On the value chain and international specialization of China's pharmaceutical industry

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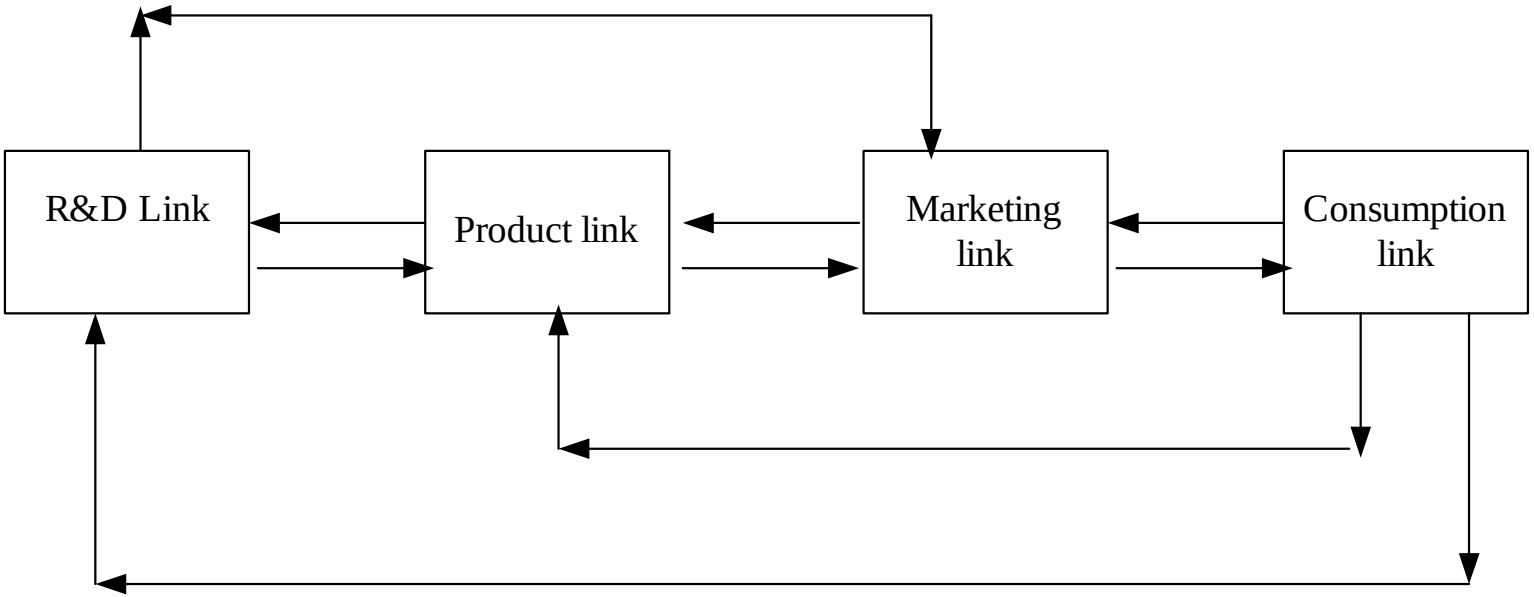
The characteristics of the value chain of pharmaceutical industry

Methodology: Value Chain Analysis

- Value Chain (Port,1985)
- The simple value chain and extended value chain (Kaplinsky,2000)

  Most product's simple value chains are similar, but the extended value chains are different.
- The producer-driven value chain and buyer-driven value chain(Gereffi,1999)

The simple value chain is similar in all kinds of medical final products, also similar with IT



PS：we get all the value chain charts from the discussion with the medical enterprises.

proprietary medicine and non-proprietary medicine

- Proprietary medicine

  No one knows the technology of proprietary medicine except the patent owner

  The R&D of a new proprietary medicine may need 10-15 years, 1 billion dollars

  Usually good and stable efficacy

  80-90 percent of the world medical market

- Non-proprietary medicine

  The imitation of the proprietary medicine after the proprietary medicine's time limit of patent protection

