

Measuring Economic Performance in Transition Economies: Some Lessons from Chinese Experience

By Angus Maddison

Transition countries are former communist command economies which have moved towards capitalist modes of resource allocation, property ownership, international trade and capital movement. In China the transition started in 1978; in Eastern Europe and the successor states of the Soviet Union after 1990. In eastern Europe the objective was to move quickly to a competitive capitalist economy. In Russia, the first phase involved a rapid handover of state assets at knock-down prices to oligarchs ; this has now changed, with significant moves towards state capitalism. In China the goal was to move pragmatically to a system with greater market incentives and gradual attrition of the state sector in favour of more or less competitive capitalist enterprise.

Table 1 lists the performance of 30 transition countries since 1973. Most successor states of the USSR performed very badly in the initial years of system change ; in Eastern Europe the improvement was mediocre . China and Vietnam were very different. They greatly augmented the pace of their growth. Together these countries accounted for 21 per cent of world GDP (measured in 1990 Geary-Khamis dollars) in 2003. China and Vietnam accounted for 15.6 per cent of the world total, the others 5.4 per cent. All of them had formerly used the Soviet material product system (MPS) to measure economic performance, and have now in principle switched to the SNA system.

Difference between MPS and SNA Measures of Economic Growth

The MPS took a narrower view of the scope of economic activity than the SNA. MPS excluded many service activities which were considered ‘non-productive’ (passenger transport, housing, health, education, entertainment, banking, insurance, personal services, government and party administration and the military). Growth was not generally measured by constructing western-style volume indices, but by deflating current values by price indices. The price system and tax-structures were different from those in capitalist countries, and measurement conventions gave incentives to exaggerate quality change when new products were introduced. Abram Bergson (1914-2003) pioneered procedures for re-estimation of Soviet GDP on a basis corresponding approximately to Western conceptions. These corrective procedures were applied to Soviet statistics by a team of CIA Sovietologists in Washington. In New York, Thad Alton and his colleagues did the same for Bulgaria, Czechoslovakia, East Germany, Poland, Romania and Yugoslavia. The CIA attempted to do the same for China, but the quality of their work was much worse than that for the USSR and Eastern Europe (see Maddison, 1998b). This research was financed for intelligence purposes, but was publicly available in annual reports to the US Congress. Maddison (1995, pp.139-146), contained an extensive appraisal of twentieth century growth estimates for eastern Europe, the 15 republics of the USSR, and China).

Some idea of the extent of these CIA adjustments can be seen by comparing the official Soviet estimates of growth of net material product for 1950-1990 (6.1 percent a year), and the CIA measure of GDP growth (3.5 percent a year) for the same period (see Maddison, 1998b, p. 312). CIA measurement activity was abandoned in 1991 and all these countries switched to use of the SNA system in principle. There have been major problems in the transition period which made accurate measurement difficult. One major problem was

the political disintegration of these countries. In 1990, there were only eight communist countries in Europe (except East Germany). 28 successor states have now emerged (15 from the USSR, 5 from Yugoslavia, and 2 from Czechoslovakia).

Table 1 Per Capita GDP Performance & GDP Levels in 30 Transition Economies 1973-2003

