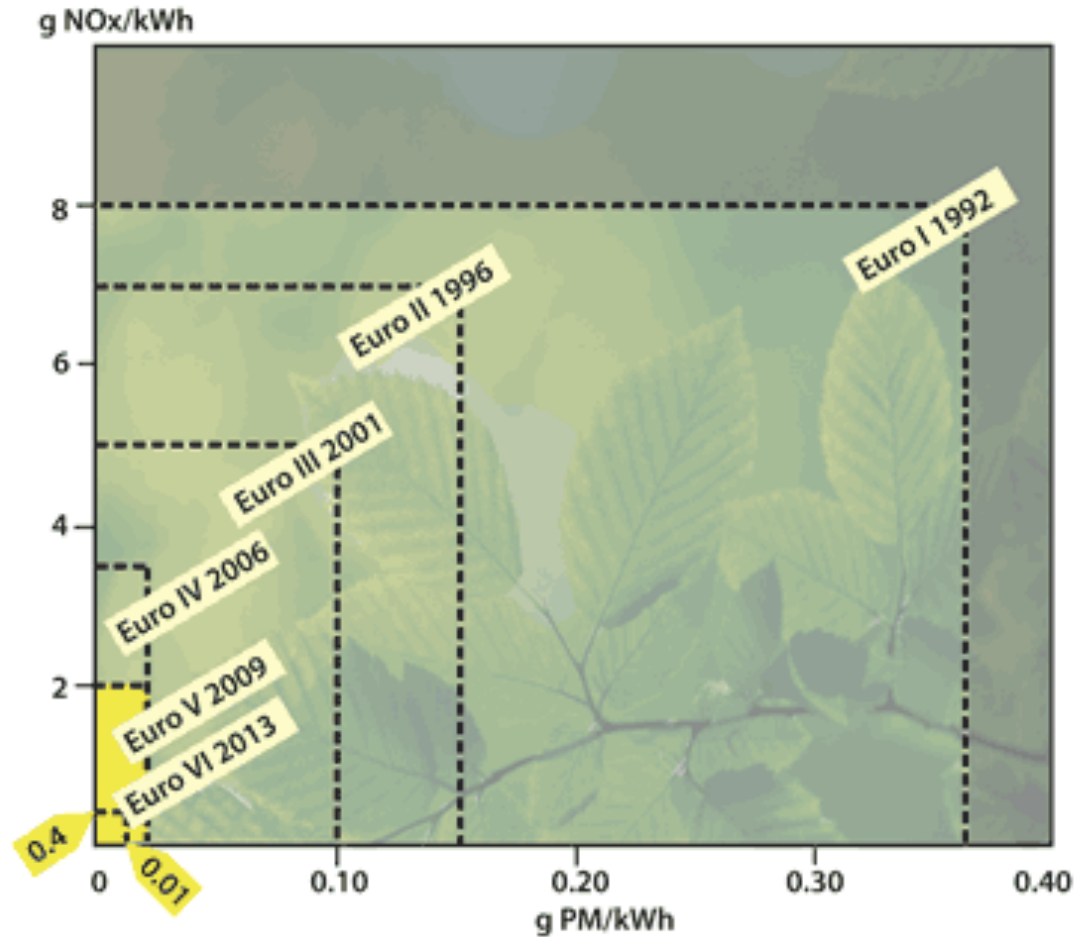
# Qoros 3

Sino-foreign JV (Chery + Israel Corporation)

