Value chains and innovation in China

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Good morning. My name is John Humphrey.
I have been working on the issue of value chains for quite a long time.
I have not focused particularly on the question of innovation and innovation systems.
As you know, value chain analysis has tended to focus on the issue of upgrading,
which is not quite the same as innovation, as I will discuss later.
However, last year I worked with some Chinese and Japanese colleagues on a project on the characteristics of domestically-oriented value chains in China.
These chains are very different to the ones that we generally study both in the West End in East Asia, and this raises some new questions about our value chain analysis.

So, today, I want to do the following

Outline

1. Challenges facing China
2. Chinese cellphone manufacture and marketing pre-2010
3. Changes after 2010
4. Explanatory factors

- This presentation is based on research carried out jointly with researchers at the Institute of Developing Economies in Japan. The co-researchers are Ke Ding, Mai Fujita, Shiro Hioki and Koichiro Kimura

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Challenges facing China
Chinese cellphone manufacture pre-2010
Changes after 2010
Explanatory factors

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1. Challenges facing China

- Rapid growth and poverty reduction, but rapidly rising wages
- Government shift to emphasising the importance of growth of domestic consumption
- But domestic market changing as incomes rise
- How do Chinese firms adapt?
- Case of cellphone sector

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Challenges facing China

China is the big success story in the global economy in the last 30-40 years.
Until recently it has sustained very rapid economic growth, at or above 10% per year.
It has reduced levels of poverty very dramatically, even if income inequalities have increased.
A lot of this economic growth was based on the ability to perform simple tasks very well and very cheaply. It became the "workshop of the world" as you all know, China supplies much of the world's needs for products such as clothing and toys, and Chinese factories assemble many of the valued products of our modern life, such as mobile phones.

But this very success creates new challenges.
1. China success in raising living standards means that its labour is now much more expensive than in the past.
2. Its export success has left it dependent on growth in a fragile global economy that shows many signs of strain.
The Chinese government itself is trying to reorient its economy towards domestic demand.
But that the domestic economy is changing rapidly as well.
As well as rising wages, we also have the development of more sophisticated consumer demand.
Chinese consumers are no longer satisfied with the simple, mass produced, cheap products that they purchased in the past.
In this presentation, I want to look at this challenge from the point of view

2. Domestic value chains in China, before 2010

- Low levels of industrial concentration

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Let's start by talking about the characteristics of domestic value chains in China, in the period before 2010.
In many ways that they exhibit characteristics that are quite different to many other countries.
The first of these is that levels of industrial concentration - the share of production in a sector that is held by the largest firms — seem to have been quite low.
This can be seen in a comparison of China with India and Japan.
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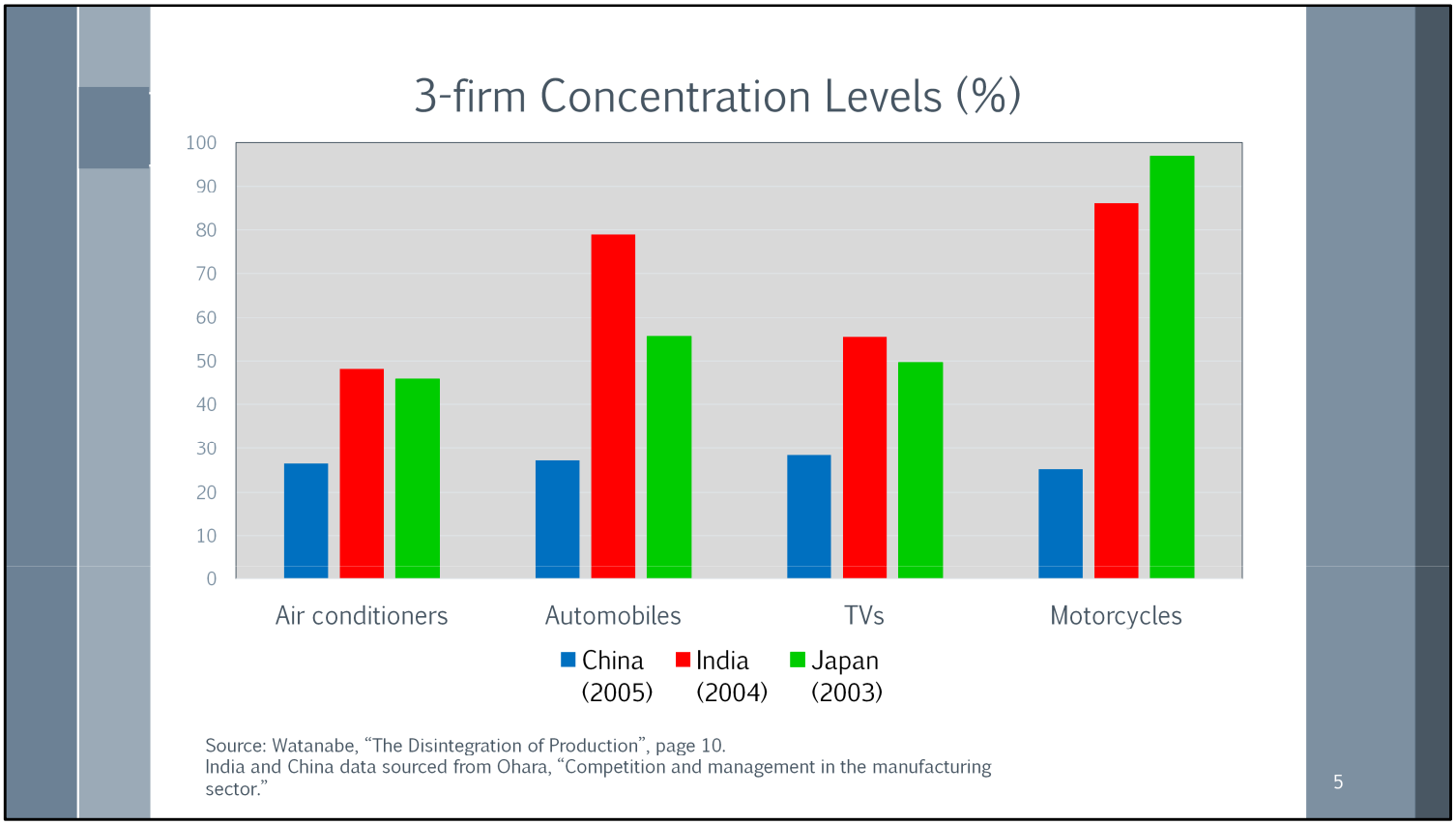