	<i>GDP per capita(1990 PPP \$)</i>			<i>Growth rate</i>		<i>GDP million 1990PPP\$</i>
	<i>1973</i>	<i>1990</i>	<i>2003</i>	<i>1973-90</i>	<i>1990-2003</i>	<i>2003</i>
Armenia	6,152	6,066	6,648	-0.80	0.71	19,957
Azerbaijan	4,434	4,639	3,394	0.27	-2.38	26,851
Belarus	5,233	7,184	7,387	1.88	0.21	76,250
Estonia	8,657	10,820	14,340	1.32	2.19	19,370
Georgia	5,932	7,616	4,040	1.48	-4.76	19,034
Kazakhstan	7,625	7,458	7,566	-0.13	0.20	115,647
Kyrgyzstan	3,727	3,602	2,354	-0.20	-3.22	11,814
Latvia	7,846	9,916	9,722	1.39	-0.15	22,583
Lithuania	7,593	8,663	7,986	0.78	-0.62	28,911
Moldova	5,365	6,165	2,581	0.82	-6.48	11,459
Russian Fed.	6,582	7,779	6,323	0.99	-1.58	914,181
Tajikistan	4,095	2,979	1,102	-1.85	-7.36	7,564
Turkmenistan	4,826	3,626	2,489	-1.77	-2.85	11,887
Ukraine	4,924	6,027	3,547	1.20	-4.00	169,088
Uzbekistan	5,097	4,241	3,768	-1.18	-0.81	97,905
Former USSR	6,059	6,890	5,397	0.76	-1.86	1,552,231
Albania	2,273	2,499	3,173	0.56	1.85	11,189
Bulgaria	5,284	5,597	6,278	0.34	0.89	47,641
Czechoslovakia	7,401	8,512	9,728	0.83	1.03	152,411
Czech Rep.	n.a.	8,895	9,905	n.a.	0.83	101,537
Slovakia	n.a.	7,763	9,392	n.a.	1.48	50,873
Hungary	5,596	6,459	7,947	0.85	1.60	79,927
Poland	5,340	5,113	7,674	-0.26	3.17	296,237
Romania	3,477	3,511	3,510	0.06	0.00	78,563
Yugoslavia	4,361	5,720	5,101	1.61	-0.88	120,432
Bosnia	n.a.	3,737	5,927	n.a.	3.61	25,148
Croatia	n.a.	7,351	7,233	n.a.	-0.44	32,523
Macedonia	n.a.	3,792	3,295	n.a.	-1.43	6,706
SerbiaMontenegro*	n.a.	5,180	2,578	n.a.	-5.23	27,903
Slovenia	n.a.	10,160	13,995	n.a.	2.49	28,152
Eastern Europe	4,988	5,440	6,476	0.51	1.35	786,400
China	838	1,871	4,803	4.84	7.52	6,187,983
Vietnam	836	1,025	2,147	0.12	5.85	175,569

* Montenegro split off from Serbia in 2006; Kosovo is likely to do the same by 2008.

Source: www.ggdc.net/Maddison.

Political disintegration involved changes in the mode of governance, big changes in the pattern of production, big changes in income distribution, creation of new currencies and exchange rates, much wider openness to international trade, and in some cases armed conflict.

In Maddison (2003), pp. 91-111 and www.ggdc.net/Maddison, for 1990 onwards I used the GDP growth estimates of the Statistics Division of the Economic Commission for Europe for Albania, Bulgaria, Romania, Slovakia and former Yugoslavia; the OECD national accounts publications for the Czech Republic, Hungary and Poland; IMF *World Economic Outlook* for the successor states of the USSR The website of the Groningen

Growth and Development Centre is a useful crosscheck and contains estimates to 2005. For 1990 onwards, I have not or tried to test the accuracy or comparability these growth measures. In 1996 we had a workshop in Groningen which brought together experts from the CIA and the former USSR. There were a number of papers on the new problems of measurement. Youri Ivanov's authoritative assessment of the problems of Russian Goskomstat was the most useful. Unfortunately, there as no follow-up to this meeting.

For Vietnamese GDP, I used *Key Indicators* of the Asia Development Bank; but have not been able to find anyone who has scrutinised their accuracy. For China, I made a detailed scrutiny of the official estimates and significant adjustments in Maddison, *Chinese Economic Performance in the Long Run*, OECD, Paris (1998a) and, with the help of Professor Harry Wu, have repeated the exercise in a second edition of this book (2007). The latest Maddison-Wu estimates show an average annual GDP growth of 7.85 per cent compared to the official 9.59 per cent for 1978-2003.

Unfortunately, official estimates of Chinese GDP growth are often used by international agencies, by the press and in political discourse, without a cautionary note. Thus in Maddison (2003, p. 231), I cited the IMF *Economic Outlook* of September, 2002 showed Chinese growth for 1970-2001 to be 8.5 per cent a year, whereas my adjusted estimate was 6.5 per cent.

Measuring Levels of Economic Performance

Apart from the problems of growth measurement, it is important to convert national currencies into a common unit in order to measure *levels* of performance. By merging time series for economic growth with cross-country estimates of GDP levels, we can make a coherent set of time-space comparisons. Exchange rates are the simplest option for cross-country comparisons, but are misleading as they are mainly a reflection of the purchasing power of traded items, and in the case of China, undervaluation is official policy. The second option is to use the purchasing power parity converters (PPPs) which have been developed by cooperative research of national statistical offices and international agencies in the past few decades. The expenditure approach, pioneered by OEEC in the 1950s on a bilateral basis, was developed much further by Kravis, Heston and Summers on a multilateral basis in their ICP (International Comparisons Project). We now have reasonably

