Innovation Strategies o f the BRICKS: Brazil, Russia, India, China, and Korea Different Strategies, Different Results

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Structure of Presentation

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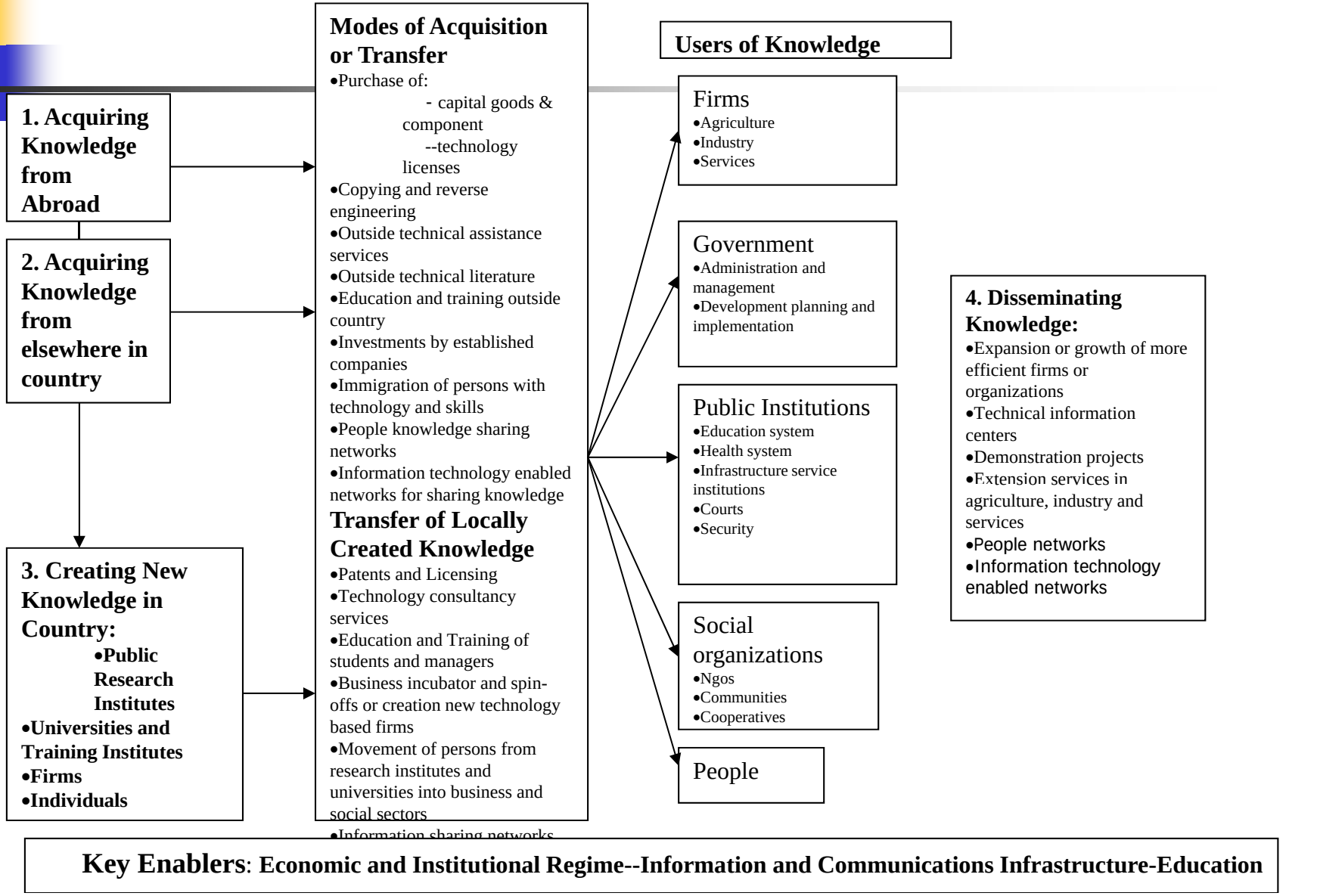
1. Innovation in Developing Countries