This is the distinctive feature of China. Three-firm concentration levels much lower than in Japan, and also lower than in India. This is not simply a developing country or large domestic market phenomenon.
Note also that we are not talking about garments/apparel, even though these sectors show the same contrasts.
Take automobiles. Three firm concentration ratio in Japan is about 55%. In India it is 80%.
In China it is just over 25%. Marukawa provides data to show that in 2009, there were 54 different firms in China assembling at least 50,000 vehicles a year. This is a staggering number. In case you think that this just shows the irrationality of the Chinese system, only eight of these firms were loss-making. And this low level of concentration was actually in spite of Chinese government policy aimed at promoting improved productivity through industry concentration.

Domestic value chains in China (continued)

- Low levels of industrial concentration
- Cell phone handset manufacturers buy out rely on other firms for key inputs such as design of printed circuit boards, moulds, software, etc.
  - Highly dis-integrated value chains
- Inter-firm linkages in value chain mostly arm's-length market relationships
- Evident not only in sectors with well-established technologies, but in sectors experiencing rapid technological change
  - Sectors include cellphones, motorcycles, air-conditioning and refrigeration, automotive, televisions.

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As well as low levels of industrial concentration, we also see some other very characteristic features of these value chains.
First, Cell phone handset manufacturers buy out rely on other firms for key inputs such as design of printed circuit boards, moulds, software, etc.
a high degree of fragmentation. There is lots of specialisation.
In other words, the cell phone value chain is highly dis-integrated.
Second, in spite of this fragmentation, relationships between businesses in the chain seem to take the form predominantly of arm's-length market relationships, with little communication.
Writing about the auto industry, Tomoo Marukawa of the University of Tokyo talks about Chinese vehicle assemblers finding defective parts from suppliers but not communicating working with suppliers to find out the causes of defects. The Chinese assemblers impose financial penalties on suppliers.
Third, We see these characteristics across a range of sectors, and certainly not just in low tax sectors. The literature on this topic provides examples from sectors such as cell phones, automotive, air-conditioning and refrigeration and motorcycles

Domestic value chains in China (continued)

- Use of technology platforms:
  - Packaged vital technologies
- Advantages for Chinese firms
  - lower barriers to entry
  - Reduce capability requirements for entrants using platforms
  - Modular architecture and standardised interfaces facilitate specialisation and vertical dis-integration
- The case of MediaTek (MTK) in cellphones