Table 2. Derivation of 1990 Benchmark Levels of GDP in Geary-Khamis International Dollars, Five East European Countries and the USSR

	<i>GDP in national currency</i>	<i>Implicit PPP Converter</i>	<i>Exchange rate</i>	<i>GDP in million international dollars</i>	<i>GDP in \$ million converted at exchange rate</i>
Czechoslovakia	811 309	6.12	17.95	132 560	45 198
Hungary	1 935 459	28.89	63.206	66 990	30 621
Poland	608 347	3.12	9.5	194 920	64 037
Romania	857 180	10.678	22.43	80 277	38 216
USSR	1 033 222	0.520	1.059	1 987 995	975 658
Yugoslavia	1 113 095	8.565	11.318	129 953	98 347

Source: GDP in national currency from *International Comparison of Gross Domestic Product in Europe 1990*, United Nations Statistical Commission and ECE, Geneva and New York, 1994, p. 61. These comparisons were carried out in cooperation with the national statistical offices, with adjustments to make the coverage of the national accounts conform to the standardised national accounting system used in Western countries. Adjustments were also made to correct for lower quality of goods in the East European countries. The results were multilateralised using the EKS

rather than the Geary–Khamis technique, and the PPP adjusted GDPs were expressed in Austrian schillings. The relative volume indices of GDP were converted to an approximate Geary–Khamis basis using Austrian GDP in international dollars as a bridge, see *op. cit.*, p. 5. This is how the column 4 results were estimated and the implicit PPP in column 3 was derived by dividing column 1 by column 4. Exchange rates were derived from IMF, *International Financial Statistics*, except for the USSR which is from World Bank, *World Tables 1995*. Since 1990, these 6 countries have become 25. Czechoslovakia has split into 2 countries, Yugoslavia into 5, and the USSR into 15. For the 15 successor states of the USSR shown in Table 1, I used the PPP adjusted estimates of B. M. Bolotin who used the ICP approach, see “The Former Soviet Union as Reflected in National Accounts Statistics” in S. Hirsch, *In Search of Answers in the Post-Soviet Era*, MEMO 3, Washington DC, 1992, pp.181-192. For the successor states of Czechoslovakia and Yugoslavia, I assumed that their proportional share in 1990 PPP adjusted GDP was the same as it was in national currency. For Bulgaria, I used the estimate in Penn World Tables, version 5.6 country 118. For Albania, I used a proxy estimate, see Maddison, *Monitoring the World Economy 1820-1992*, OECD, Paris, p. 217. The OECD released a comparison of the level of GDP in 1996 PPP adjusted dollars in 20 of these countries, using the EKS technique of multilateralisation, see *A PPP Comparison for the NIS, 1994, 1995 and 1996*, OECD, February 2000. These OECD estimates for the 15 Soviet successor states (when backcast to 1990) differed significantly from my estimates derived from Bolotin, but I preferred my estimates, because the Geary-Khamis approach is distinctly superior to the EKS method, and because the quality of the data was probably better in the 1990 comparison than in 1996 (see p. 342 of Maddison 2001 for a confrontation of my results with those of OECD, 2000).

comparable estimates of this kind for 70 countries for the benchmark year 1990, and shortcut PWT (Penn World Tables) measures developed by Kravis, Heston and Summers for another 84 countries. The ICP multilateral approach is a highly sophisticated comparative pricing exercise. The most satisfactory variant is the Geary-Khamis approach which gives a weight to countries corresponding to the size of their GDP. Table 2 shows the derivation of the 1990 Geary-Khamis PPP converters I used for the USSR and eastern Europe. For Vietnam I used the ICP PPP estimate in *ESCAP Comparisons of Real Gross Domestic Product and Purchasing Power Parities 1993*, UN, Bangkok, 1999 (see Maddison, 2001, p. 220).

A third PPP option is the ICOP (International Comparison of Output and Productivity) variant developed at the University of Groningen. This involves comparison of value added by industry of origin, rather than by expenditure. This option was used by Ren Rouen to make a bilateral Chinese/USA comparison for 1987 (see *China’s Economic Performance in International Perspective*, OECD, Paris, 1997); I updated his results to 1990, and adjusted them to a Geary-Khamis equivalent (see Maddison, 2007).

