

Innovation Opportunity in China's Industrial Base under FDI Framework

Prof. Xiangdong Chen

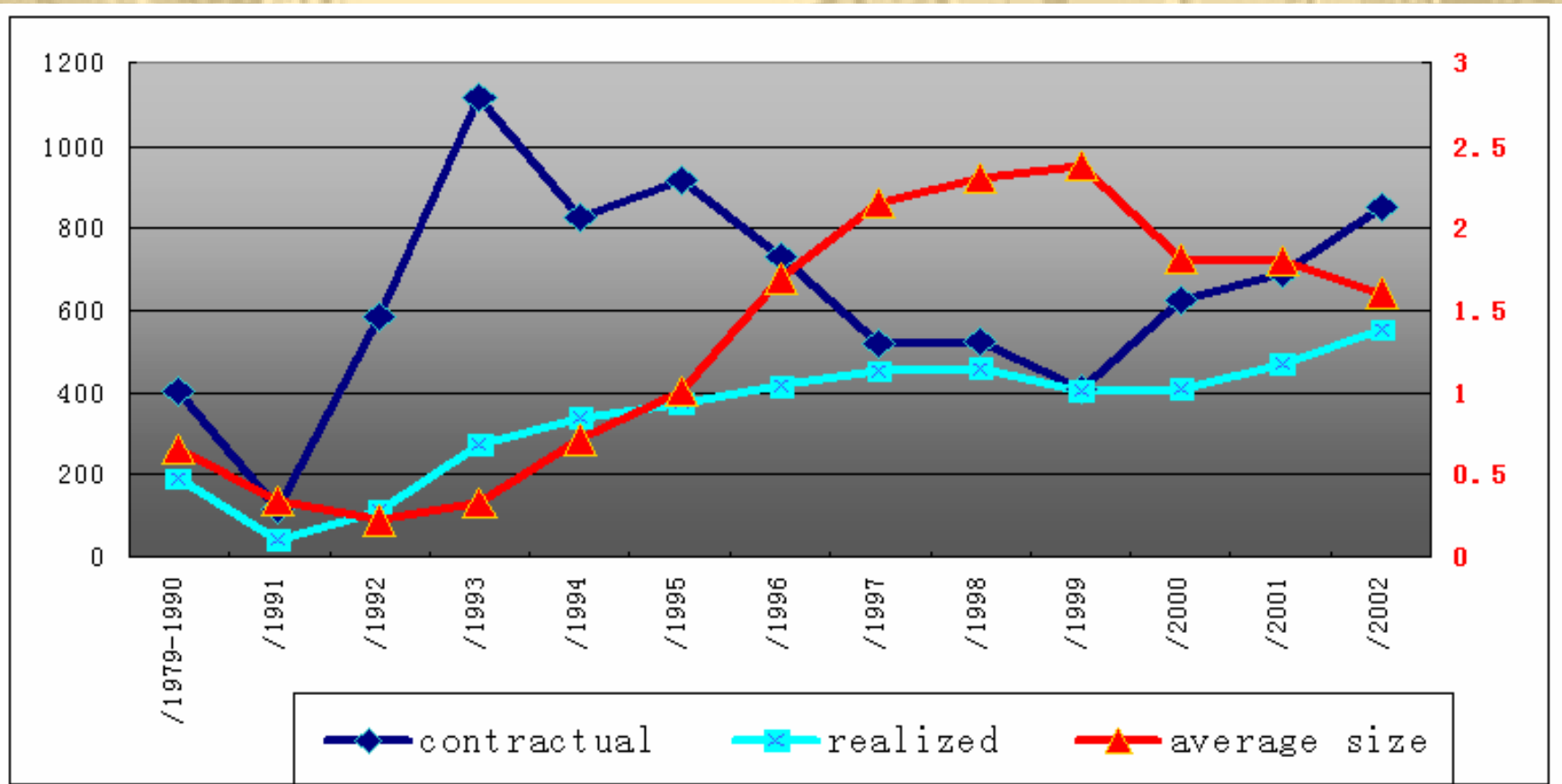
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Foreign Direct Investment in China

(volume: billion USD; **size: million USD**, 1979 - 2002)

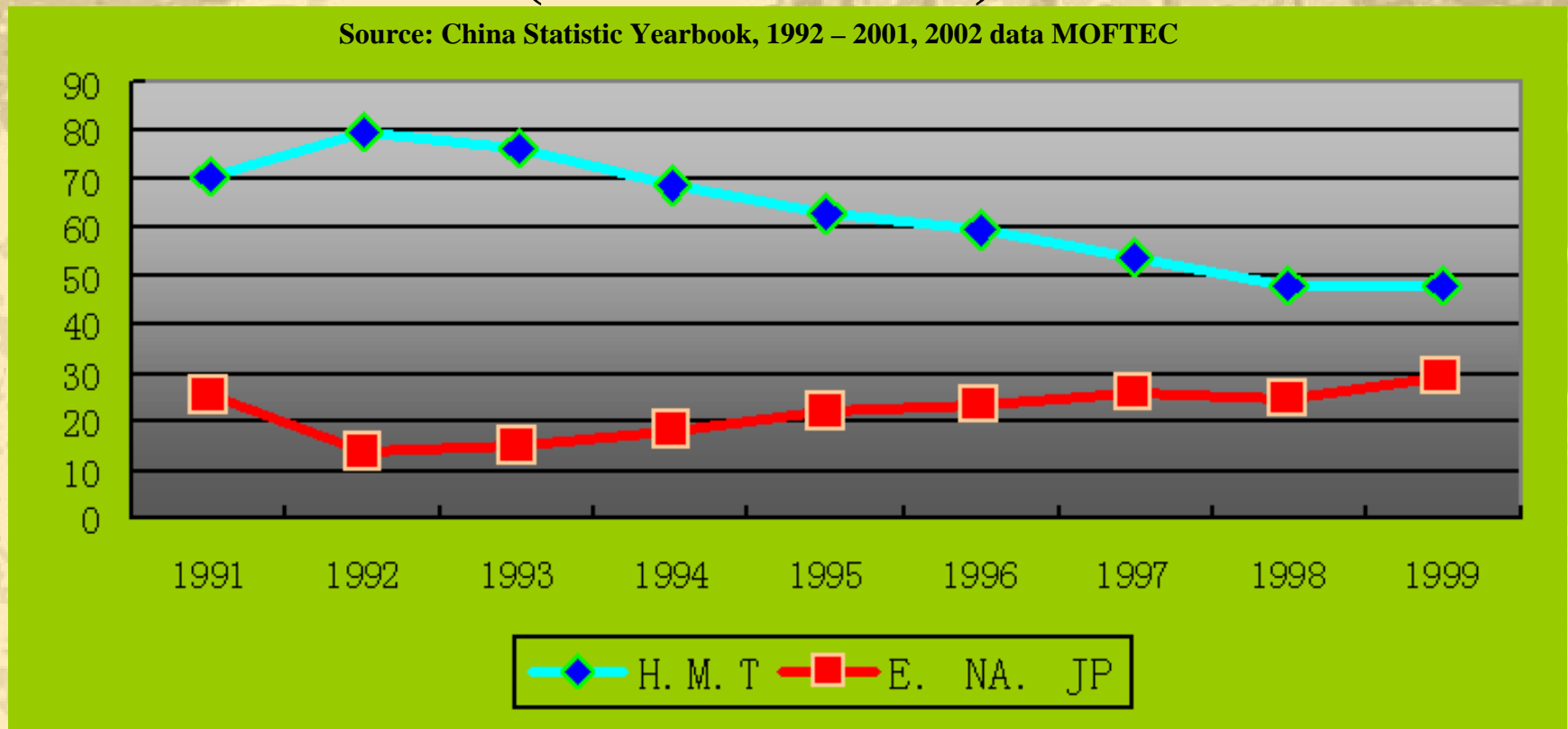


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Source: China Statistical Yearbook, 1992 - 2001, 2002 data MOFTEC website 2003