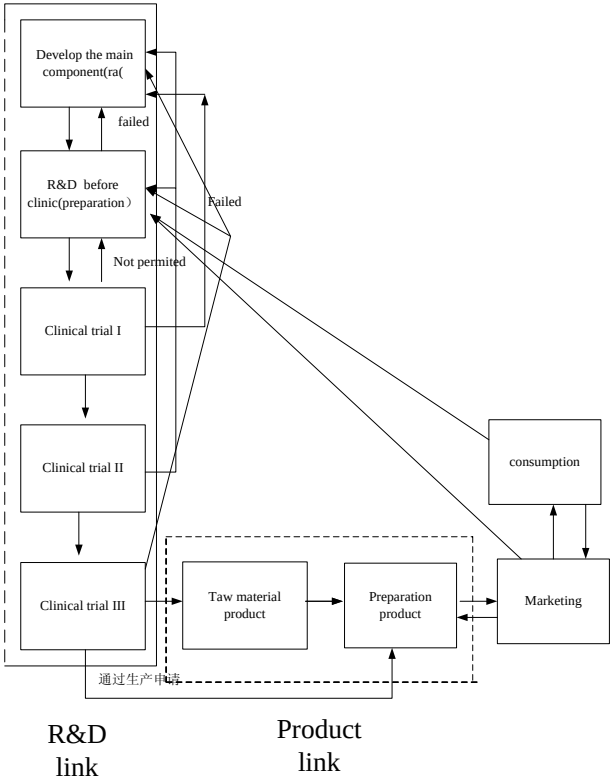
  R&D is more simple than proprietary medicine

  the efficacy is a little week

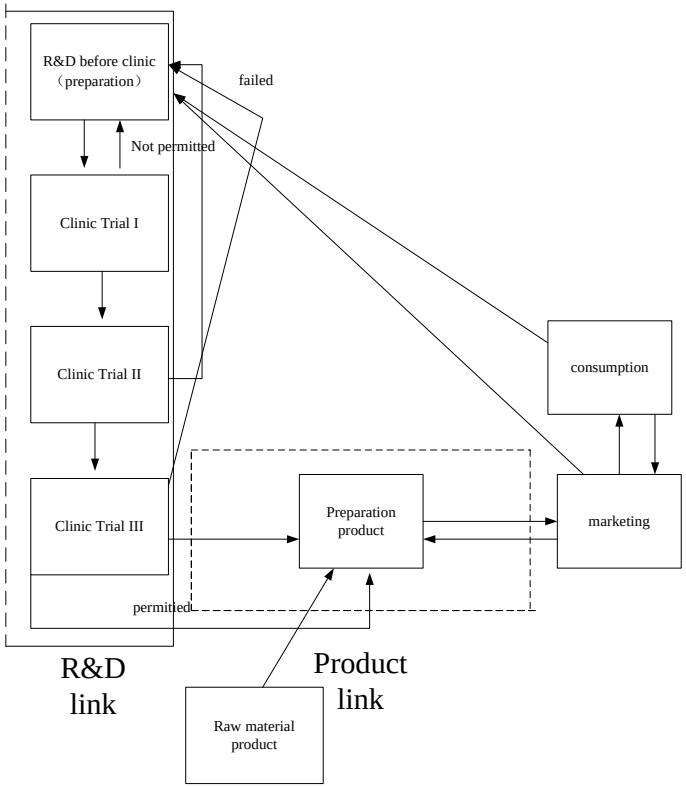
  10-20 percent of the world medical market

Value Chain Analysis of the proprietary medicine and non-proprietary medicine

Proprietary medicine



Non-proprietary medicine



Value chain Analysis of the proprietary medicine and non-proprietary medicine

- Three special characteristics:
- If No R&D, No raw medicine production and preparation production in proprietary medicine
- Low R&D in the preparation production in non-proprietary medicine
- Even no R&D, raw medicine product can be produced in non-proprietary medicine

Producer-driven value chain and buyer-driven value chain

- Gereffi(1999)

	Producer-driven value chain	buyer-driven value chain
Drivers of global value chain	Industrial capital	Commodity capital
core competency	R&D or Production	marketing
Barriers to entry	Economies of Scale	Economies of Scope
Typical industries	Computers	Toys
Ownership of Manufacturing Firms	Transnational Firms	Local Firms
Main net work links	Investment-based	Trade-based

VCA of the medical industry

Conclusion:

The proprietary medical industry is obviously producer-driven.