It is clear from Table 2 that the PPP valuation of GDP is substantially higher than the exchange rate valuation for all these countries, with a range of 3:1 in Poland to 1.3:1 in Yugoslavia. In China the difference is more extreme, with PPP more than five times higher than the exchange rate. Unfortunately, the need for PPP conversion is frequently neglected, thus Lord Patten, the last British governor of Hong Kong, in a retrospective article in the *International Herald Tribune* on 22 June 2007, suggested that in 1997, the GDP of Hong Kong was 22 per cent of that of China. My estimate, using a PPP converter, shows that Hong Kong’s GDP was less than 4 per cent of China’s GDP in 1997. Frequently, Japan is cited as the world’s second biggest economy, when its GDP is less than half the Chinese. Another example is the exaggeration of China’s role in global warming: it is often suggested that China is

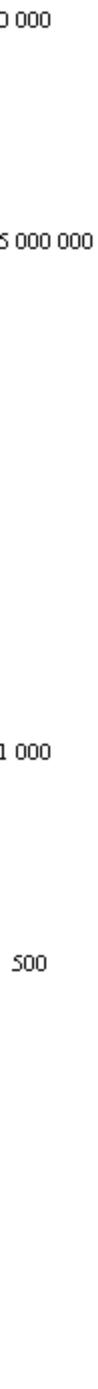
especially delinquent as an emitter of greenhouse gases. In 2003, its carbon emissions were 0.63 tons per thousand dollars of GDP if the official exchange rate is used. This is very much higher than the 0.19 tons per thousand dollars of GDP in the USA. When PPP converters are used the Chinese ratio is lower than that of the USA (0.17 tons per thousand dollars of GDP).

Maddison-Wu Adjustments to the Official Chinese Growth Rate, 1952-2003

A detailed explanation of our remeasurement will be presented in detail in another session of this conference, so I concentrate here on the most significant adjustments and their impact. Figure 1 provides a confrontation of the official and our alternative measure for 1952-2003. It is clear that our GDP measure shows slower

Figure 1
Confrontation of Official and Maddison Estimates of GDP Level, 1952-2003

million 1990 GK \$



growth than the official. Generally, the contours are similar, but there is a kink in our curve in 1996-1999, where we show significantly slower growth than the official estimates, and faster growth thereafter. This suggests that the official estimates for these years have been deliberately smoothed.

What are the official estimates?

The official estimates for 1952-78 are no longer published in the NBS, *China Statistical Yearbook*. In the 1988 Yearbook, pp. 28 and 42 there were two official estimates of aggregate economic performance. The “total product of society” showed average annual growth rate in “comparable prices” of 7.9 per cent for 1952-78. It referred to aggregate gross output of five sectors and involved a good deal of double counting because each of the component sectors had significant inputs from the others. “Net material product” which the Chinese called “national income” showed 6 per cent growth for the same period at “comparable prices”. This was better as it deducted most inputs except “non-material services”. These Soviet style measures have both been jettisoned. There was a joint retrospective exercise by the statistical office and Hitotsubashi University in 1997 which provided western type estimates for 1952-1995. This exercise showed a growth rate of GDP of 4.7 per cent a year for 1952-78, and it is these estimates which I have considered official for these years. The Maddison-Wu revision shows a growth rate of 4.4 for this period.

For 1978-2003, official estimates are published annually in the *China Statistical Yearbook*. They are based on SNA guidelines, but there is still room for improvement. There is a continuous series in current prices, but constant price GDP is shown only as annual percentage changes.

Maddison-Wu Adjustments to the Official Estimates

In my 1998 book on the Chinese economy, I reconstructed GDP by industry of origin. For agriculture, I made my own estimates for 125 crop and livestock items from FAO sources, adjusted for farm and non-farm inputs. I found approximately the same rate of growth as the official estimates for 1952-1990. In view of the close congruence with the official estimates up to 1990, the official estimates were used to update the Maddison estimates from 1991 to 2003.

For industry, Wu’s estimates of gross value added in industry were used. This is a volume index, with detailed time series on physical output and prices from the *China Industrial Economic Statistical Yearbook*. Value added was derived from the official input-output table. Wu’s sample covers 117 products, with detailed time series showing annual movement for 15 branches of manufacturing as well as mining and utilities. He shows a growth rate of 10.1 per cent a year for industry as a whole for 1952-78, compared to the official 11.5 per cent; and 9.75 per cent a year for 1978-2003 compared to the official 11.5 per cent. The aggregate impact on GDP of the Wu measure, is to reduce the 1978-2003 growth rate from 9.59 per cent a year to 8.8 per cent.