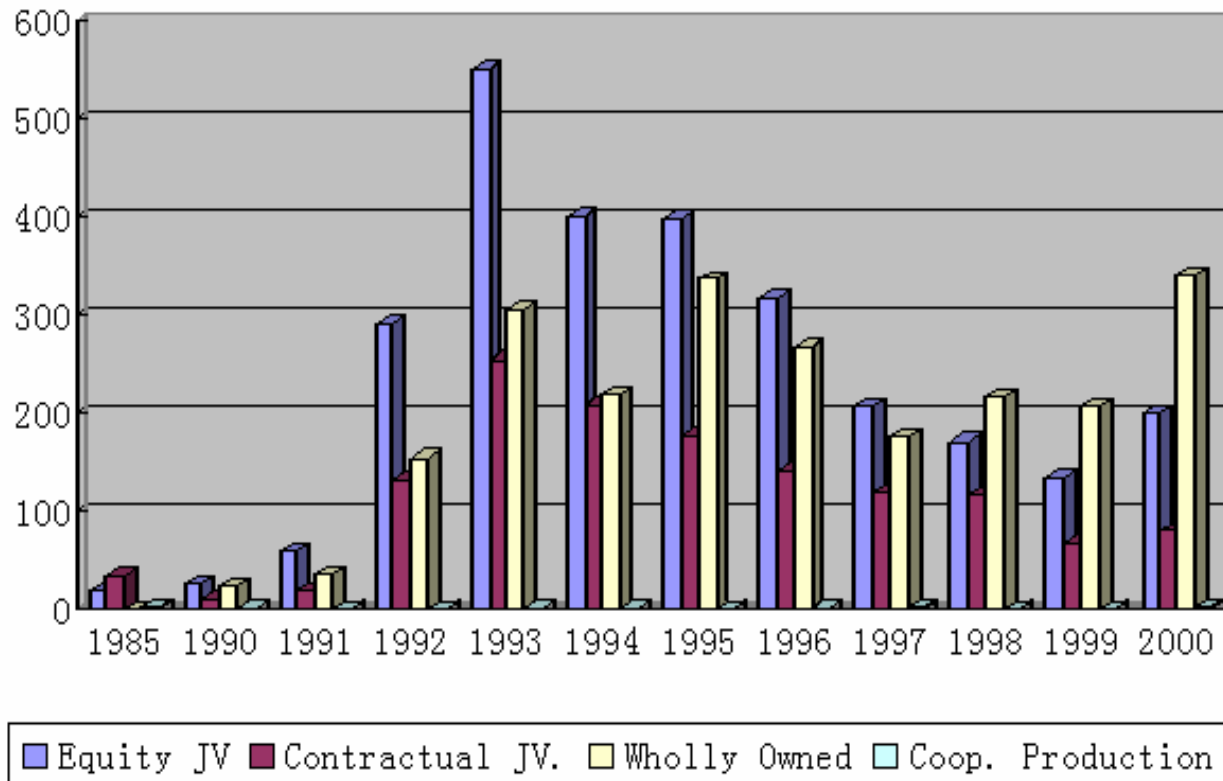
Investment source: H.M.T. vs E. NA. JP (billion USD)

Source: China Statistic Yearbook, 1992 – 2001, 2002 data MOFTEC



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Development of FDI in China



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FDI: development of concept

- ⌘ Foreign Direct Investment:
 - ⌘ “Investment that bring (foreign) investors effective **control** and is accompanied with **managerial participation**” (Robock and Simmonds, 1983)

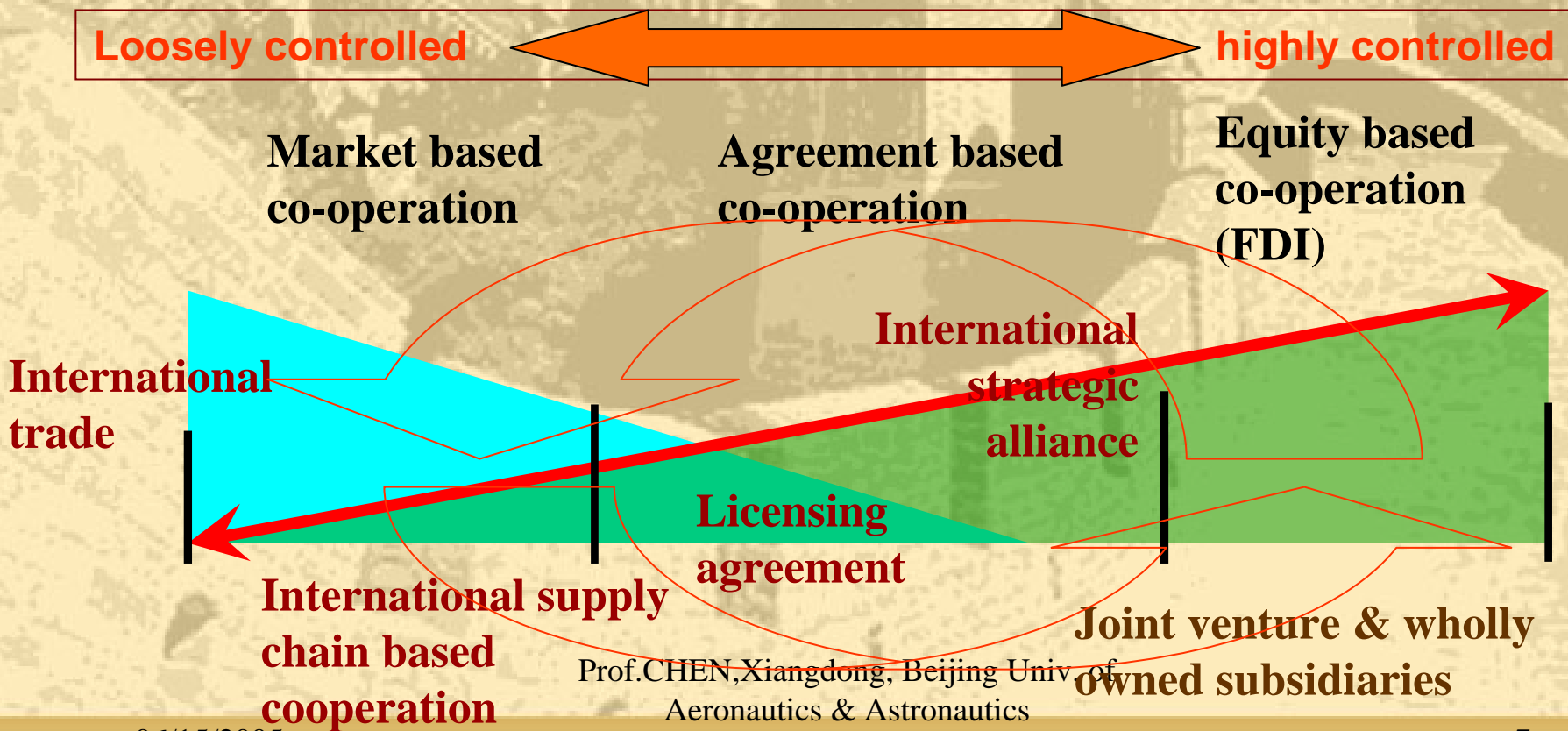
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Major Motives of FDI by Multinational Companies

- ⌘ Narula and Dunning (2000):
 - ⌘ To seek nature resource;
 - ⌘ To seek new market;
 - ⌘ **To restructure existing production through rationalization;**
 - ⌘ **To seek strategically created assets.**

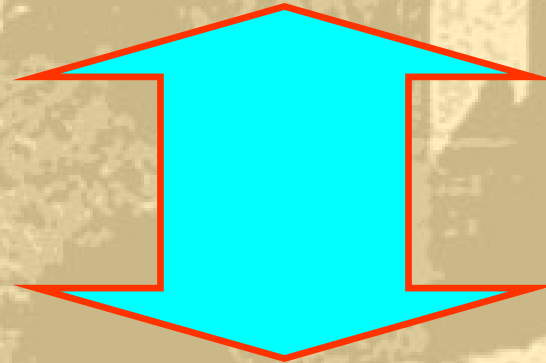
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Internationalization under FDI flows



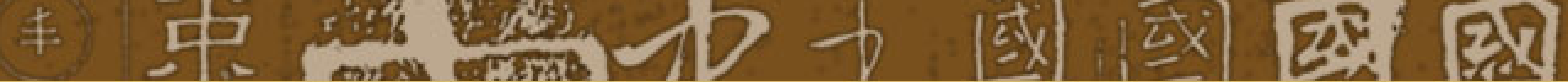
Innovation Opportunities?