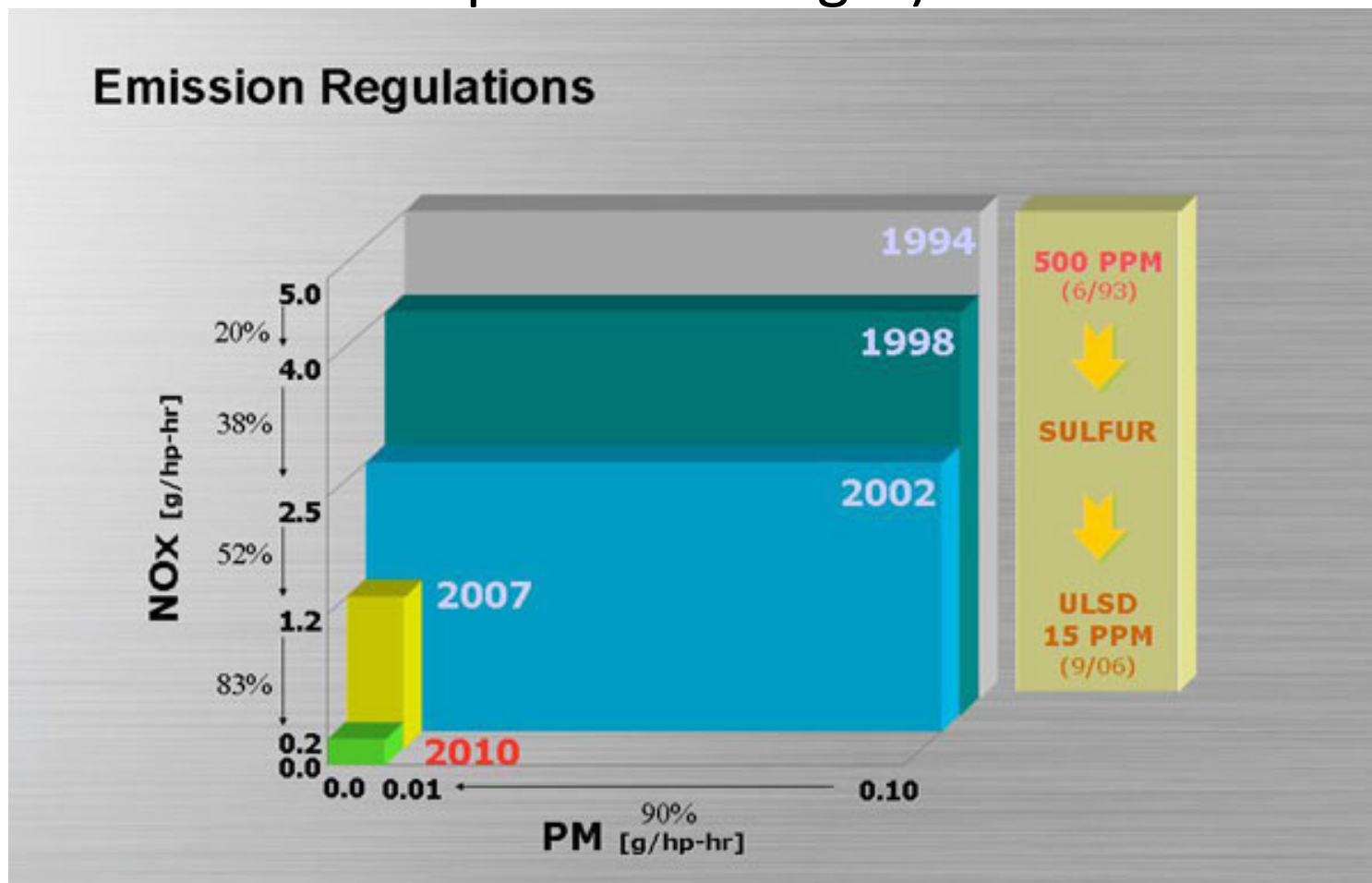
Top ranked of 33 cars tested in 2013 Euro NCAP