For construction, transport, communications, retail trade, wholesale trade and restaurants I accepted the official estimates, but I made a major adjustment to the official measure of the growth of “non-material services”.

These were excluded from the old MPS accounts, and are now included. The difference between my measure and the official for this sector is that I assume zero growth in labour productivity, whereas NBS assumes productivity growth of 5.1 per cent a year from 1978 to 2003 (faster than labour productivity growth in the rest of the service sector).

I assumed zero productivity in these services (banking, insurance, housing services, administration of real estate, social services, health, education, entertainment, personal services, R & D activities, the armed forces, police, government and party organisations), using employment as a proxy measure of output. I did this because this is the recommended procedure in the international standardised *System of National Accounts* (1993, p. 134). In OECD countries, average productivity growth in this sector is virtually zero, see Table 3.

TABLE 3 GDP PER PERSON EMPLOYED IN OECD COUNTRIES, 1973-90
(annual average compound growth rates)

	<i>Agriculture</i>	<i>Industry</i>	<i>Non-material services</i>	<i>Other services</i>
Denmark	6.42	2.24	0.26	1.76
France	5.22	3.01	0.98	1.84
Germany	5.48	1.83	1.00	2.62
Italy	3.35	3.14	0.00	1.12
Netherlands	4.25	1.63	-1.00	1.60
Spain	6.26	4.74	1.35	2.15
Sweden	3.84	2.12	-1.60	1.71
UK	3.77	2.79	0.57	1.25
USA	2.95	1.20	-1.00	0.77
Average	4.62	2.52	0.06	1.65

Source: van Ark (1996), pp. 109-115.

The aggregate impact of my zero productivity assumption for these services, is to reduce the 1978-2003 GDP growth rate by 0.82 percent. Thus the official 9.59 per cent is reduced to 8.8 per cent because of the Wu amendment, and further reduced to 7.98 per cent because of the zero productivity assumption. The final reduction to 7.85 per cent is due to differences in sector structure between my estimates and the official.

Time-space Comparison GDP of Growth and Level Performance 1990-2030

In the 2007 revision of my 1998 book on China, I made projections of Chinese and world economic performance to 2030, compared the past and potential performance of five countries which constitute half of world GDP, and tried to explain why China performed so much better than Russia in 1990-2003.

1) Chinese reformers gave first priority to agriculture. They ended Mao's collectivist follies and offered individual peasant households the opportunity to raise their income by their own efforts. Russian reformers more

or less ignored agriculture as the potential for individual peasant household enterprise had been killed off by Stalin in the 1920s. The Chinese government encouraged small-scale manufacturing production in township and village enterprises. Local officials and party elite got legal opportunities for greatly increasing their income if they ran the enterprises successfully.

Table 4a Comparative GDP Performance of China, Russia, Japan, India and the USA, 1990-2030

	<i>(GDP levels in billion 1990 PPP dollars)</i>					<i>(China as per cent of)</i>			
	<i>Russia</i>	<i>Japan</i>	<i>China</i>	<i>USA</i>	<i>India</i>	<i>Russia</i>	<i>Japan</i>	<i>USA</i>	<i>India</i>
1990	1,151	2,321	2,124	5,803	1,098	185	92	37	199
1991	1,093	2,399	2,264	5,792	1,112	207	94	39	204
1992	935	2,422	2,484	5,985	1,169	266	103	42	212
1993	854	2,428	2,724	6,146	1,238	319	112	44	220
1994	745	2,455	2,997	6,396	1,328	402	122	47	226
1995	715	2,504	3,450	6,558	1,426	483	138	53	242
1996	689	2,590	3,521	6,804	1,537	511	136	52	229
1997	699	2,636	3,707	7,110	1,611	530	141	52	230
1998	662	2,609	3,717	7,407	1,716	561	142	50	217
1999	704	2,605	3,961	7,736	1,820	563	152	51	218
2000	774	2,667	4,319	8,019	1,900	558	162	54	227
2001	814	2,673	4,781	8,079	2,009	587	179	59	238
2002	852	2,664	5,374	8,209	2,080	631	202	65	258
2003	914	2,699	6,188	8,431	2,267	677	229	73	273
2015	1,300	3,116	12,271	11,467	4,665	944	394	107	263
2030	2,017	3,488	22,983	16,662	10,074	1,139	659	138	228

Source: 1990-2003 from www.ggd.net/Maddison; 2015 and 2030 projections derived from Maddison (2007b).