⌘ Research based innovation: *Supply*



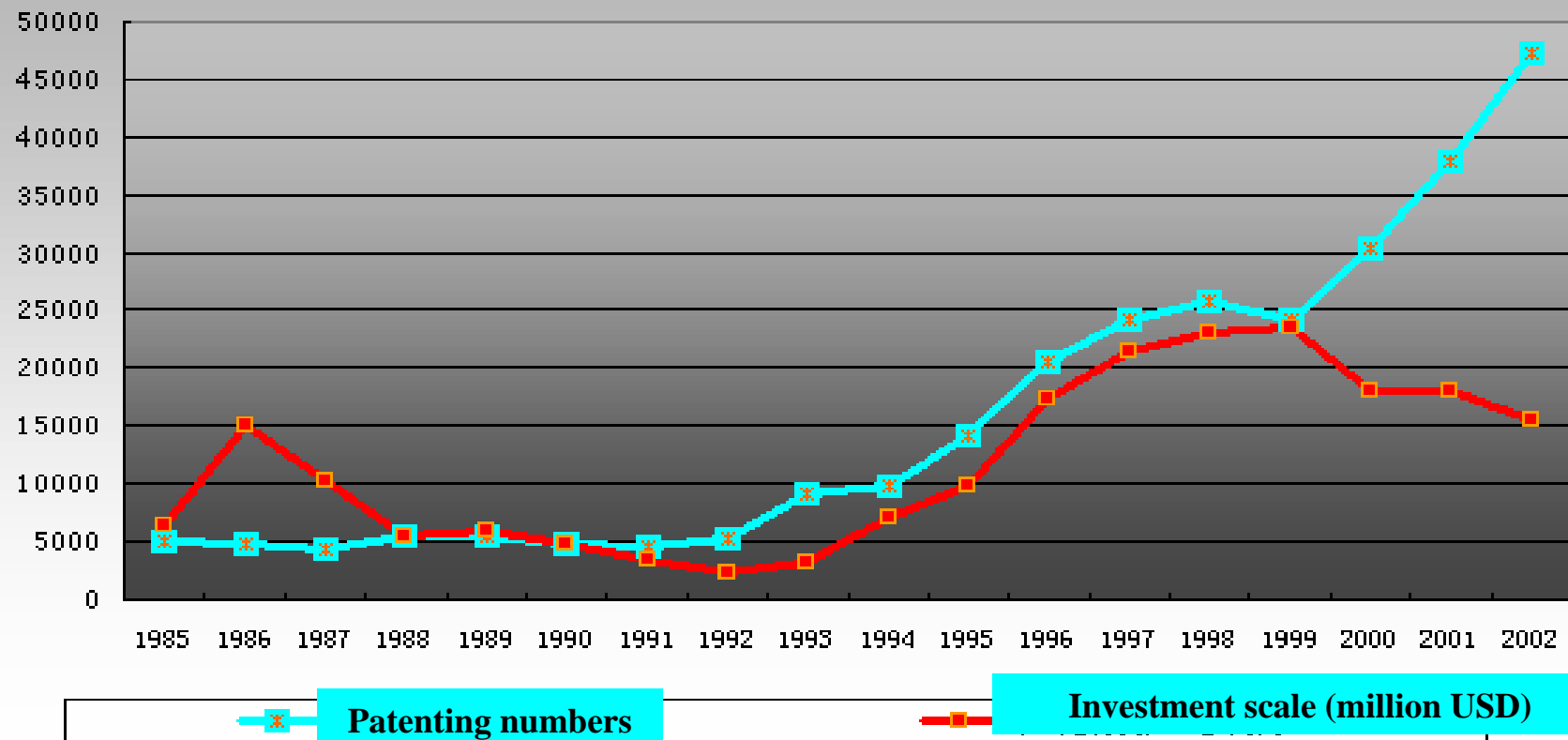
⌘ Production based innovation: *Demand*

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Comparison of FDI firms:

Investment Scale vs. Patenting in China



Patenting technology in China

**Table 1 Overseas patent applications to China Intellectual Property House:
From top five countries (% of all overseas applications)**

| Country Year | Japan | The US | Germany | France | Netherlands |
|-------------------------|---------------|---------------|----------------|---------------|--------------------|
| 1995 | 36.25% | 20.97% | 9.02% | 4.52% | 2.11% |
| 1996 | 34.77% | 22.41% | 8.66% | 4.22% | 2.46% |
| 1997 | 34.83% | 24.56% | 9.24% | 4.21% | 2.78% |
| 1998 | 36.56% | 24.88% | 9.68% | 3.86% | 2.58% |
| 1999 | 32.14% | 28.57% | 9.69% | 4.17% | 2.81% |
| 2000 | 32.59% | 27.74% | 9.18% | 4.57% | 3.27% |
| 2001 | 36.34% | 23.79% | 9.14% | 4.02% | 3.70% |

Source: <China Science & Technology Yearbook>, 1996 - 2002.

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FDI quality: typical measures

Innovation capacity (factors input):

- * *Numbers of technical personnel in mid & large sized FDI firms in different regions in China*
- * *Investment in R&D in local FDI firms*
- * *Value of Imported Technology in local FDI firms*

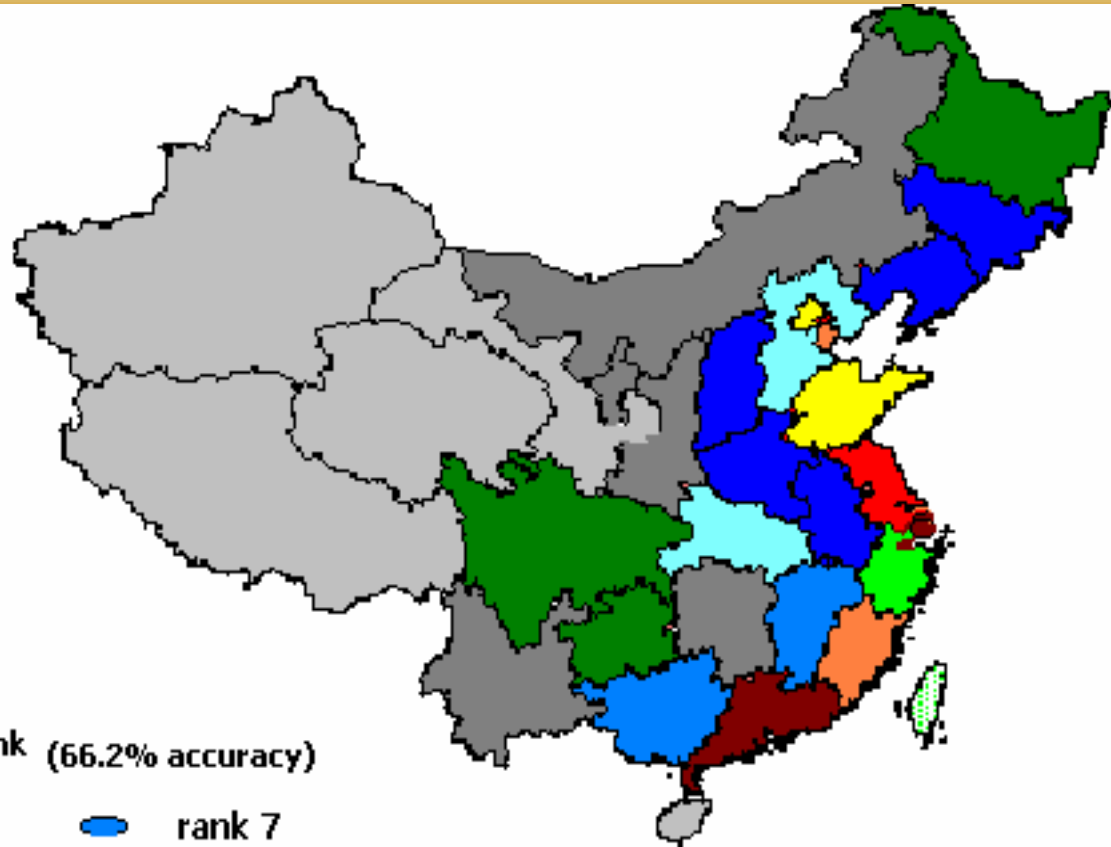
Innovation capacity (factors output):

- * *numbers of new product developed in local FDI firms*
- * *Numbers of granted patents hold by FDI firms*












Investment strength of FDI firms in different regions in China

- * *Numbers of large sized FDI firms in the region*
- * *Average investment scale of FDI firms in the region*
- * *Average increase of FDI volume and scale*

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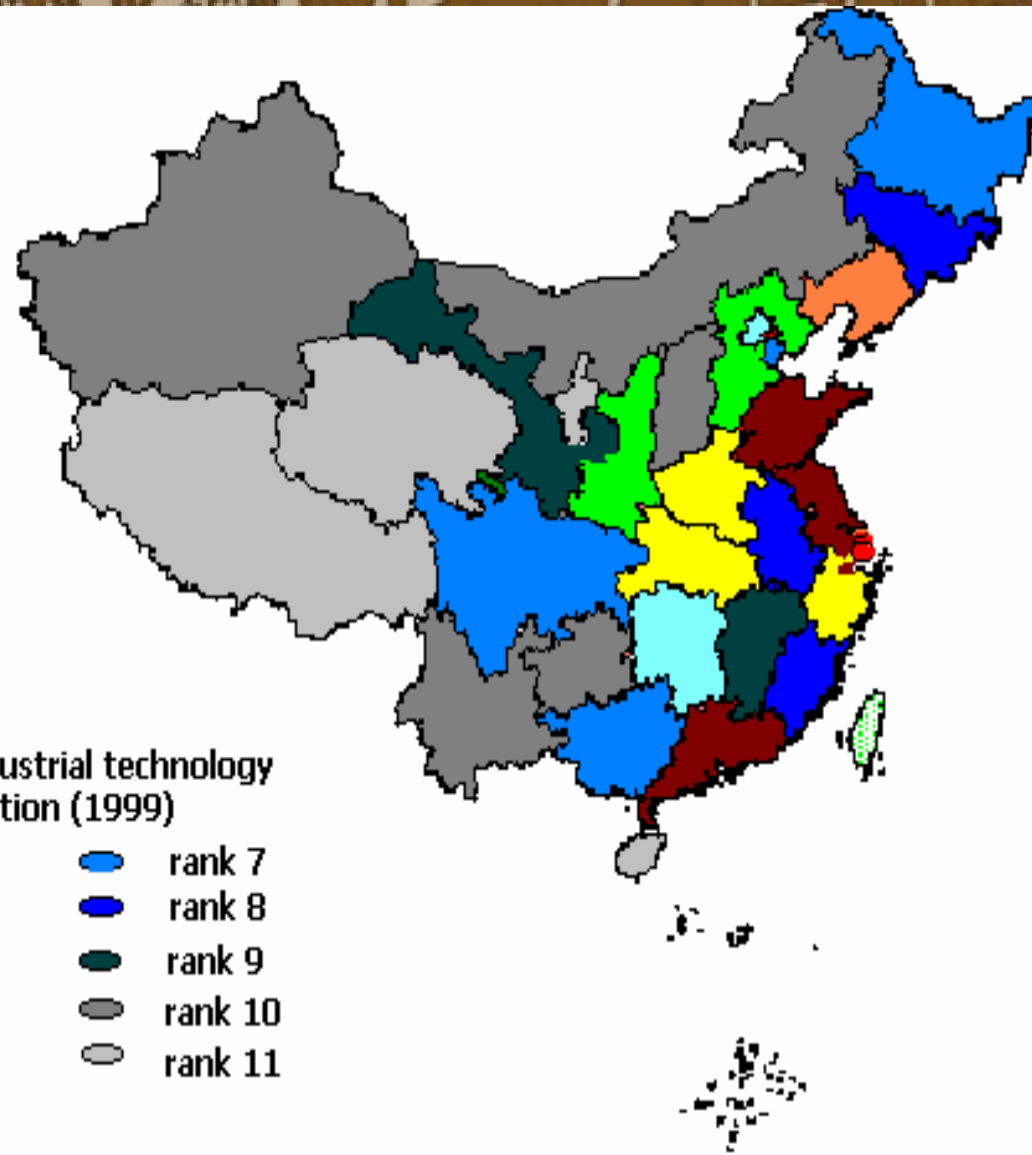
FDI quality rank (66.2% accuracy)

