



From knowledge based to valuation oriented catching-up: China's recent shift in global positioning in the solar PV industry

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Introduction

- ▶ Challenges of catching-up studies
- ▶ Borrowing new insights
- ▶ How far does knowledge relatedness matter?
- ▶ Case selection: Chinese solar photovoltaic (PV)
- ▶ Analysis
 - ▶ From 20 expert interviews in China
 - ▶ Qualitative content and patent analysis



Moving beyond knowledge based catching-up

- ▶ Challenges: Knowledge-base focused
 - ▶ The role of multinational companies and indigenous innovations
 - ▶ Moving up in global value chains (GVCs)
 - ▶ Spillovers to new related fields
 - ▶ **Middle-income trap**
- ▶ Insights from **Economic geography**
 - ▶ Relatedness matters: relative competitive advantage in related fields
 - ▶ **Unrelated diversification?**
- ▶ Insights from **Transition studies**
 - ▶ (Re)configuration of socio-technical systems
 - ▶ Shaping institutional context, creating markets, etc.

Moving beyond knowledge based catching-up

- ▶ How far does knowledge relatedness matter in latecomer catching-up and leapfrogging?
 - ▶ From semiconductor to solar PV
 - ▶ Identify emerging alternative trends

Development of the Chinese solar PV industry

- Related capabilities
- Upgrading in GVC



*Formation, boom and crisis
(late 1990s - late 2000s):*

Positioning in existing GVCs

- Entrepreneurs
- Foreign markets
- Relied on German companies
- Largest world producer
- Anti-dumping policies

*Exponential growth
(late 2000s - around 2013):*

Strong positioning in GVCs

- Consolidation
- Vertical integrations
- Bankruptcies
- FIT, Not well implemented
- Overcapacity, price war
- Exports, new firms

*Beyond VC focus
(since around 2013):*

Moving to the forefront of innovations

Constructing socio-technical system

- Possible industrial and environmental leapfrogging

?

Tapping emerging windows of opportunity: towards a socio-technical system

From knowledge focused to market oriented
industrial policy approach

- **PV Forerunner Base Plan**: standards & competitions
- PV Super-Forerunner Base Plan: selection for trials
- **PV Poverty Reduction Policy**
- Minimal grid connection for PV
- Market competition
- **PV system integration**
- Wider applications: electricity systems, house facades, other applications
- **Experimental initiatives**