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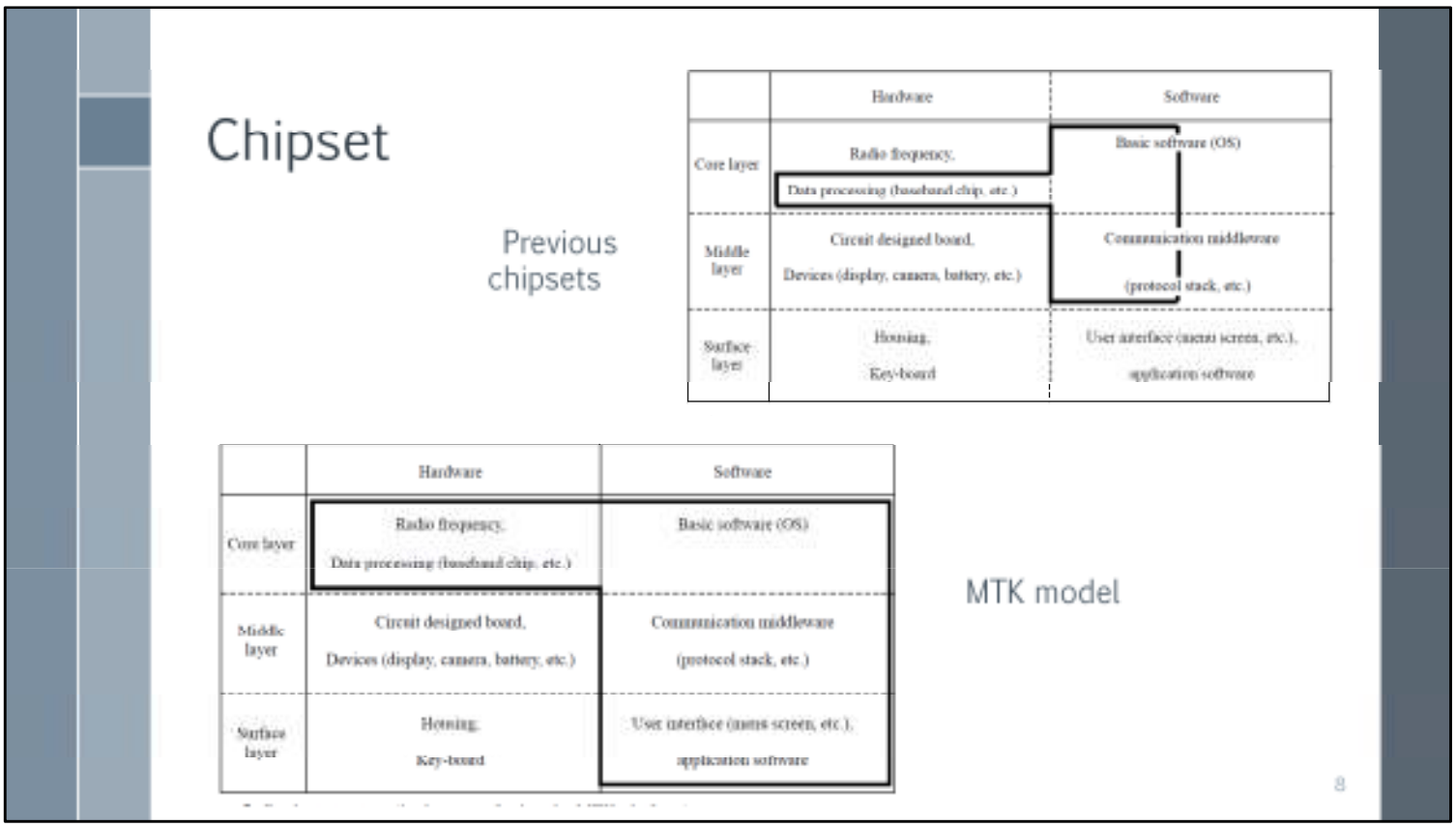
The final, and perhaps the most important, aspect of these domestic value chains is their extensive use of technology platforms.
What is a technology platform?
It is the provision of a core technology in a form that can then be used by many different firms and incorporated into a range of products.
The core chipset of a personal computer provided by Intel is an example.
But we see it across Chinese industries. Examples include Chinese passenger vehicle companies using engines and gearboxes provided by specialist suppliers. Or, at one point, the reliance of Chinese air conditioner manufacturers on compressors supplied by Toshiba from Japan.
In many cases, these core technologies were provided by non-Chinese firms.
The advantages of working in this way are:

lower barriers to entry
Reduce capability requirements for entrants using platforms
Modular architecture and standardised interfaces facilitate specialisation and vertical dis-



The MTK strategy was not only to provide the core technology in the form of the chip.
This is done by many firms in the cell phone industry.
MTK INTEGRATED more functions into the core chipset, increasing overall modularity and simplifying the integration of the core technology into cell phone handsets.
The two diagrams show the difference between the developed MTK platform and previous chipset platforms.
The integration of these functions greatly simplified the tasks of the downstream users.