The non-proprietary medicine is both producer-driven and buyer-driven(the buyer-driven link: raw medicine product).

The core link of the total medical industry is the front of the R&D link.

The situation of the international specialization of pharmaceutical industry in the world

Most international trade is between developed countries.

	Proportion of Export (2008)	Proportion of Import (2008)
Developed Countries	90.55%	80.15%
EU15 and Switzerland	80.02%	56.85%
USA	7.98%	15.73%
Canada	1.53%	2.84%
Australia	0.86%	1.84%
Japan	0.89%	2.90%
Other Countries:	9.45%	19.85%
India	1.51%	0.53%
China	1.81%	1.45%

PS: the original data is from UN commodity trade statistics.

The situation of international specialization of pharmaceutical industry in the world

- Why developed countries dominate the international specialization?
- The high R&D intensity
- The high technical criteria(such as FDA)
- Big transnational firms
- Few labor-oriented links in the value chain

The situation of the international specialization of pharmaceutical industry in the world

- High horizontal intra-industry trade degree
- Methodology:

  Grubel&Lloyd(1975):GL INDEX

$$GL_j = \frac{\sum_{i=1}^{N}(X_i + M_i) - \sum_{i=1}^{N}(|X_i - M_i|)}{\sum_{i=1}^{N}(X_i + M_i)} \times 100$$

X_i, export of the i product; M_i, import of the i product

The situation of the international specialization of pharmaceutical industry in the world

	Year	GL index of the total medical trade	GL index of the raw medicine	GL index of the preparation trade
France	2004	73.25	48.98	76.78
	2008	78.54	60.77	80.19
Germany	2004	59.2	57.8	59.33
	2008	61.34	40.41	63.08
Switzerland	2004	66.87	46.66	70.03
	2008	57.26	51.7	57.82
England	2004	77.97	57.48	79.36
	2008	75.8	80.06	75.6
USA	2004	69.58	77.66	67.96
	2008	63	65.91	62.51

The characters of the international specialization of pharmaceutical industry In the world

- High horizontal intra-industry trade degree
- Methodology: Fukao & Ishido（2004）

$$\frac{Min(M_{kk'j}, M_{k'kj})}{Max(M_{kk'j}, M_{k'kj})} \leq 0.1;$$ unilateral trade;

$$0.1 \leq \frac{Min(M_{kk'j}, M_{k'kj})}{Max(M_{kk'j}, M_{k'kj})} \leq 10 \text{且} 0.8 \leq \frac{P_{kk'j}}{P_{k'kj}} \leq 1.25 \text{时，}$$ horizontal inter-industry trade;

$$0.1 \leq \frac{Min(M_{kk'j}, M_{k'kj})}{Max(M_{kk'j}, M_{k'kj})} \leq 10 \text{且} 0.8 \leq \frac{P_{kk'j}}{P_{k'kj}} \geq 1.25 \text{或} \frac{P_{kk'j}}{P_{k'kj}} \leq 0.8 \text{时，}$$ vertical inter-industry trade

$M_{kk'j}$:country k export to country k' in commodity j, $P_{kk'j}$: the price, 0.1、1.25 and 0.8 is threshold

The situation of the international specialization of pharmaceutical industry in the world

	proportion of unilateral trade(2008)	proportion of vertical intra-industry trade(2008)	proportion of horizontal intra-industry trade(2008)
Germany and USA	20.89%	30.11%	49.01%
France and USA	16.28%	10.97%	72.75%

The situation of the international specialization of pharmaceutical industry in the world

- In most medical industry, intermediate products trade is few, mostly concentrated in raw medicine

	preparation trade(2008) (final product)	Raw medicine trade(2008) (intermediate product)
proportion of export	90.40%	9.60%
proportion of import	90.59%	9.41%

Empirical research on the position of China's pharmaceutical industry in the global value chain

- Low concentration degree in China medicine industry
- From PHRMA, we know 30 biggest firms in USA has 77 percent shares in the USA market.
- But All the big firms in China only has 20 percent shares in the market.