- | | | | |
|---|--------|---|---------|
|  | rank 1 |  | rank 7 |
|  | rank 2 |  | rank 8 |
|  | rank 3 |  | rank 9 |
|  | rank 4 |  | rank 10 |
|  | rank 5 |  | rank 11 |
|  | rank 6 | | |

Regional innovation capacity (production based measures)

- ⌘ **Local Chinese large & medium sized Firms:**
 - ⌘ **Patents granted**
 - ⌘ **Local technical personnel**
 - ⌘ **Local R&D measures**
 - ⌘ **Local technology import**

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Geographical industrial technology capacity distribution (1999)

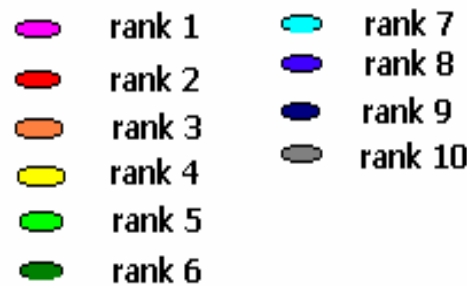
- | | |
|--------|---------|
| rank 1 | rank 7 |
| rank 2 | rank 8 |
| rank 3 | rank 9 |
| rank 4 | rank 10 |
| rank 5 | rank 11 |
| rank 6 | |

Regional innovation capacity (Research based measures)

- ⌘ *R&D activities in local research institutes & higher education (volume & scale)*
- ⌘ *Invention Patents*
- ⌘ *Technology trade in local market*

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Geographical distributions of R&D related activities in China, 1999



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Brief summary:

- ⌘ **FDI firms' impacts on local industrial innovation capacity: process technique & new to market product.**

Gaps between research based innovation and production based innovation do exist

Supply shortage vs. Supply pressure

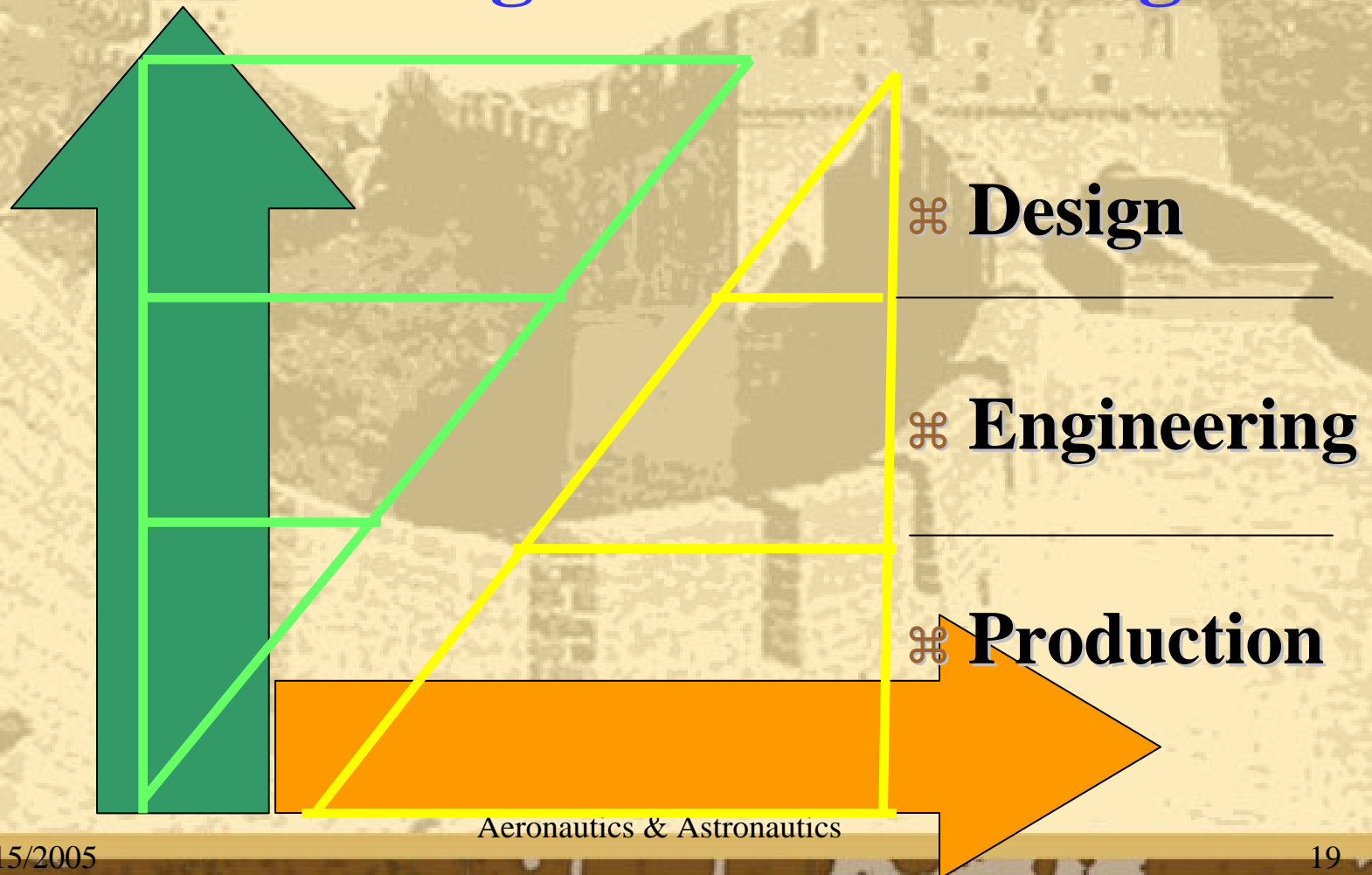
FDI firms may restrict China's industrial technology resources: by supplying embedded technology (equipment) !

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Table 1 **Classification of innovation based on nature of initiative activities**

| | Knowledge-creating | Knowledge learning |
|-----------------------------|---|---|
| Research-based innovation | <p>Mode 1: “idea-generators”</p> <p>typical indicators:</p> <p>R&D in universities and research institutions / academic papers</p> <p>Theoretical models / methods / patented inventions</p> | <p>Mode 3: “learning community”</p> <p>typical indicators:</p> <p>Technical information transfer / alliance among research bodies / R&D internationalization / patent license / technical personnel exchange</p> |
| Production-based innovation | <p>Mode 2: “production pioneers”</p> <p>typical indicators:</p> <p>R&D in business firms on new product / new techniques / patented utility models / industrial design / management system restructuring</p> | <p>Mode 4: “equipped skills”:</p> <p>typical indicators:</p> <p>Transfer of technical know-how and equipment between business firms / technology import & export / merge of technical firms</p> |