Simplification for the technology users

- Core technology on a single chip
- Provision of technical support by MTK
- Relaxed attitude towards licensing
- Reference designs for printed circuit boards provided, including bills of materials

> "a complete turn-key solution: a domestic handset firm could purchase an MTK solution and extensively customise the user interface and functionality, or it could use the basic interface and essentially slap on a casing "

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Core technology on a single chip
Provision of technical support by MTK
Reference designs for printed circuit boards provided, including bills of materials

The model is summed up by this quote
CLICK

Summary: the characteristics of low-end cellphone sector, up to 2010-12

- Fragmentation. Estimated 2000 firms producing branded handsets
- Technology platforms
- Use of design houses for printed circuit board design
- Specialist mould makers for design production of plastic casings
- Some use of contract assembly

In fact, the small firms that proliferated up to 2010 also had the services of design houses and mould manufacturers who supplied printed circuit boards and casings to many of the small companies
This diagram shows vertical disintegration. Highly simplified.
Core platform technology comes from chip companies, with MTK, the Taiwanese company, having a dominant market share in China .
Independent design houses in China [do what]
Components come from a range of suppliers. [Ding on buyers and specialist buying companies]
Specialist companies to produce moulds for handsets.
WHERE are PCBA?
Distribution not by the "system integrators".

Summary (continued)

- Before the smartphone
- Low cost — 45-50% cheaper than mainstream, branded phones
- Limited product differentiation
- Aimed at lower-income consumers, particularly in small towns and rural areas

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To summarise, this is how one important part of the cellphone industry might been described in 2010.
There has been a market in China for low-and products aimed at low-income consumers, often in rural areas.
Still cheap. Cheap. One recent blog estimated the average cost of a smart phone to be 500 yuan, $80.
And for export too.
One company in Shenzhen exporting 1.5 million phones a month — mostly to Asia and Africa, the consumer price for a smart phone is $40-$80.
Price to the consumer for a feature phone is $7-$11, with a minimum order for this price of 100,000 units to South Asia

Often by small companies
But were Produced in millions. Ding Ke estimates the 2010 shipments of shanzhai cell phones to have been at least 360 million units.
Competing against market leaders
About half the price of mainstream branded competitors.

"One salient paradoxical phenomenon amidst the fast growth of China's manufacturing industry is that while enterprises expand production volumes in a speedy way, the accumulation of their R&D capabilities lags far behind."

Ge, D. and Fujimoto, T. (2004) 'Quasi-Open Product Architecture and Technological Lock-In: An Exploratory Study on the Chinese Motorcycle Industry', *Annals of Business Administrative Science vol* 3 No. 2: p 15.

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And in some ways this is quite unexpected.
The analysis of the East Asian model of industrialisation place great emphasis on the acquisition of technological capability as the key to success and active app is by companies, and by government to facilitate this acquisition.
In China, we see businesses achieving success, including branding their products, without any attempt to acquire technological capability.
They rely on a range of businesses that supply core technologies and key services.
As summarised by two Japanese analysts, Ge and Fujimoto,
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3. Changes after 2010

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In a nutshell, in cellphones
CLICK This is replaced by
CLICK This

The change was particularly marked in cell phones, but there appear to be some parallel shifts in industry structure in the other sectors that I mentioned. With some increases in firm concentration, closer links between buyers and suppliers and an emphasis on improving quality.

Changes after 2010

- Decline of the small-scale sector:
  - by 90% in terms of production and number of companies 2010-2016 Failure to dominate 4G and smart phone technologies
  - Emergence of new customer-focused Chinese companies:
- Opportunity arising from decline in small-scale sector not taken up by international companies (Apple or Samsung)
- Increasing industry concentration.
  - By 2016, top for handset brands had 59% of smartphone market
- Emergence of high-profile Chinese brands
  - Oppo, Vivo, Xiaomi
- Increasing vertical integration
- Greater coordination along the chain — more complex exchanges of information
- Increasing use of brand-specific distribution channels (owned or franchised)
- Increasing investments in capability acquisition

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However, signs of rapid change.
But the most dramatic changes, and the best documented ones, come in the mobile phone sector
Evidence of:

1. Greater concentration and emergence of new Chinese brands
2. Vertical integration. Activities of independent design houses largely taken in-house by handset manufacturers.
3. Greater coordination along the chain. Evidence of continuous and intensive contact between platform providers and handset manufacturers.
4. Increasing use of brand-specific distribution channels, owned franchised
5. Investments in the acquisition of technological capabilities.