Empirical research on the position of China's pharmaceutical industry in the global value chain

- Lower R&D intensity

	China	USA	Japan	Germany	France	England	Korea
	2007	2006	2006	2006	2006	2006	2006
Manufacture	3.5	10.2	11	7.6	9.9	7	9.3
High-tech industry	6	39.8	28.9	21.5	31.9	26.6	21.3
medical industry	4.7	46.2	37.1	23.9	33.4	42.3	6.3

PS: the data is collected from ministry of Science and Technology of the People's Republic of China.

Empirical research on the position of China's pharmaceutical industry in the global value chain

- We can assume that in the production link, China may has comparative advantage in the non- proprietary medicine raw medicine link.
- Empirical Research methodology:

  we also use TC index (trade special coefficient), GL index and Horizontal and Vertical intra-industry trade degree.

Empirical research on the position of China's pharmaceutical industry in the global value chain

Year	TC index of China	TC index of India
2004	0.19	0.55
2005	0.17	0.5
2006	0.17	0.49
2007	0.15	0.47
2008	0.13	0.52

Empirical research on the position of China's pharmaceutical industry in the global value chain

Year	Intermediate products		Preparation products	
	TC index of China	TC index of India	TC index of China	TC index of India
2004	0.73	-0.01	-0.56	0.76
2005	0.74	-0.11	-0.56	0.74
2006	0.78	-0.15	-0.58	0.70
2007	0.79	-0.13	-0.58	0.70
2008	0.80	-0.06	-0.60	0.71

Empirical research on the position of China's pharmaceutical industry in the global value chain

Year	GL index of China	GL index of India
2004	34.45	38.26
2005	33.76	39.1
2006	31.16	40.04
2007	30.62	42.4
2008	29.32	40.11

Empirical research on the position of China's pharmaceutical industry in the global value chain

		Unilateral trade(import)	Unliateral trade(export)	VIIT	HIIT
China	Total medical trade	34.03%	53.12%	12.85%	0.00%
	Preparation trade	87.95%	0.00%	12.05%	0.00%
	raw medicine trade	0.00%	85.92%	14.08%	0.00%
India	Total medical trade	8.96%	0.00%	89.86%	1.18%
	Preparation trade	0.00%	0.00%	95.19%	4.81%
	raw medicine trade	0.00%	12.74%	87.26%	0.00%

Empirical research on the position of China's pharmaceutical industry in the global value chain

- Now we can see, China TC index in preparation trade is obviously negative. But TC index in raw medicine trade is obviously positive.
- India is on the contrary.
- GL index and the proportion of VIIT and HIIT also explain this fact.
- So we can conclude: China is mainly on the raw medicine link in the global value chain in the industry.
- From VCA, The added value of the raw medicine link is lowest in the links.
- So China lies in the bottom of the smile curve.

Empirical research on the position of China’s pharmaceutical industry in the global value chain

- raw medicine production link is a link of the value chain of final production. So the international specialization of raw medicine and Preparation can be seen as a type of vertical specialization.

China’s vertical specialization degree in medical industry

- Methodology: VS index.
- The difference of processing import and general import
- Chen Xikang and Zhu Kunfu(2008) use a new method which is called input-Holding-Output Model of the Non-Competitive Imports Type Capturing China’s Processing Exports to solve this problem.
- But their origin IO table has no medical industry.
- With their help, we constructed the input-holding –output table which include medical industry. You can see the method in the paper.