# Euro I-VI emission standard evolution (here, heavy-duty vehicles)



# Dramatic improvements in emissions controls (here, European heavy vehicles, but same pattern for light)



# Chinese emissions standards steadily converging with Europe (and ahead of India, SEA)

**Table 1: Emission Standards for New Light-Duty Vehicles\***

Country	95	96	97	98	99	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
EU	E1	Euro 2			Euro 3			Euro 4			Euro 5			Euro 6																	
HK,PRC	Euro 1		Euro 2			Euro 3			Euro 4			Euro 5																			
South Korea	Euro 4											Euro 5																			
PRC <sup>a</sup>	Euro 1					Euro 2			Euro 3			Euro 4																			
PRC <sup>e</sup>	Euro 1				Euro 2			Euro 3			Euro 4			Euro 5																	
Taipei, China	US Tier 1					US Tier 2 Bin 7 <sup>f</sup>																									
Singapore <sup>a</sup>	Euro 1					Euro 2																									
Singapore <sup>b</sup>	Euro 1					Euro 2			Euro 4																						
India <sup>c</sup>	Euro 1					Euro 2			Euro 3																						
India <sup>d</sup>	E1				Euro 2			Euro 3			Euro 4																				
Thailand	Euro 1					Euro 2			Euro 3						Euro 4																
Malaysia	Euro 1			Euro 2						Euro 4																					
Philippines	Euro 1								Euro 2			Euro 4																			
Vietnam	Euro 2											Euro 4					Euro 5														
Indonesia	Euro 2																														
Bangladesh <sup>a</sup>	Euro 2																														
Bangladesh <sup>b</sup>	Euro 1																														
Pakistan	Euro 2 <sup>a</sup>													Euro 2 <sup>b</sup>																	
Sri Lanka	Euro 1																														
Nepal	Euro 1																														

**Notes:**

\*The level of adoption vary by country but most are based on the Euro emission standards

a – gasoline; b – Diesel; c – Entire country; d – Delhi, Mumbai, Kolkata, Chennai, Hyderabad, Bangalore, Lucknow, Kanpur, Agra, Surat, Ahmedabad, Pune and Sholapur; Other cities in India are in Euro 2; e – Beijing [Euro 1 (Jan 1999); Euro 2 (Aug 2002); Euro 3 (2005); Euro 4 (1 Mar 2008); Euro 5 (2012)], Shanghai [Euro 1 (2000); Euro 2 (Mar 2003); Euro 3 (2007); Euro 4 (2010)] and Guangzhou [Euro 1 (Jan 2000); Euro 2 (Jul 2004); Euro 3 (Sep-Oct 2006); Euro 4 (2010)]; f – Equivalent to Euro 4 emissions standards; Vietnam will implement Euro 3 standards for motorcycles by 2017.