Table 4b Comparative Per Capita GDP Performance of China, Russia, Japan, India and the USA, 1990-2030

	<i>(Per capita GDP levels in 1990 PPP dollars)</i>					<i>(China as per cent of)</i>			
	<i>Russia</i>	<i>Japan</i>	<i>China</i>	<i>USA</i>	<i>India</i>	<i>Russia</i>	<i>Japan</i>	<i>USA</i>	<i>India</i>
1990	7,779	18,789	1,871	23,201	1,309	24	10	8	143
1991	7,373	19,355	1,967	22,849	1,299	27	10	9	151
1992	6,300	19,482	2,132	23,298	1,341	34	11	9	159
1993	5,752	19,478	2,312	23,616	1,390	40	12	10	166
1994	5,020	19,637	2,515	24,279	1,463	50	13	10	172
1995	4,813	19,979	2,863	24,603	1,538	59	14	12	186
1996	4,645	20,616	2,892	25,230	1,630	62	14	11	177
1997	4,717	20,929	3,013	26,052	1,680	64	14	12	179
1998	4,475	20,662	2,993	26,824	1,760	67	14	11	170
1999	4,776	20,594	3,162	27,699	1,835	66	15	11	172
2000	5,277	21,051	3,421	28,403	1,885	65	16	12	181
2001	5,573	21,062	3,759	28,347	1,963	67	18	13	191
2002	5,865	20,969	4,197	28,535	2,012	72	20	15	209
2003	6,323	21,218	4,803	29,037	2,160	76	23	17	222
2015	9,554	24,775	8,807	35,547	3,663	88	36	25	240
2030	16,007	30,072	15,763	45,774	7,089	98	52	34	222

2) China did not disintegrate as the USSR did. The proportion of ethnic minorities is much smaller in China, and in spite of its size, China is a nation state rather than an empire. By patient diplomacy and accepting capitalist

enclaves it grew by reintegrating Hong Kong and Macao as special administrative regions.

3) In the reform era, China benefited substantially from the great number of overseas Chinese. A large part of foreign investment and foreign entrepreneurship has come from Hong Kong, Singapore, Taiwan and Chinese in other parts of the world.

4) China started from a very low level of productivity and income. In 1978, when the reform era began, per capita income was less than 15 per cent of that in the USSR and its degree of industrialisation was much smaller. If the right policies are pursued, backwardness is a favourable position for a nation which wants to achieve rapid catch-up. The very fact that the Chinese income level was so much lower than that of Hong Kong, Japan, Malaysia, South Korea, Singapore and Taiwan made it easier to capture the advantages of backwardness, and make big structural changes. It means that its period of super-growth can stretch further into the future than theirs.

5) Chinese family planning policy reduced the birth rate and changed the population structure in a way that promoted economic growth. In 1978-2003 the proportion of working age rose from 54 to 70 per cent. In China, life expectation has risen. In Russia it has fallen.

6) The leadership was very sensitive to the dangers of hyper-inflation which China had experienced when the KMT were in charge. Instead of destroying private savings as in Russia, they were encouraged and have increased enormously. They are the main reason that it was possible to raise investment to such high levels. Russian shock therapy involved a period of hyper-inflation, large-scale capital flight, currency collapse and default on foreign debt. China remained internationally creditworthy and had negligible capital flight. Its tax incentives attracted large scale foreign investment, which facilitated its technological advance.

7) The state sector was not privatised, but waned by attrition. There are now many wealthy entrepreneurs in China and some have enjoyed official favours, but China did not create super-rich oligarchs by selling off state enterprises at knock-down prices as Russia did. In Forbes Magazine's listing of the world's 100 richest billionaires in 2007, 13 were in Russia, 3 in Hong Kong and none in China.

8) China has made massive strides to integrate into the world economy. It gave high priority to promotion of manufactured exports, setting up tax-free special enterprise zones near the coast. Exports were also facilitated by maintaining an undervalued currency. The rebound in the Russian economy since 1998 has been largely driven by the rise in the price of its exports of oil and natural gas. If Hong Kong is included, China is now the biggest exporter, accounting for nearly 11 per cent of the world total. In 2006, exports were \$1,286 billion including Hong Kong, Germany was second, with \$1,126, USA third with \$1,038, Japan fourth with \$650 billion, Russia was seventh with \$305 billion (see IMF, *International Financial Statistics*, April, 2007).