Internationalization of Resources: ---- tangibles VS. intangibles



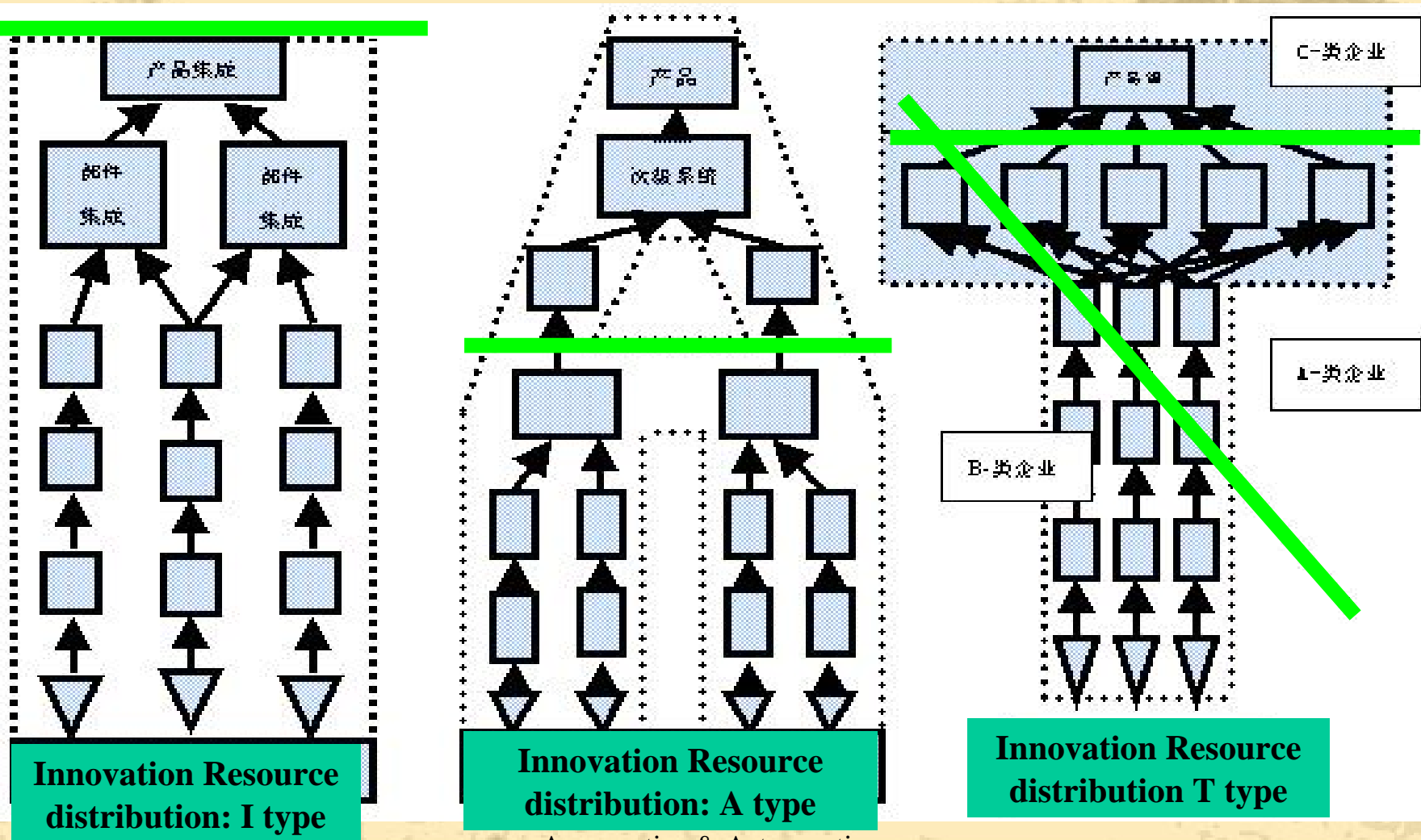
“Internationalization”---

Manufacturing sectors: Where can the resources be well matched?

- ⌘ International Design / knowledge resources**
- ⌘ International Engineering Resources**
- ⌘ International Production Resources**

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“Era of Modularization” ---- Clark (1997)



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Three Typical Firms under Modularization era:

- ⌘ General purpose component supplier
- ⌘ Special purpose modular component (sub-system supplier)
- ⌘ System integrator

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e.g.: China's processing projects for overseas customers

- ⌘ Processing projects become major part of China's international trade
- ⌘ Value added along with the supply chain
- ⌘ Where is the position for Chinese firms

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Share of Processing Items to overall International Trade in China (%)

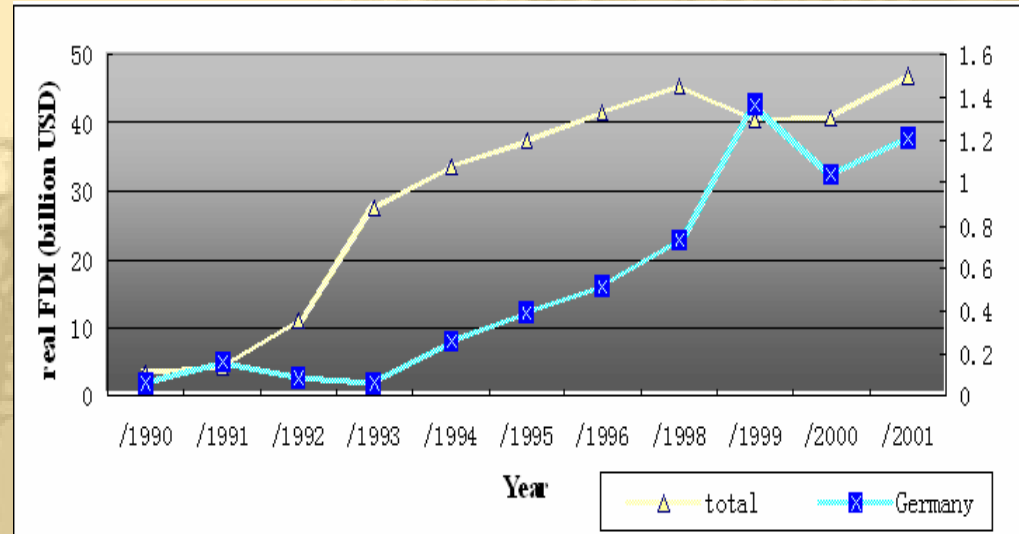
| | |
|------|------|
| 1991 | 45.2 |
| 1992 | 46.6 |
| 1993 | 48.2 |
| 1994 | 47.1 |
| 1995 | 49.5 |
| 1996 | 55.8 |
| 1997 | 54.5 |
| 1998 | 56.9 |
| 1999 | 56.9 |
| 2000 | 55.2 |
| 2001 | 55.4 |

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A Glance at German FDI in China

⌘ German FDI:

- ⌘ Manufacturing based
- ⌘ Technology intensive
- ⌘ Highly controlled
- ⌘ Key industrial sectors: chemical, pharmaceutical, auto, IT, etc.



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Shares of investment into China by companies from regions & countries

| | | | | | | | | 1998 | 1999 | 2000 | 2001 |
|----------------|------|------|-------|------|------|------|------|------|------|------|------|
| Shares | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | | | | |
| China H. K | 53.9 | 55.2 | 68.27 | 62.8 | 58.3 | 53.5 | 49.6 | 40.7 | 40.6 | 38.1 | 35.7 |
| USA | 13.2 | 7.32 | 4.64 | 7.49 | 7.37 | 8.21 | 8.3 | 8.58 | 10.5 | 10.8 | 9.5 |
| EU countries | 4.32 | 5.63 | 2.21 | 2.44 | 4.55 | 5.68 | 6.56 | 8.75 | 11.1 | 11.0 | 8.87 |
| Germany | 1.83 | 3.68 | 0.81 | 0.20 | 0.77 | 1.03 | 1.24 | 1.62 | 3.41 | 2.56 | 2.58 |
| Japan | 14.3 | 12.1 | 6.45 | 4.80 | 6.16 | 8.29 | 8.25 | 7.48 | 7.37 | 7.17 | 9.27 |
| Sub summary | 85.7 | 80.2 | 81.6 | 77.6 | 76.3 | 75.6 | 72.6 | 65.5 | 69.5 | 67.0 | 63.2 |

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Technology Transfer to China: Accumulated Volume (1991 –2001)

| Rank | Country | Volume | Numbers of Projects | Average Size (million USD per project) |
|------|----------------|----------------|---------------------|---|
| | | billion USD | Items | |
| | total | 125.281 | 41672 | 3.0006 |
| 1 | Germany | 21.084 | 4748 | 4.4406 |
| 2 | the US | 20.605 | 9587 | 2.1492 |
| 3 | Japan | 20.043 | 7167 | 2.7966 |