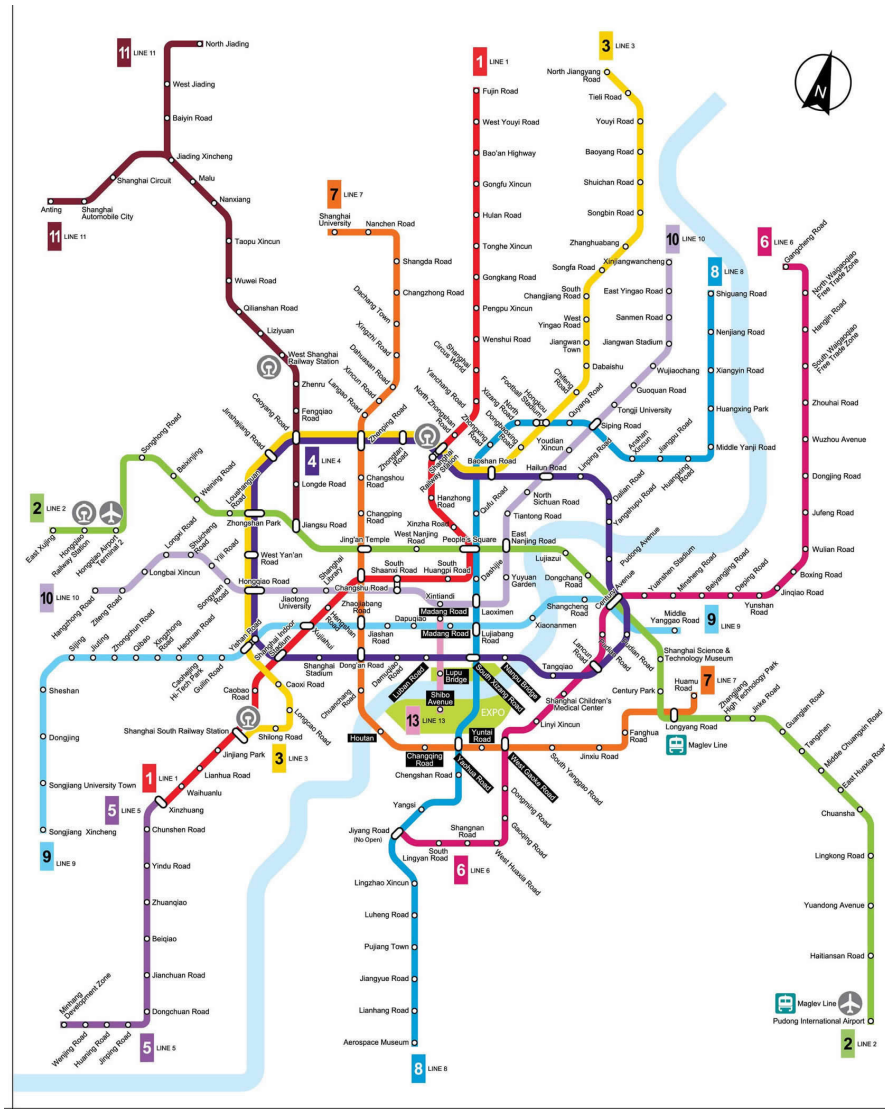




# But what about CO<sub>2</sub>?

- Yes, a very real problem—But government is taking measures:
- Increase in gas prices (once lower than in US, now higher)
- Stiff new fuel efficiency standards (roughly similar to new US standards)
- Promotion of electric vehicles
  - Serious effort so far has met with little success
  - But beginning to adjust strategy

# Not just cars: massive increase in RR, transit Shanghai: 1992 no lines; 2014: 14; 2020: 22 lines



# China in comparative perspective: Why look at auto industrialization?

1. Auto industry was a crucial part of industrialization in Europe, US, Japan: complexity, quality, linkages
2. Shift of demand to developing countries— auto industry now important in poorer countries
3. Globalization and regional and global liberalization of trade, DFI: just controlling the domestic market no longer adequate



# Extensive growth:

mass production of given products

1. Example: Thailand vs. Philippines
2. Tasks not so difficult
3. But requires combination of stability, flexibility
4. Ability to meet needs of MNCs
  - Efficient infrastructure, incl. customs, tax, etc.
  - Stable, relatively quiescent labor relations (cf. India)
5. Measure: assembly of finished vehicles (not perfect, but pretty good, and straightforward)

# Intensive Growth

## 1. More demanding

- Develop new capacities independently
- Management of complex design and production chain--not just assembling cars designed and engineered abroad
- Tacit knowledge (Can't just copy foreigners)
- Requires local capital, at least for basic parts

## 2. No one perfect indicator

- Fine division of labor → can't just look at exports
- Ex: export of Toyota transmissions from Philippines (historical fluke)

# Composite of Six Measures

1. Capacity to conceive, design, engineer, and produce new parts and vehicles
2. R&D and design investment intensity (% of revenues)
3. At least some role for local capital—otherwise few opportunities for learning by doing
4. Creation of independent models and even brands
5. Innovative activities (especially next-generation power plants, auto electronics)
6. Overseas activities (exports; DFI; R&D; design centers)

# Variations in performance: Volume and depth (upgrading)

	Extensive Growth		Intensive growth (upgrading)	
	Low	High	Medium	High
<i>Role of local capital</i>				
<i>Substantial</i>		Malaysia	China Taiwan (mostly niche growth)	Korea
<i>Minor</i>	Philippines	Thailand Indonesia		

# Why the variation?

1. Degree of promotion and protection à la Japan 1950s?
  - Perhaps a bit of truth to this, but
  - All countries started with protection and promotion
  - All gradually forced to liberalize
2. Quality of “developmental state” or “good governance” generally?
  - On many indicators, there’s a strong correspondence
  - But also some anomalies, especially
    - China—auto performance is better than you would predict from quality of general institutions
    - Malaysia—auto performance is worse