- Innovation in developing countries should not be defined just in terms of shifting global frontier technology, but in terms what is new to the country, the sector or the firm.
- Innovation strategy should include policies and mechanisms that affect a country's ability to
  - Draw on global knowledge
  - Create knowledge domestically
  - Disseminate knowledge.
- Such strategy will be affected by
  - the broader economic incentive and institutional regime (what the OECD calls the framework conditions)
  - education and training, and
  - underlying ICT infrastructure

2. Framework

Figure 1: Schematic of the Innovation System in a Developing Country



3. Basic Indicators

GDP (2006)	Brazil	China	India	Korea	Russia
GNI (2006 nominal billion)	893	2,621	909	857	822
GNI as share of Global GNI (%)	1.83	5.38	1.87	1.76	1.69
GNI/capita (2006 nominal)	4,710	2,000	820	17,690	5,770
GNI (trillion 2006 PPP)	1,648	6,119	2,726	1,113	1,817
GNI as share of global GNI(2006 PPP)	2.74	10.16	4.53	2.94	3.02
GNI/capita (2006 PPP)	8,700	4,660	2,460	22,990	12,740
Growth of GDP 1980-1990	2.7	10.2	5.8	9.4	..
1990-2000	2.7	10.6	5.9	5.84	-4.7
2000-2006	3.0	9.8	7.4	4.6	6.4
Merchandise Exports (millions)	137,470	968,936	120,254	325,465	304,520
Merchandise Exports(% of World Total)	1.14	8.02	1.00	2.69	2.52
Commercial Service Exports (millions)	17,946	91,421	75,057	50,385	30,691
Service Exports (% of World Total)	0.65	3.30	2.71	1.82	1.11
Population (millions, 2006)	189	1,312	1,110	48	143
Population as Share of Global Population	2.89	20.07	16.98	0.73	2.19
Life expectancy at birth(2006)	72	72	64	78	66
Human Dev Index 1995	.737	.681	.545	.852	.779
2005	.800	.777	.619	.921	.802
% below $1/day poverty line (2004)	7.5	9.9	33.3	2.0*	2.0**
% below $2/day poverty line (2004)	21.2	34.9	80.0	2.0*	12.1**
Gini Coefficient (2004)	57.0	46.9	36.8	31.6	39.9

4. Characterization of BRICKs

- ***Brazil*** is an upper middle income country which industrialized rapidly in the 60s and 70s under protectionist policies. It got stuck in the 80s and 90s, and remains primarily a commodity exporter with some islands of technological excellence, but a poor record of growth.
- ***China*** is a lower middle income manufacturing powerhouse that has transitioned towards a market economy. It has leveraged its rapid growth by integrating into the global economy and efficiently tapping global knowledge and is now investing heavily in its own innovation capability
- ***India*** is a low income country which was quite autarkic for the first 40 years since independence in 1947. Its recent explosion of growth is being powered by knowledge intensive service exports facilitated by information technology
- ***Korea*** is a recent entrant to high income status which relied on strong export orientation and large domestic conglomerates. It moved rapidly from a labor intensive manufactured exporter to an exporter of medium and high technology products, with little reliance on direct foreign investment
- ***Russia*** is a former technology and military superpower whose economy contracted through a wrenching transition towards a market economy. It finally began to grow based on petroleum related exports, and regained the ranks of middle income country status, but has been losing its manufacturing sector.