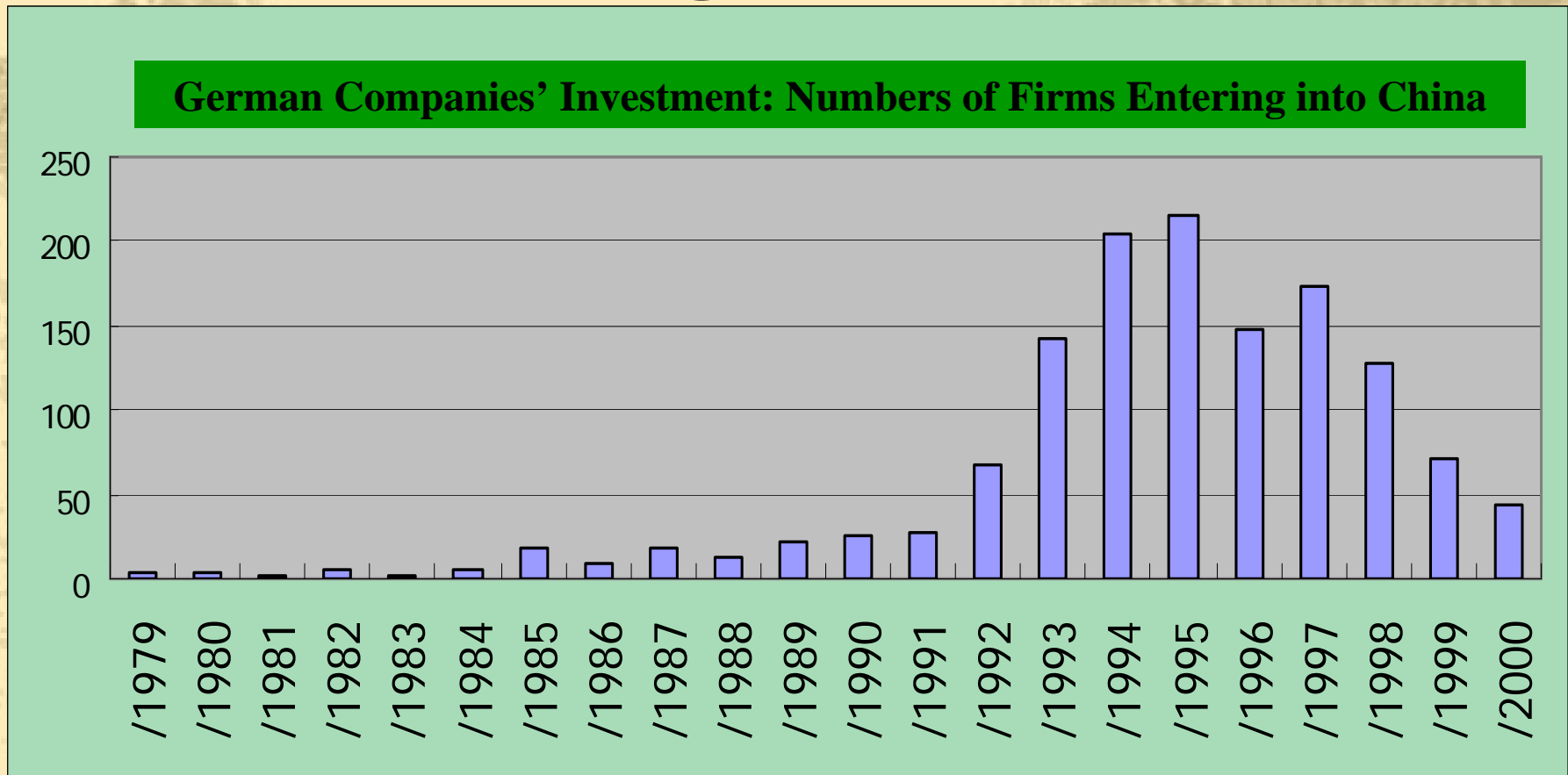
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German Investment in China: time period

- ⌘ **1981-1991**, initial stage: slow increase
 - ⌘ 95 projects until 1989. Sharp decrease in early 1990's, only 40 projects in those two years
- ⌘ **1992-1994**, investment booming, project number exceed total investment in past 13 years
- ⌘ **1995 till present**, steady increase

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Entering into China

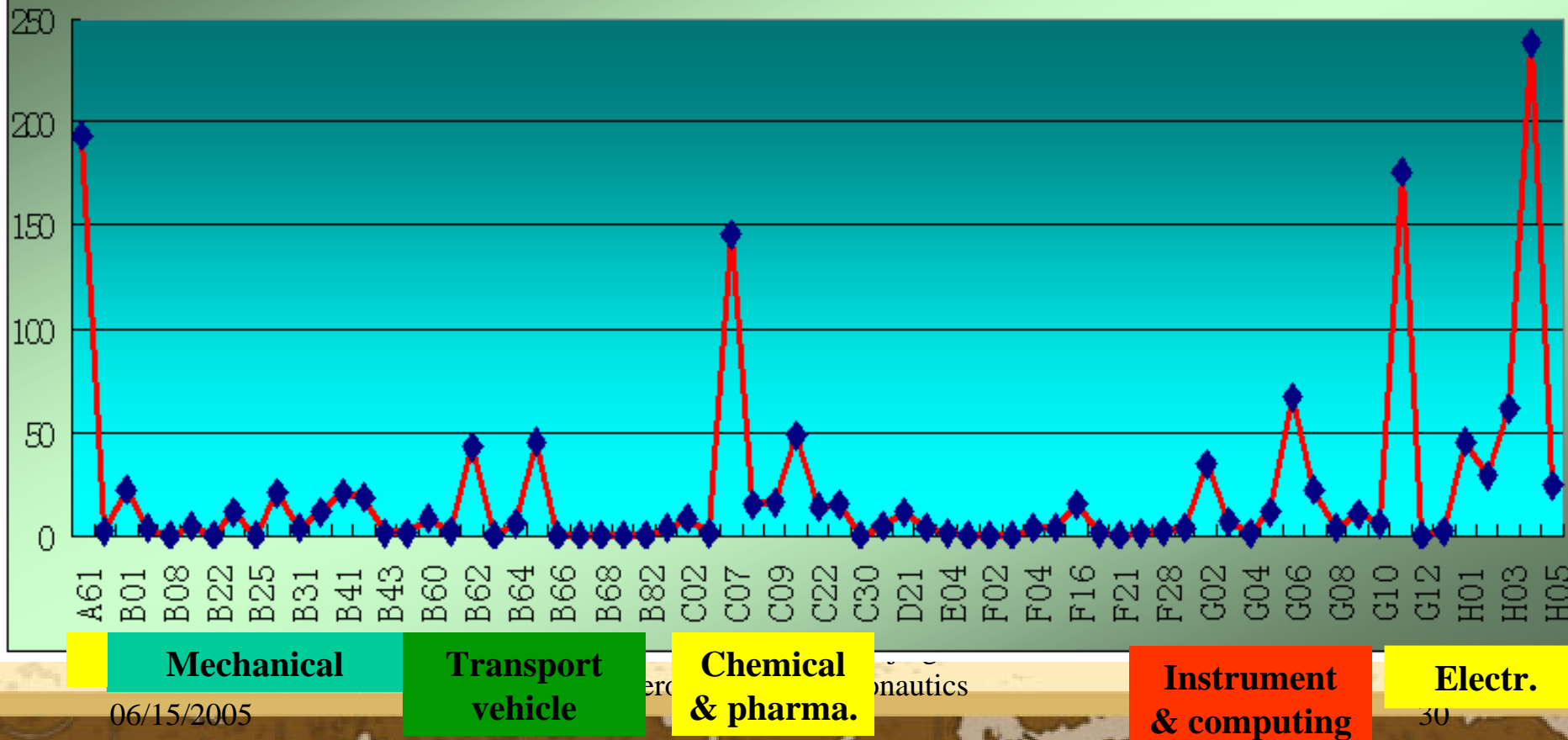


Source: German Chamber of Commerce Database, 2001

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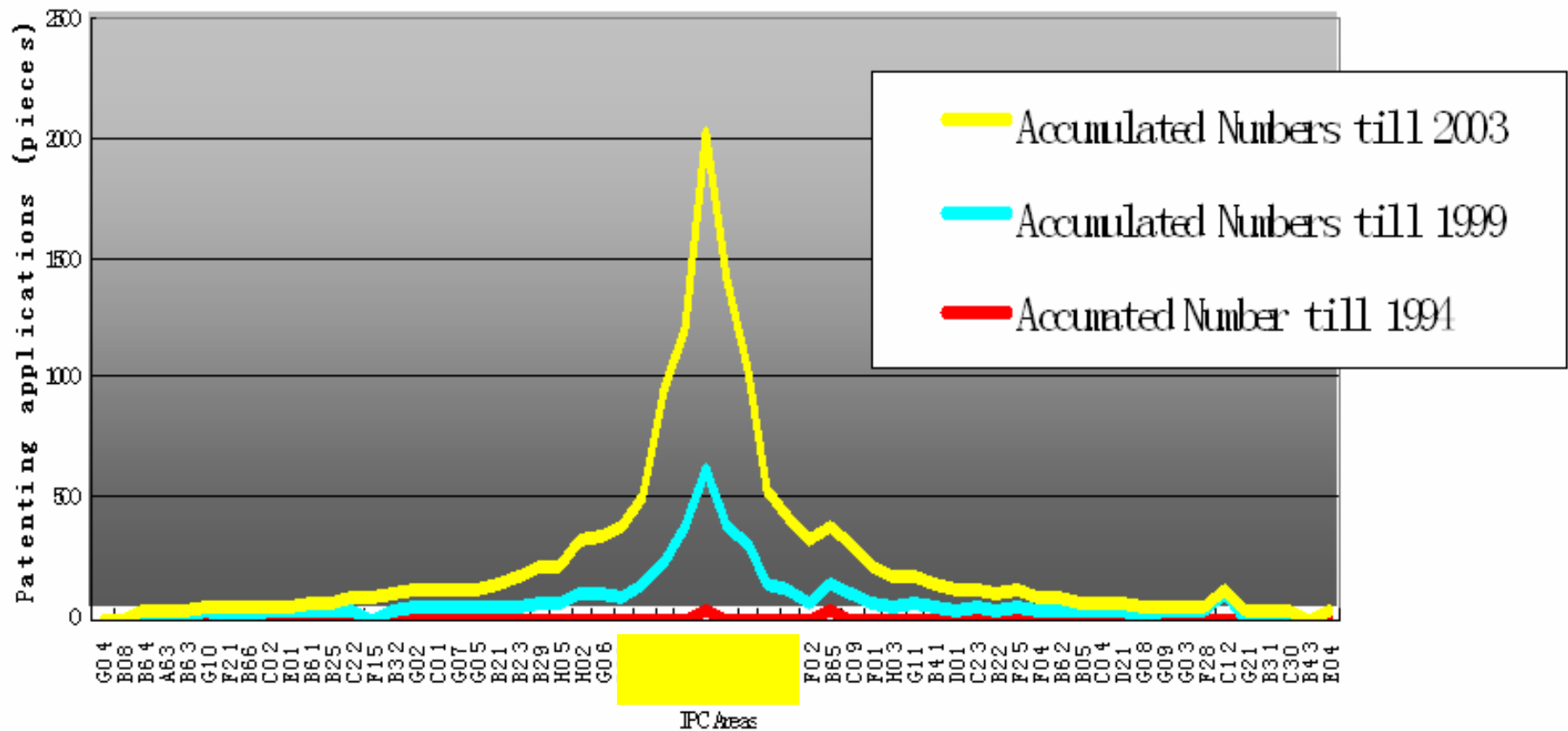
Patenting Technology in China by German companies