# Perceived quality of institutions

Country	Weberian bureaucracy (meritocratic recruitment; rewarding, long-term careers)	Corruption	Physical infrastructure (transport; telecoms; energy)	Specialized research and training services (availability)
Japan	NA (Very high)	7.8 (17 <sup>th</sup> )	6.0 (15 <sup>th</sup> )	5.6 (13 <sup>th</sup> )
Korea	13	5.4 (39 <sup>th</sup> )	6.0 (12 <sup>th</sup> )	3.9 (46 <sup>th</sup> )
<b>China</b>	<b>NA (Fairly high)</b>	<b>3.5 (78<sup>th</sup>)</b>	<b>4.1 (72<sup>nd</sup>)</b>	<b>4.4 (50<sup>th</sup>)</b>
Taiwan	12	5.8 (33 <sup>rd</sup> )	5.1 (37 <sup>th</sup> )	5.2 (21 <sup>st</sup> )
Malaysia	10.5	4.4 (56 <sup>th</sup> )	4.5 (51 <sup>st</sup> )	5.0 (25 <sup>th</sup> )
Thailand	8	3.5 (78 <sup>th</sup> )	4.1 (70 <sup>th</sup> )	4.1 (69 <sup>th</sup> )
Indonesia	NA (Low)	2.8 (110 <sup>th</sup> )	3.4 (95 <sup>th</sup> )	4.4 (52 <sup>nd</sup> )
Philippines	6	2.4 (134 <sup>th</sup> )	2.8 (128 <sup>th</sup> )	4.0 (77 <sup>th</sup> )

# Need to look more specifically at *institutions for industrial upgrading*

- Standards and testing, including quality and safety
- Technology diffusion
- Market information and development
- Education and training
- Links to industry associations
- *Given constraints of time, will look at just two*



# Education and research

- Deeply affected by national governments in funding, testing, allocation across fields, etc.
- Can look at several measures at different levels
  - Years of schooling
  - Rank in international tests such as PISA
  - S&E Journal articles
  - Production of auto-related engineers

# Result: huge gap between NEA and SEA

1. SEA hasn't done so badly in years of schooling, but
2. Much weaker on all other measures (though some improvement from low base in S&T articles)
  - PISA scores
  - S&T articles (incl. top 1%)
  - Auto engineering-related PhDs