Table 5 Basic Growth Accounts, China, Japan, South Korea and the USA 1952-2003
(annual average compound growth rates)

	China		Japan	
	1952-78	1978-2003	1952-78	1978-2003
	Macroeconomic Performance			
Population	2.02	1.20	1.10	0.41
GDP	4.39	7.85	7.86	2.53
Per Capita GDP	2.33	6.57	6.69	2.11
Labour Input	2.57	1.89	1.12	0.07
Education	4.49	2.63	1.19	1.12
Quality adjusted labour input	4.87	3.23	1.72	0.63
Non-Residential Capital	7.72	7.73	9.57	5.03
Labour Productivity	1.78	5.85	6.67	2.46
Capital Productivity	-3.09	0.11	-1.56	-2.39
Capital per Person Engaged	5.02	5.73	7.97	4.38
Total Factor Productivity	-1.37	2.95	3.32	0.36
Export Volume	2.6	14.42	13.17	4.09
	United States		South Korea	
	1952-78	1978-2003	1952-78	1978-2003
	Macroeconomic Performance			
Population	1.34	1.07	2.21	1.06
GDP	3.61	2.94	8.63	6.68
Per Capita GDP	2.24	1.85	6.28	5.56
Labour Input	1.12	1.10	3.40	1.75
Education	1.12	1.20	3.13	3.13
Quality adjusted labour input	1.69	1.61	5.02	2.15
Non-Residential Capital	3.39	3.23	10.89	10.24
Labour Productivity	2.47	1.82	5.05	4.85
Capital Productivity	0.22	-0.38	-2.05	-3.22
Capital per Person Engaged	1.85	1.81	8.77	8.05
Total Factor Productivity	1.28	0.69	1.48	0.93
Export Volume	5.19	5.91	26.1	11.2

Source: Population and GDP for all countries from Maddison www.ggd.net/Maddison. Hours, education and capital stock for Japan and USA mainly from Maddison (1995a pp.253-4) updated in Maddison (2007). See also Maddison (1995b , pp.150-156), for details of capital stock estimation for Japan and USA; for these two countries I assumed that non-residential structures had a life of 29 years and machinery and equipment 14 years. Korean labour input and education 1952-78 from Maddison (1998, p. 66). Growth of Korean productive fixed capital stock 1952-78 from van Ark and Timmer (2002, pp.239-240). Korean labour input 1978-2003 from Groningen Growth and Development Centre database; capital stock 1978-2003 from Pyo, Rhee and Ha (2006, p. 108). China employment, education and capital stock from Maddison (1998a) updated. I was unable to break down the Chinese capital stock between non-residential structures and machinery, and assumed an average asset life for the two assets combined of 25 years.. Labour input for Japan, Korea, and the United States refers to total hours worked, and to employment for China. Labour quality is improved by increases in the average level of education of the population of working age; it was assumed that the impact on the quality of labour input was half the rate of growth of education. In calculating total factor productivity growth, labour input was given a weight of 0.65, education .325 and capital 0.35.

Table 6. Characteristics of China's 31 Provinces* in 2005

Pinyin	Population (000s)	Gross Regional Product (million yuan)	GDP Per Capita (yuan)	Wade-Giles
Beijing	15,360	688,631	44,843	Peking
Tianjin	10,430	379,762	35,452	Tientsin
Shanghai	17,780	915,418	51,486	Shanghai
Hebei	68,440	1,009,611	14,752	Hopei
Shanxi	33,520	417,952	12,469	Shansi
Nei Monggol	23,860	389,555	16,327	Inner Mongolia
Liaoning	42,200	800,901	18,979	Liaoning
Jilin	27,150	362,027	13,334	Kirin
Heilongjiang	38,180	551,150	14,436	Heilungkiang
Jiangsu	74,680	1,830,566	24,512	Kiangsu
Zhejiang	48,940	1,343,785	27,458	Chekiang
Anhui	61,140	537,512	8,791	Anhwei
Fujian	35,320	656,895	18,598	Fukien
Jiangxi	43,070	405,676	9,419	Kiangsi
Shandong	92,390	1,851,687	20,042	Shantung
Henan	93,710	1,058,742	11,298	Honan
Hubei	57,070	652,014	11,425	Hupei
Hunan	63,200	651,134	10,303	Hunan
Guangdong	91,850	2,236,654	24,351	Kwangtung
Quangxi	46,550	407,575	8,756	Kwangsi
Hainan	8,260	89,457	10,830	Hainan
Chongqing	27,970	307,049	10,978	Chungking
Sichuan	82,080	738,511	8,997	Szechwan
Guizhou	37,250	197,906	5,313	Kweichow
Yunnan	44,420	347,289	7,818	Yunnan
Tibet	2,760	25,121	9,102	Tibet
Shaanxi	37,180	367,566	9,886	Shensi
Gansu	25,920	193,398	7,461	Kansu
Qinghai	5,430	54,332	10,006	Tsinghai
Ningxia	5,950	60,610	10,187	Ninghsia
Xinjiang	20,080	260,419	12,969	Sinkiang
Total	1,306,280	18,308,480	14,016	Average