German Companies' Application for Patenting Technology in China



Patenting Technology in China by German Companies (up to 1994, 1999, 2003)

Patenting Technology in China: German Firms (1994, 1999, 2003)



Research Approach

- Development of a questionnaire
- Written survey among 164 companies with their HQs in Germany and FDI in China:
 - including production facilities
 - excluding representative offices
- 33 responses from which 21 could be used (12,8%)
- Support of mail survey through phone and personal interviews and two indepth case studies
- Analysis of the data

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German Investment in China: sector distribution

| sectos | sectors | numb |
|--------------------------|--|--------|
| First Industries | Agriculture | 4.34% |
| | Mechanical & Electr. | 268 |
| | Electronic, Information | 297 |
| | Chemical & Phamaceutical | 177 |
| Second Industries | Textile | 54 |
| | Construction & Enviromental | 145 |
| | other | 60 |
| Third Industries | Service (Transportation, Finance & Education) | 233 |
| | Aeronautics & Astronautics | 18.06% |
| Total | | 1290 |

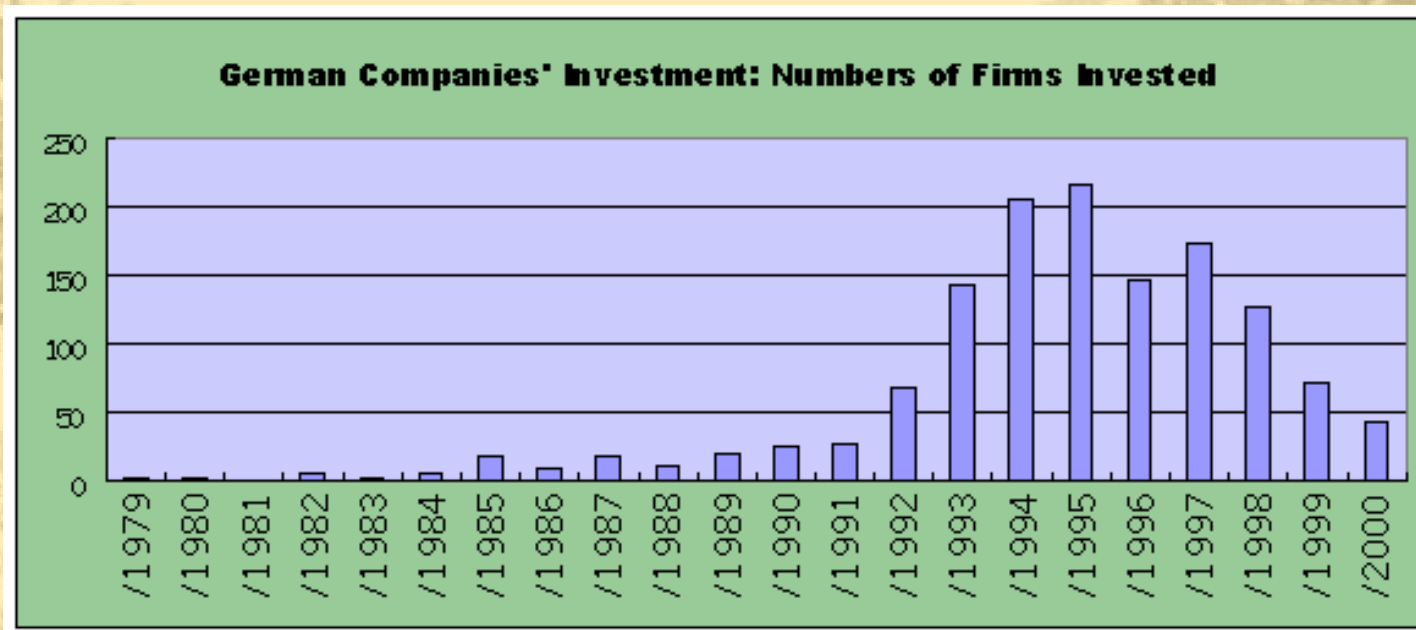
77.60 %

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Source: German Chamber of Commerce Database, 2000

Entering Time of German Firms in China



Source: basic sample database

| | Late Entry | Mid Entry | Early Entry |
|----------------------|----------------------|--------------------|----------------------|
| Entering into China | After 1992: 73.4% | Before 1992: 13.3% | Around 1980's: 13.3% |
| R&D investment start | No investment: 37.5% | After 1992: 50% | Before 1992: 6.73% |

Source: own mail survey

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Characteristics of German Firms Investing in China

Characteristics of German parent companies investing in China

| | Lower level | Mid level | Higher level |
|-----------------------|--------------------------------|--------------------------|---------------------------------|
| Number of employees | Less than 99: 27.8% | 100-999: 16.8% | More than 1000: 55.6% |
| Annual turnover | Less than 50 million DM: 22.2% | 50-500 million DM: 27.8% | More than 500 million DM: 50.0% |
| R&D expenditure ratio | Less than 1.4%: 13.4% | 1.4–3.5%: 33.3% | More than 3.5%: 53.3% |
| Average export ratio | Less than 10%: 38.5% | 10-34%: 7.6% | More than 35%: 53.9% |

Characteristics of German subsidiaries in China

| | Lower level | Mid level | Higher level |
|-----------------------|-------------------------------|-------------------------|---------------------------------|
| Investment volume | Less than 1 million DM: 21.4% | 1-100 million DM: 57.2% | More than 500 million DM: 21.4% |
| Annual turnover | Less than 5 million DM: 15.4% | 5-99 million DM: 53.8% | More than 100 million DM: 30.8% |
| R&D expenditure ratio | Less than 1.4%: 40% | 1.4–3.5%: 50.0% | More than 3.5%: 10% |
| Average export ratio | Less than 10%: 66.7% | 10-40%: 25.0% | More than 60%: 8.3% |

Source: own mail survey

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Survey Results: Ownership of Subsidiaries of German Firms Investing in China

- 36% wholly owned by German firms
- 47.4% holding more than 51% of shares
- 5.3 hold exactly 51%
- 5.3% have less than 49%
- Ownership mode is dominated by majority shares
- Wholly owned property ,boomed‘ since 1996

Source: own mail survey

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Survey Results: Technology Transfer of German Firms Investing in China

- Technology transfer to subsidiaries:
 - 76.9% transferred technology to their subsidiaries
 - 7.7% expressed their intention for the future
 - 15.4% no technology transfer and no intention in future
- Characteristics of technology transfer:
 - 68.7% production/ process technology
 - 18.8% adapting products to local needs through R&D
 - 12.5% new product design

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Survey Results: Customers of German Firms Investing in China

Investigated German companies in China - supplying nature (in %)

| Outside of China market (Industrial buyers) | | Within China market (Industrial buyers) | | | | China and world market Consumer goods | |
|--|---------------------------|--|------------------|---------------------|------------------|--|-----------|
| Upstream sectors | Down stream sectors | Upstream sectors | | Down stream sectors | | Durable | Commodity |
| | | Joint ventures | Locally owned | Joint ventures | Locally owned | | |
| 4.2 | 4.2 | 37.5 | 29.2 | 4.2 | 4.2 | 8.3% | 8.3% |
| Sub total: 8.4% | | Sub total: 75.1% | | | | Sub total: 16.6% | |

- **Summarized main results:**
 - **83.4% to industrial customers, 16.6% consumers**
 - **70.9% to upstream industrial buyers**
 - **75.1% to Chinese market (41.7% to Joint Ventures in China)**

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Source: own mail survey
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Survey Results: Suppliers of German Firms Investing in China