Education

		Brazil	China	India	Korea	Russia
Literacy	**1995**	**83.2**	**80.8**	**53.3**	**97.0**	**99.4**
	2006	**88.6**	**90.9**	**61.0**	**97.9**	**99.4**
Av. yrs education	**(2000)**	**4.88**	**6.35**	**5.06**	**10.84**	**10.03**
Basic education		Basically universal but poor quality	Universal but spotty quality	Incomplete and poor quality	Universal and good quality	Universal and good quality
Sec Enrl Ratio	**1980**	**34**	**46**	**30**	**78**	**96**
	2006	**106**	**76**	**54**	**96**	**91**
Ter Enrl Ratio	**1980**	**11**	**2**	**5**	**15**	**46**
	2006	**24**	**22**	**11**	**91**	**70**
Skilled labor training		Relatively under developed because too much focus on remediation	Well developed training market inside and outside firms	Very poorly developed training market, except for high technology firms	Well developed training market including firm training	Not well developed for the needs of a market economy

5. Acquiring Global Knowledge (Trade)

		Brazil	China	India	Korea	Russia
Trade as Share of GDP	1990	16	44	23	59	55
	2006	26.5	73.9	47.6	85.3	55.2
Merchandise Xs % of GDP	1995	6.1	20.4	8.6	24.2	20.5
	2006	12.9	36.6	13.2	36.7	30.9
Manuf. Xs % of Merch. Xs	1995	54	84	74	93	26
	2006	51	92	70	89	17
High tech Xs% manuf Xs	1998 2006	9 12	15 30	5 5	27 32	12 9
Com,.Serv Xs % of GDP	1995	0.8	2.5	1.9	4.3	2.7
	2006	1.7	3.5	8.2	5.7	3.1
Tariff & Non Tariff Barriers	1995	56	20	0	69	52
	2006	71	70	51	66	44
Av. tariffs (2006 in %)	simple	12.1	8.9	16.8	9.1	11.4
	weighted	6.7	4.3	14.5	7.4	9.6

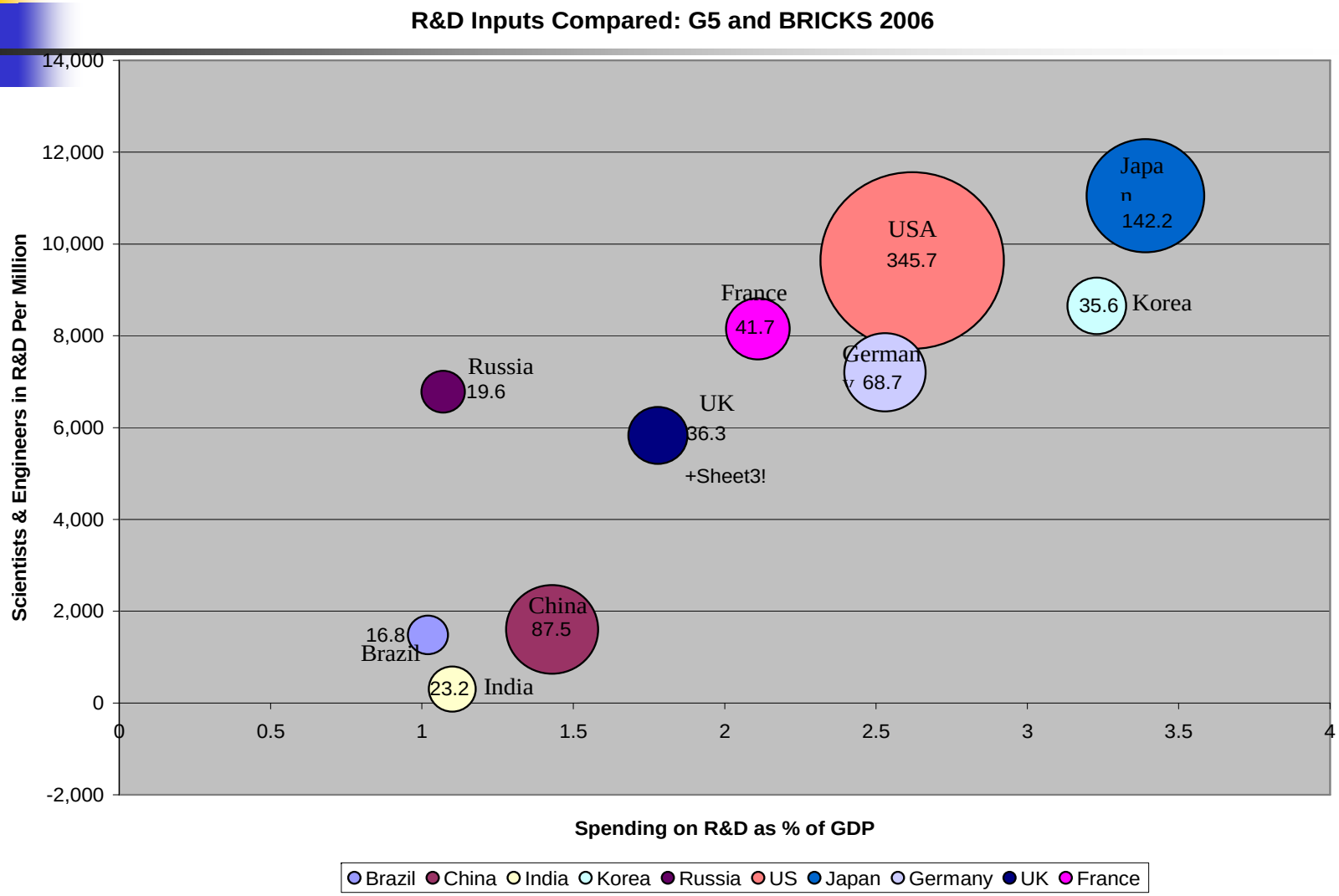
4. Acquiring Global Knowledge (FDI and Technology Licensing)