- In fact, there are 22 provinces, 5 autonomous regions, and 4 municipalities
Hong Kong and Macao are special administrative regions.

Source: Gross Regional Product in 2005, in current prices, and population on November 1st 2005 from NBS, *China Statistical Yearbook* 2006, pp. 63 and 101.

Table 7
Intensity of Energy Use & Emissions, China, USA, & World 1973-2030

(energy in million metric tons of oil equivalent; carbon emissions

	in million metric tons)			
	1973	1990	2003	2030
	China			
Total Energy Use	472	880	1,409	2,630
tons per capita	0.54	0.78	1.09	1.80
tons/\$1000 GDP	0.64	0.41	0.22	0.11
Carbon Emissions	244	615	1,043	2,100
per capita emissions	0.28	0.52	0.81	1.44
	USA			
Total Energy Use	1,736	1,928	2,281	2,889
tons per capita	8.19	7.71	7.86	7.94
tons/\$1000 GDP	0.49	0.33	0.27	0.17
Carbon Emissions	1,283	1,321	1,562	1,828
per capita emissions	6.05	5.28	5.38	5.02
	World			
Total Energy Use	6,248	8,811	10,760	14,584
tons per capita	1.60	1.68	1.71	1.78
tons/\$1000 GDP	0.39	0.32	0.26	0.15
Carbon Emissions	4,271	5,655	6,736	8,794
per capita emissions	1.09	1.08	1.07	1.08

Source; Primary energy consumption, 1973-2003, from International Energy Agency, *Energy Balances of OECD and Non-OECD Countries*, 2005 edition, OECD, Paris. Carbon emissions, 1990-2003, from International Energy Agency, *CO2 Emissions from Fuel Combustion, 1971-2003*, 2005 edition, 1973 supplied by IEA. I converted CO2 to carbon by dividing by 3.667 (the molecular weight ratio of carbon dioxide to carbon). Projections for 2030 were derived from the “alternative scenario” of IEA for that year in *World Energy Outlook 2006*, pp. 528-9, 534-5 and 552-3. I adjusted the IEA projections for 2030 by the difference between their GDP projections and mine (a downward coefficient of 0.875 for China, and 1.069 upward for the USA). The “alternative scenario” takes account of energy-efficiency policies countries might reasonably be expected to adopt over the projected period; IEA also show a “reference scenario” which provides a “baseline vision” of how energy demand would evolve if governments do nothing beyond their present commitments. GDP in 1990 Geary-Khamis PPP dollars and population from www.ggd.net/Maddison.

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Appendix: An Important Incongruity in the Official Estimates of Employment

Until 1997, NBS had, in addition to the sixteen branch breakdown (pp. 92-93), more aggregative employment estimates for 3 sectors, primary, secondary and tertiary (pp. 87). The figure for total employment was the same in the two tables.

In Yearbooks from 1997 onwards, there is a discrepancy between the two tables. Total employment in the 3 sector table is much bigger than for the 16 sectors. In the 2006 Yearbook (pp. 128 & 130), the 3 sector total for 1990 (end-year) was 647.5 million and the actual total for the 16 sectors was 567.4 million. Hence a discrepancy of 80.1 million. For 2002, the discrepancy had risen to 99.6 million. Instead of explaining the discrepancy, the Yearbooks disguised it by showing the same "total" for the 16 sector breakdown as for the three sector aggregate.

The 16 sector series continues to be published, but the figures stop at the year 2002 in the last four Yearbooks. It would seem that the 3 sector breakdown is derived from the sample population census (see Yue, 2005) and

the sixteen sector breakdown from labour force statistics, but users of the employment figures are entitled to a detailed explanation or reconciliation of the two types of estimate. They are also entitled to know why the 16 sector breakdown has been discontinued. In the present situation, meaningful measurement of labour productivity is no longer possible.