Investigated German companies in China - purchasing nature (in %)

| Outside of China market | | | Within China market | | | | |
|-------------------------|---------------|------------------|---------------------|---------------|------------------|---------------|------------------|
| General parts | Special parts | Natural resource | General parts | | Special parts | | Natural resource |
| | | | Joint ventures | Locally owned | Joint ventures | Locally owned | |
| 10.3 | 7.7 | 2.0 | 12.8 | 20.5 | 21.0 | 21.0 | 5.1 |
| Sub total: 18% | | 2.0% | Sub total: 33.3% | | Sub total: 42.0% | | 5.1 % |
| Sub Total: 20% | | | Sub Total: 79.4% | | | | |

- **Summarized main results:**
 - **79.4% buying from Chinese suppliers**
 - **20% buying from outside of China**

Source: own mail survey

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Survey Results: Important Strengths of German Subsidiaries for Successfully Competing in China

| | Rank | Mean |
|----------------------------------|------|--------|
| Advanced production technology | 1 | 3.8667 |
| Distribution networking strength | 2 | 3.0714 |
| Expertise & niche market | 3 | 3.0000 |
| Marketing strength | 4 | 2.8571 |
| Product differentiation | 5 | 2.5714 |
| Supply chain strength | 6 | 1.9333 |

Source: own mail survey

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Survey Results: Major Success Factors for Technical Innovation in Chinese Subsidiary

| | Rank | Mean |
|---|------|--------|
| Active technology transfer between Germany/ China | 1 | 4.3333 |
| Technical training for local employees | 2 | 3.9167 |
| Appropriate human resource management | 3 | 3.5833 |
| The advanced product / service brought to China | 4 | 2.9167 |
| Significantly updating local quality guarantee system | 5 | 2.9167 |
| Significantly updating local production equipment | 6 | 2.6667 |
| Successful networking with European firms in China | 7 | 2.4615 |
| Well established technical equipment and technicians | 8 | 2.4167 |
| Strong local R&D capability within China | 9 | 2.0000 |

Source: own mail survey

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Survey Results: Major Difficulties of German Firms on Investment in China

| | Rank | Mean |
|--|------|--------|
| Practical confusion on Chinese business law system | 1 | 3.1538 |
| Lower quality of locally produced raw materials in China | 2 | 3.0000 |
| Ambiguity of responsibility in Chin. management system | 3 | 2.9231 |
| Lack of trust btwn German & Chinese management | 4 | 2.8667 |
| Market information in China is not precise | 5 | 2.8462 |
| Lack of intellectual property right protection | 6 | 2.7857 |
| Higher change & mobility of employees in joint venture | 7 | 2.7692 |
| Negotiation process is complex and time-consuming | 8 | 2.6923 |
| Foreign exchange balance problem due to larger import | 9 | 2.5714 |
| Strong and negative local government intervention | 10 | 2.2857 |
| Different local technical standard | 11 | 2.2143 |
| Loosely controlled quality guarantee system in China | 12 | 2.1429 |
| Lack of stable and economic local distribution channel | 13 | 2.0714 |
| Lack of market demand for subsidiary's products | 14 | 1.7143 |

Source: own mail survey

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Survey Results:

Planned Investment in the Future of German Firms in China

| | Rank | Mean |
|---|------|--------|
| Introducing more advanced products into China-based joint venture | 1 | 3.5000 |
| Enlarging investment scale on the same product | 2 | 3.0000 |
| Building up internal R&D in the Chinese subsidiary | 3 | 2.6429 |
| Deepening production co-operation | 4 | 2.4615 |
| Retraction from placing our production in China | 5 | 2.0000 |
| Retraction from manufacturing in China | 6 | 1.5714 |
| Retraction internal R&D in the Chinese subsidiary | 7 | 1.3636 |

Source: own mail survey

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Summary and Conclusions (I)

- Long-term investment dominates
- **Strong control of investment**
- **Industrial customer - oriented ...**
- **Chinese domestic market – oriented**
- **Located in industrial regions (Shanghai, East coast) and Beijing (79% of investigated firms)**

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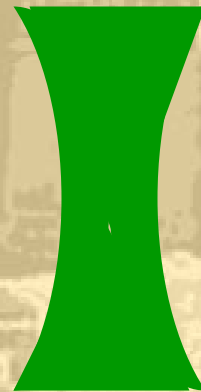
Summary and Conclusions (II)

- **Technology transfer to subsidiary, but primarily with production/ process technology**
- Introduction or generation of more advanced products in China *may* gain importance in the future (own indicators are weak; Under what circumstances? When?)
- German FDI can be characterized as :
 - market enlargement and penetration

Brief conclusion:

⌘ **FDI firms' impacts on local industrial innovation capacity**

**Gaps between research based innovation and production based innovation:
Supply shortage**

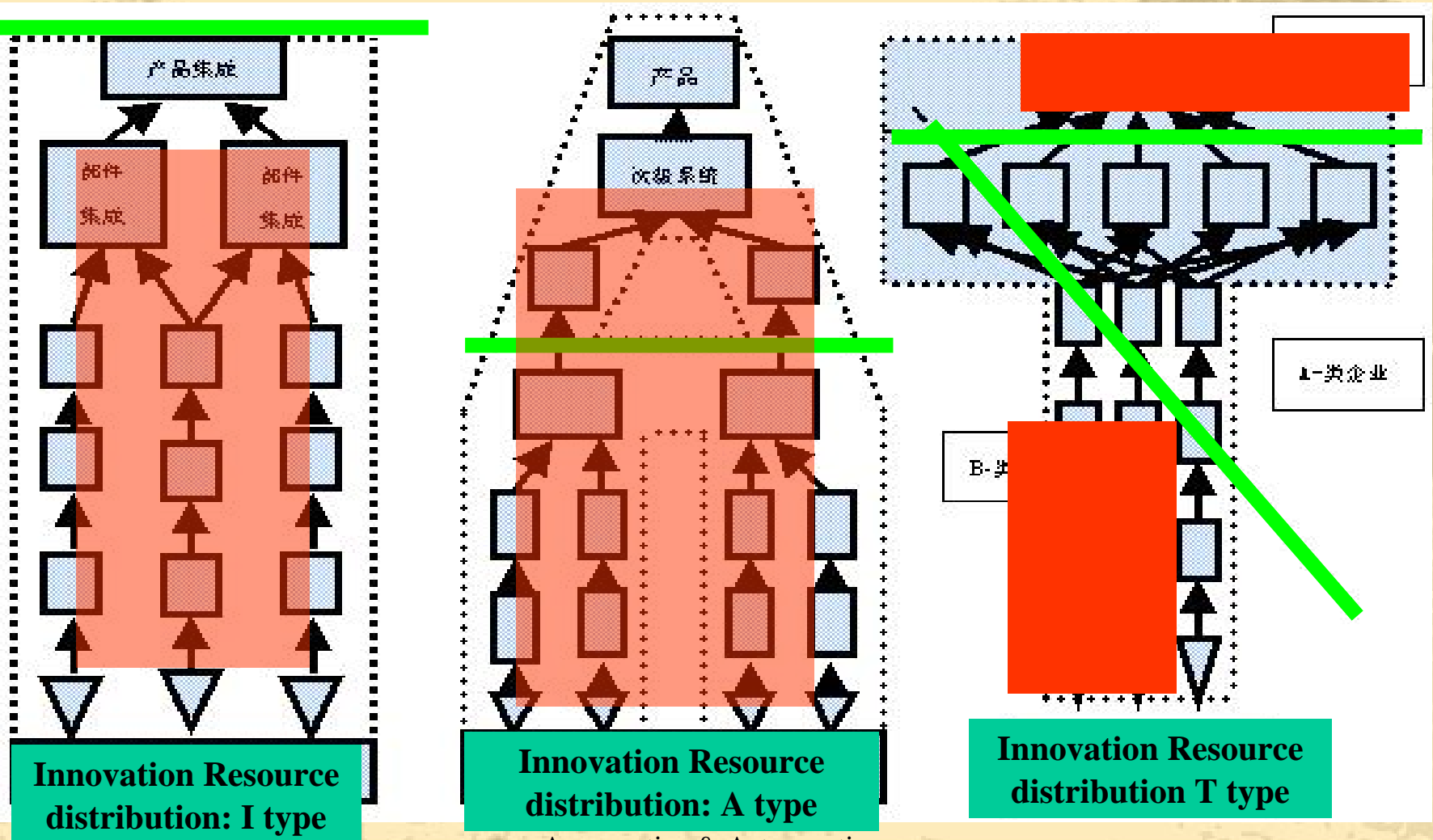


FDI firms' supply on embedded technology (equipment) !

Supply pressure

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“Under the Era of Modularization”



Innovation Resource distribution: I type

Innovation Resource distribution: A type

Innovation Resource distribution T type

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Conclusion

- ⌘ Innovation opportunity:
 - ⌘ Suppliers with higher economic advantage (innovation in management)
 - ⌘ Integrators with different key components (product innovation, designs)
 - ⌘ Supply chain based innovation (key component / sub-system oriented innovation)

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**Thanks and comments /
questions well come**

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