# PISA 2012

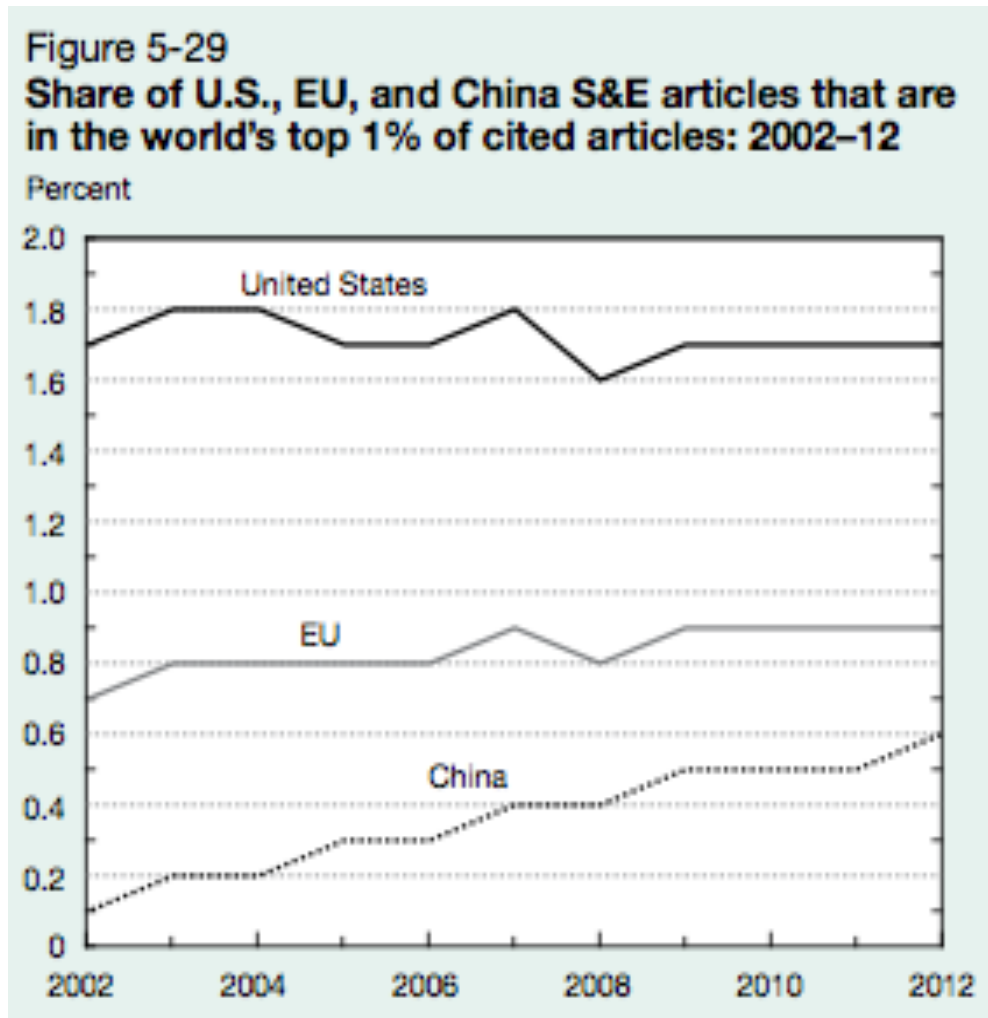
Three clear groups: NEA > OECD > SEA

Country (math rank, out of 65)	Math	Reading	Science	Creative Problem Solving (out of 44)	Happiness at School (out of 65)
Japan [7]	536	538	547	552 (3)	24
Korea [5]	554	536	538	561 (2)	64
<b>China (Shanghai) [1]</b>	<b>613</b>	<b>570</b>	<b>580</b>	<b>536 (6)</b>	<b>28</b>
Taiwan [4]	560	523	523	534 (7)	19
<i>OECD Average (tied with UK for 26<sup>th</sup>)</i>	494	496	501	500	50
Malaysia [52]	421	398	420	422 (39)	6
Thailand [50]	427	441	444	NA	4
Indonesia [64]	375	396	382	NA	1
Philippines [NA]	NA	NA	NA	NA	NA

# S&E Journal Publications (SCI + SSCI)

Country	2001	2011	Annual increase (%)	Share of world total, 2011
Japan	58,082	47,106	-1.7%	5.7%
Korea	11,008	25,593	8.8%	3.1%
<b>China</b>	<b>21,134</b>	<b>89,894</b>	<b>15.6%</b>	<b>10.9%</b>
Taiwan	7,912	14,809	6.5%	1.8%
Malaysia	472	2,092	16%	0.3%
Thailand	727	2,304	12.2%	0.3%
Indonesia	189	270	8.1%	--
Philippines	141	241	10%	--

# NOT just quantity: China's share of top 1% S&E Journal Articles



# High-end engineering skills

1. Best performance among “BRICS” countries: “China's elite institutions produce more than twice as many engineering graduates as the entire U.S. higher educational system” (Carnoy et al. 2013: 322)
2. Auto-engineering PhDs
  - At least 267 in China in 2011 (中国汽车工业年鉴 2012: 398)
  - Few if any in SEA (can't find comprehensive data)
3. Foreign managers (e.g. Bosch Suzhou): Chinese engineers are smart, ambitious, just lack experience
4. Much greater interaction with foreign design and engineering companies than JKT in past, or SEA today