Tapping emerging windows of opportunity: towards a socio-technical system

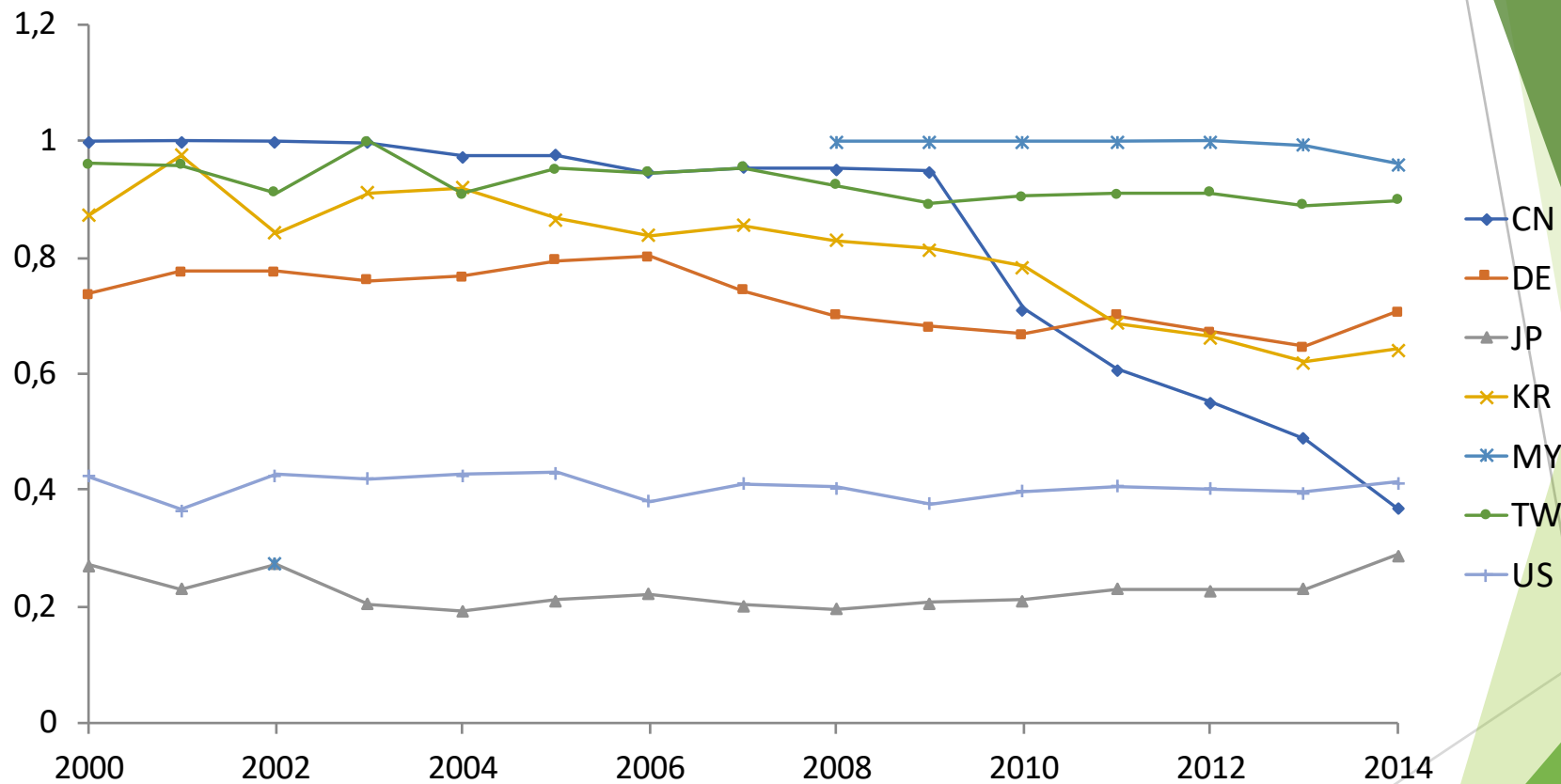
Dynamics of business restructuration:
enabling new approaches to GVC positioning

- **Integration and disintegration ?**
- Non-mainstream alternatives: monocrystalline
- **Unsustainable** price war
- **New business models:** asset-light, ICT, Internet of things, cloud computing

Beyond production based value chain:
system integration for PV deployment

- **Against mainstream** e.g. thin film
- **Buildings, roads, consumer products,** satellites, planes
- **Inverters, Storage, Balance-of-systems (world's top)**
- **ICT innovations** (grid connections, decentralization, complementary energy, electric vehicle charging stations, energy management platform)
- **Against conventional architectures**

Relative share of backward linkages (of international to total solar patents)



Source: European Patent Office Worldwide Patent Statistics Database PATSTAT, 2018.

Ranking of patent classes (backward linkages to “other” classes)

	Patent classes				
Geography	Rank#1	Rank#2	Rank#3	Rank#4	Rank#5
<i>Worldwide</i>	H02J	F24J	H02M	H05B	C23C
<i>CN</i>	H02J	H02S	H02M	F24J	B32B
<i>DE</i>	H05B	C09K	C07D	C07F	C07C
<i>JP</i>	H02J	B32B	H05B	C08G	C23C
<i>KR</i>	H05B	H02S	G02F	C09K	C07D
<i>TW</i>	C23C	G02F	H02J	G02B	H02M
<i>US</i>	F24J	H02J	H02M	C23C	G02B

Source: European Patent Office Worldwide Patent Statistics Database PATSTAT, 2018.

Note: For the period of 2010-2014. Cells highlighted in blue with labels of H02x relate primarily to activities that integrate PV into electricity systems.

Discussion and Conclusion

China's solar PV industry

- ▶ Strong positioning in GVCs
- ▶ Building socio-technical systems: Markets and demand

Moving beyond knowledge based focus

- ▶ Beyond GVC: new realms
- ▶ Market creation, entrepreneurial experimentations (demand side of innovations)
- ▶ **Unrelated diversifications**

Future research

- ▶ Limitations: PV is a footloose technology
- ▶ Replications to smaller developing countries?



Thank you.

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