	Brazil	China	India	Korea	Russia
Foreign Direct Investment	Much FDI has come to produce for protected domestic market rather than for export.	One of main means of rapidly modernizin g China.	Much less DFI overall India has only recently liberalized FDI regime	Very little DFI until aftermath of 1997 Asian financial crisis	Very little FDI except for oil and gas sector
Average Gross FDI/GDP 2000-2005	3.4	3.2	0.9	0.9	1.6
Royalty and license fee payments ($ million 2006)	1,404	5,321	421	4,487	2,002
Royalty and license fee payments/million population (2006)	7.53	4.08	0.40	92.68	14.06

6. Investing in Domestic R&D

Indicator		Brazil	China	India	Korea	Russia
Researchers in R&D	1995	26,578	531.997	145,115	118,640	650,000
	2006	84,971	926,252	117,528	179,812	464,577
Researchers /million popul.	1995	168	445	157	2.636	4,439
	2005	462	714	119	3,723	3,246
R&D spending (US$ blns)	nominal 2006	9.1	37.5	7.7	27.4	8.9
	PPP 2006	16.8	87.5	23.2	35.6	19.6
R&D Spending (% of GDP)	1995	.92	0.55	0.8	2.5	
	2006	1.02	1.43	.85	3.20	1.07
Scientific and technical articles	1995	3,471	9,261	9,591	3.806	19,974
	2006	9,889	41,596	14,608	16,396	14,412
S&T articles/ million population	1995	21.5	7.69	10.3	84.4	134.8
	2005	52.3	31.9	13.4	339.5	100.7
Patents by U.S. Patent Office	Av. 1991-1995	65	56	36	1,322	74
	Av. 2002-2006	135	448	316	4,233	194
Patents per million population	Av.1991-1995	0.40	0.05	0.04	29.2	0.50
	Av. 2002-2006	0.75	0.35	0.30	88.4	1.34

R&D as % GDP and S&E/Million



7. Disseminating Knowledge

- There are very wide productivity differences across firms in any sector in developing countries
- A lot can be gained by raising the average level to the best local use
- More can be gained by raising average best local use to best global use

Wide Divergence in Productivity:

Illustration from Labor Productivity in Brazil

Sector	Max / Min	Adj Max as % of Max	Adj Max / Mean
Food & Beverage	12,900.07	57.22	9.42
Textile	1,169.01	67.31	5.99
Apparel	79,103.56	31.60	9.14
Leather & Footwear	65,897.30	73.33	4.81
Chemicals	9,879.34	61.91	7.83
Machinery & Equipment	315,929.99	37.98	33.83
Electronics	6,658.67	52.03	10.00
Auto-Parts	689.60	64.88	4.17
Furniture	26,916.31	35.06	7.88
Average	**57,682.65**	**53.48**	**10.34**

Comparative Matrix - 1

	Brazil: Commodity Exporter with islands of excellence	**China:** Manufacturing workshop for the world	**India:** Knowledge intensive service exporter	**Korea:** Conglomerate lead export growth	**Russia:** From industrial superpower to natural resource led growth and exports
Performance	Very weak until post 2000 commodity boom	Excellent throughout	Weak until acceleration in late 80's and major jump in 2000	Strong except for 1997 financial crisis period	Very weak until post 1998 recovery and rapid natural resource based growth
EIR Macro	Weak	Very Strong	Strong	Moderate	Variable
EIR Rule of Law	Weak	Weak	Weak	Moderately weak	Very Weak
EIR Stability	Moderate	Very Strong	Moderate	Moderate	Very Strong
Broader Policy Regime	Inward oriented still	Outward oriented	Very Inward until recently	Outward since late 1960s	Inward oriented except for petro xs
Tap global knowledge through trade and technology transfer	Low, relatively closed economy, but some use of tech licensing	Excellent with massive imports of capital goods &components	Very poor except for ICT sector	Excellent with much knowledge from foreign buyers	Poor until last decade when started strong imports

Comparative Matrix - 2

	Brazil:	China:	India:	Korea:	Russia:
Tap global knowledge through FDI inflows	High, but did not get as much externalities as China	Very high and got strong externalities	Very low until quite recently because of restrictions	Very low until after 1997 financial crisis	Low but some inflows more recently into petroleum sector
Human capital	Weak especially in quality, limits on absorption capability	Ramped up quickly, has surpassed Brazil in av. yrs of ed.; US in # of tertiary	Low tertiary enrollment rates, poor quality except for IITs and ITM	Very strong but too rigid. Too academic, not very good at working in groups	Very Strong but lost lots of high level human capital. Also gap in more market oriented disciplines
ICT hardware	Very low	High	Very low	Very high	Low
ICT software	Low except for financial services	High	Very high	Moderate because of language.	High, but not using it well
R&D	Moderate 1.1% in 2006	High 1.43 % of GDP in 2006	Moderate 1.1% of GDP, in 2006	Very high 3.2% of GDP in 2006	Moderate: 1.08% GDP in 2006 from 2% of GDP in 1990
Overall Innovation System	***Active S&T***, but not so successful in growth or welfare. Problems with low human capital and poor economic incentive regime	***DFI dependent Active S&T*** Now moving from imitation to innovation Very successful	***Autarkic*** until early 90s active S&T policy, now both tapping global knowledge and innovating Not as successful	***Autonomous*** Little FDI, but tapping global knowledge, investing in R&D and education	***Isolated*** Had strong R&D sector and high human capital, but poor economic and institutional regime. Lost much high level technical human capital and reduced R&D effort in transition to market economy

8. Lessons-1

- Innovation is key component of economic growth
- Economic and institutional regime are of fundamental importance
- Tapping global knowledge effectively is essential
- Its not just a matter of getting more FDI, but of how it is harnessed

8. Lessons-2

- Critical importance of education
- Importance of Diaspora
- Importance of copying and reverse engineering
- Focus on innovation strategy changes over time
- Importance of strong diffusion efforts

9. Implications for Other Developing Countries

- Priority on tapping global knowledge that already exists
- Priority on domestic diffusion efforts
- Importance of developing R&D capability
  - To monitor and access relevant global knowledge
  - To adapt knowledge to local conditions
  - To create new knowledge
- The importance of the broader economic and institutional regime in providing pressure and incentives to improve performance

Thank You!

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