4. Explanations of recent changes in China

Candidates for explaining changes in industrial organisation.

1. Technological change
2. Changes in consumer demands and markets

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So how do we explain the recent changes in China I mentioned at the beginning.
I will look at two candidates for explaining these changes, Intense competition and low profitability

1. Technological change
2. Changes in consumer demands and markets

I don't think here that this is a question of selecting one rather than another. They are likely to combine, and it may be the case that one factor explains more about transformations in one particular sector, while in another sector a different factor will have greater explanatory value.

Market changes (1)

- Chinese market evolving rapidly
  - Growing discretionary spending
  - Willingness to trade up to premium brands Market shifts from low-end phones (under $100) to high-end phones (over $300)
- Implications of product differentiation:
  - Collaboration with technology suppliers to create greater functionality and product differentiation — customer-specific components, chips and innovations
  - Introduction of smart phones and increased functionality may reduce the level of modularity of product architecture
  - Collaboration with technology suppliers needed to plan handset manufacturer product launch strategy
  - Investments in product innovation requires greater technological capability and increase size of handset manufacturers

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the Chinese consumer market is evolving rapidly. A recent note on consumer attitudes and trends in China produced by McKinsey (Atsmon and Magni 2016) argues that Chinese consumers are indeed changing their consumption habits quite rapidly. They point to growing discretionary spending in line with increasing incomes and a willingness to "trade up" by buying more expensive versions of the same products, including premium brands.

There has been a shift in the market for low-end phones, under $100, to higher end phones, over $300. By 2015, the market was split evenly between under $100, 100-$300 and over $300

Product differentiation is important for growth

Therefore, more firm-level investment in innovation. This means relying less on "system on chip" solutions that bring together hardware and software packages, because these place limits on product differentiation. So this drives increasing technological capability, associated with larger firms, and more complex activities, and so more vertical integration.

More demand for firm-specific inputs — as a possible consequence of differentiated products. Not absolutely necessary

Increased functionality developed to meet customer needs may require changes in different parts of the product (level of modularity declines)

So some of these market elements also interact with the technology elements.

For example, if customers focus more on brands and increased functionality, then the benefits of applying new technologies will increase

Market changes (2)

- Closer links between buyers and suppliers because:
  - Quality matters more. Increased emphasis on quality and need to resolve problems quickly
  - Innovation and product differentiation requires chain collaboration, above all if complexity of interactions along the chain increases
- Branding matters, and this has economies of scale
  - Particularly in the development of distribution networks
  - More use of manufacturer-owned retail outlets and franchises (VIVO has 250k outlets)

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Branding matters, and this has economies of scale
Particularly in the development of distribution networks
And if consumers are more concerned about quality, then the supply chain has to be managed better. More communication.

So some of these market elements also interact with the technology elements.
For example, if customers focus more on brands and increased functionality, then the benefits of applying new technologies will increase
One example. Photo enhancement for selfies. Requires collaboration from phone, software, processing chips, etc.

Technological change

- Big changes in technology globally since 2010
  - Replacement of feature phone by smart phone, including in China
  - Globally, big shift in structure of industry and market leaders
- Possible breakdowns in modularity
  - 3G and 4G technologies. Are they more complex to handle?
  - Software more complex in smartphones — needs more joint problem-solving
  - Multimedia applications tend to create interdependencies and conflicts that have to be addressed across firm boundaries
  - Turning new platforms into new products requires cross-firm knowledge
- These factors may lead to firm-level concentration
  - Greater technological capability required. R&D for software and hardware

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At the global level, there have been enormous restructurings of the cell phone industry. Rapid advances in technology with the introduction of 3G and 4G phones and smart phones, alongside a decisive shift in the associated software and apps (which decisively affect customers' experiences and their perceptions of functionality) have been directly associated with substantial restructuring of the global industry — Nokia and Blackberry are former market leaders that have turned into casualties.

But how would these affect industrial organisation?

breakdowns in modularity

3G and 4G technologies. Are they more complex to handle?

Software more complex in smartphones — needs more joint problem-solving

Multimedia applications tend to create interdependencies and conflicts that have to be addressed across firm boundaries

Turning new platforms into new products requires cross-firm knowledge

Why firm-level concentration

Greater technological capability required. R&D for software and hardware

Conclusions

- Chinese market moves away from "cheap and cheerful"
- Changing consumer demand may drive substantial structural changes in industry
- But speed of change may be exceptional in cell phones because of the underlying changes in technology
- More work needed on the interaction between market characteristics and technology