China’s vertical specialization degree in medical industry

	DVS			TVS		
	G	P	T	G	P	T
Medical industry	**0.0042**	**0.5253**	**0.2732**	**0.0129**	**0.5937**	**0.3816**
Manufacture of Metal Products	0.0034	0.7382	0.2323	0.0189	0.776	0.4589
Manufacture of Transport Equipment	0.0066	0.6905	0.3257	0.0214	0.7552	0.5369
Manufacture of Communication Equipment, Computers and Other Electronic Equipment	0.0079	0.7239	0.3443	0.0227	0.7723	0.5189

The domestic value-added rate in some industry

	AV			BV		
	G	P	T	G	P	T
Medical industry	**0.4148**	**0.2397**	**0.2827**	**0.9871**	**0.4063**	**0.6184**
Manufacture of Metal Products	0.2665	0.1296	0.1678	0.9811	0.224	0.5411
Manufacture of Transport Equipment	0.288	0.1436	0.1815	0.9786	0.2448	0.4631
Manufacture of Communication Equipment, Computers and Other Electronic Equipment	**0.2655**	**0.1151**	**0.1749**	**0.9799**	**0.1581**	**0.379**

Empirical research on the position of China's pharmaceutical industry in the global value chain

- The VS index is lower than most industries, especially the IT.
- The domestic value-added rate is higher than most industries, such as IT.
- China lies both in the bottom of the medical industry and the IT industry.

Empirical research on the position of China's pharmaceutical industry in the global value chain

- In medical industry, the front link is in China. But in IT industry, the back-end link is in China.
- So fewer Processing trade in medical industry and processing trade is dominated by domestic enterprises.
- The raw medicine product is more like capital-oriented link

CRO in China

- The CRO (contract research organization) in China
- R&D link has the higher modularization degree in the clinic trial.
- So we think the CRO in China is mostly in the clinic trial link.

CRO in China

Year	Clinic trial number by TNE	TNE number	Value-added by TNE (100 MRMB)
2005	79	707	364.05
2006	123	739	432.9
2007	137	797	570.12

CRO in China

Year	TNE in China				TNE in total Wrold			
	Phase I	Phase II	Phase III	Phase IV	Phase I	Phase II	Phase III	Phase IV
2005	2.56%	16.67%	55.13%	25.64%	8.66%	32.14%	38.78%	20.41%
2006	5.79%	9.92%	69.42%	14.88%	15.04%	32.52%	34.68%	17.76%
2007	5.69%	17.89%	55.28%	21.14%	20.46%	35.33%	27.59%	16.61%
2008	8.21%	9.70%	53.73%	28.36%	25.07%	32.77%	25.94%	16.22%

China’s different position in the three sub industry

- NBSC divided the medical industry into 3 sub industry: chemical medicine(about 60%), biological products(about 10%) and TMC(about 30%).
- China’s position in the three sub industry is a little different.

China’s different position in the three sub industry

- From our calculation, In the chemical medicine industry, China’s position in the global value chain is almost the same as the total industry.
- In the biological products industry, China’s position in the global value chain is more like “raw material” than “raw medicine”.

China’s different position in the three sub industry

- TMC is only used in the Chinese economic circles, almost no share in the main medical market——Europe and North America.
- China comparative advantage is more on the material production than on the patent medicine production in the Chinese medical industry.
- Japan is on the higher level in the small global value chain in the Chinese economic circles.

The empirical research of the bilateral trade between China and Japan in the Chinese medicine industry

	Chinese medical materials (including herbal pieces)	Chinese patent medicines	health products	total Chinese medicine
HIIT	0	0	0	0
VIIT	0	89.22%	0	29.94%
unilateral trade	100	10.78%	100%	70.06%

Summary

- The value chain is producer-driven and the R&D link is the core link in the medical industry.
- The international specialization is more like horizontal intra-industry specialization between developed countries.
- But in the production link of non-proprietary medicine, only the raw medicine link is more like buyer-driven.
- Chinese medical industry lies in the raw medicine production, which is the bottom of the smile curve. But this vertical specialization is different from that in the IT industry.
- From our calculation, the VS index in medical industry is lower than that in the IT industry. It means, the bottom of smile curve in medical industry is higher than that in IT industry.
- In the R&D link, The clinic trial link need not only scientists ,but many many “brave” patients. This is China’s advantage. So TNCs like to use CRO mode in the vertical specialization of the R&D link.


Thanks!