# National Automotive Institutes

(and, especially in China, local institutes, too;  
Cf. Eric Thun, *Changing Lanes in China*, 2006)

1. Wide range of functions
  - a. Standards (international, local)
  - b. Testing and certification
  - c. Technology diffusion, including trouble-shooting
  - d. Especially important for smaller firms that can't rely on parent companies
2. Measures
  - a. Date established
  - b. Staffing



# Huge NEA-SEA Gap; China's CATARC Earliest and Biggest

Country	Institute	Year Established	Staff	Notes
Korea	Korea Automotive Technology Institute (KATECH)	1990	600 (300 each)	Korean-NCAP, 1999- Also KMAP; KOITRA; KIST; SPEC, plus various economic research organizations
	Korea Automobile Testing and Research Institute (KATRI)	1987		
<b>China</b>	<b>China Automotive Technology and Research Center (CATARC)</b>	<b>1985</b>	<b>3,360</b>	<b>Chinese-NCAP, 2006- Also many research institutes at SOEs; National Passenger Car Quality Supervision and Inspection Center; etc.</b>
Taiwan	Automotive Research & Testing Center (ARTC)	1990	300	Also ITRI (technology; economic research); CSIST; MIRDC
Thailand	Thailand Automotive Institute (TAI)	1998	100	A major focus on planning (less work on technology)
Malaysia	Malaysia Automotive Institute (MAI)	2010	20	Includes economic analysis of automotive industry (less work on technology) Also MIROS (2007-) hosts ASEAN NCAP (2011-)
Indonesia	--none--	--	--	
Philippines	--none--	--	--	

# China's CATARC, 2012



# Why the difference in institutions?

1. Political support—but why do leaders invest in long-term, complex institution building?
2. External threats
  - a. Much stronger in NEA, including China
  - b. Taiwan: changes in policy closely follow intensity and character of external threat
3. Natural resources with which to earn foreign exchange
  - a. Much weaker in NEA
  - b. China: Transition from resource rich to poor (cf. 1980s in Shanghai: rectify forex imbalances or else)

# Interesting Anomalies

1. Institutional approach generally accords well with outcomes
2. But **Malaysia** has underperformed
  - Lack of external military and economic threats
  - Natural resources
  - Ethnic politics
3. **Taiwan** has performed about as expected, but with unusual strategy
4. **China**
  - Overall institutional quality is mixed
  - But strong on industrial outreach

# The Chinese anomaly

- In key respect, different from all other cases: initial base of socialist planning
  - Lots of institutions
  - But often ineffective or counterproductive (e.g. Stalinist-planning attempt 中国汽车工业公司 (1964-2007) → CATARC)
- **China's task has been not so much to build institutions as to *scrap and rebuild* them**
- China specialists, keenly aware of the problems but not oriented to comparisons with other developing countries, tend to underestimate the sheer weight, and the degree of improvement

# Chinese challenges

1. Preferences for SOEs (“designated drivers”—Greg Anderson) over higher-performing private or local state companies
  - a. Ideologically and politically loathe to let SOEs lose ground
  - b. But China wants performance, and will reward those that provide it
2. Overcapacity and excessive competition
  - a. Allow bankruptcy, especially of Chinese firms
  - b. Facilitate mergers
  - c. Both hard, especially bankruptcy, even though that would be more efficient
3. Relations with global assemblers—what to do with 50% ownership rule?
4. Ownership vs. locus of activity

Market size + activist legacy → even when foreigners win, they are increasingly relying on Chinese talent



# Outlook

1. No neat solutions either way—incremental, painful reform likely
2. But Chinese government is highly unlikely to allow all Chinese firms to lose out, and control of by far the largest market gives it lots of leverage
3. Steady expansion of already substantial capabilities
4. Exports to advanced countries? Yes, but will take time
  - a. Starting with Eastern and Southern Europe
  - b. US will be last—by the time Chinese firms come, they will have built up strong positions
  - c. But moving to DFI much faster than Japan and Korea did—better at leveraging global capabilities