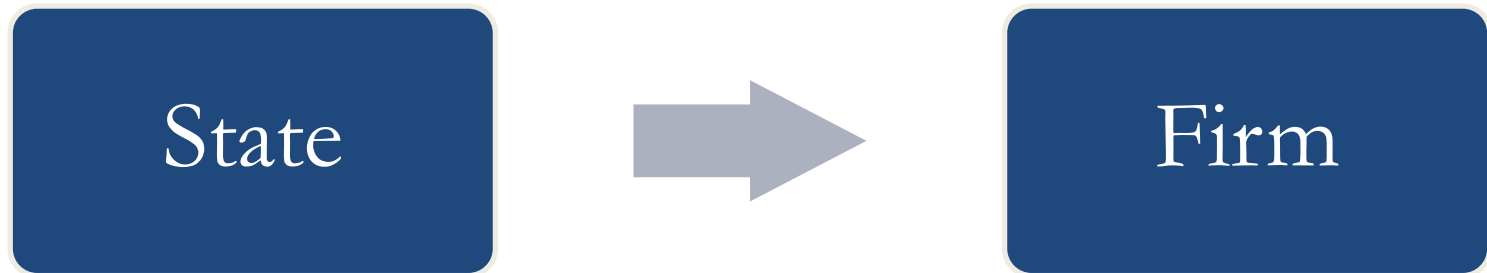# LOCALIZING MARKETS: POLITICAL ECONOMY OF ELECTRICITY SECTOR REFORM IN CHINA

Michael R. Davidson

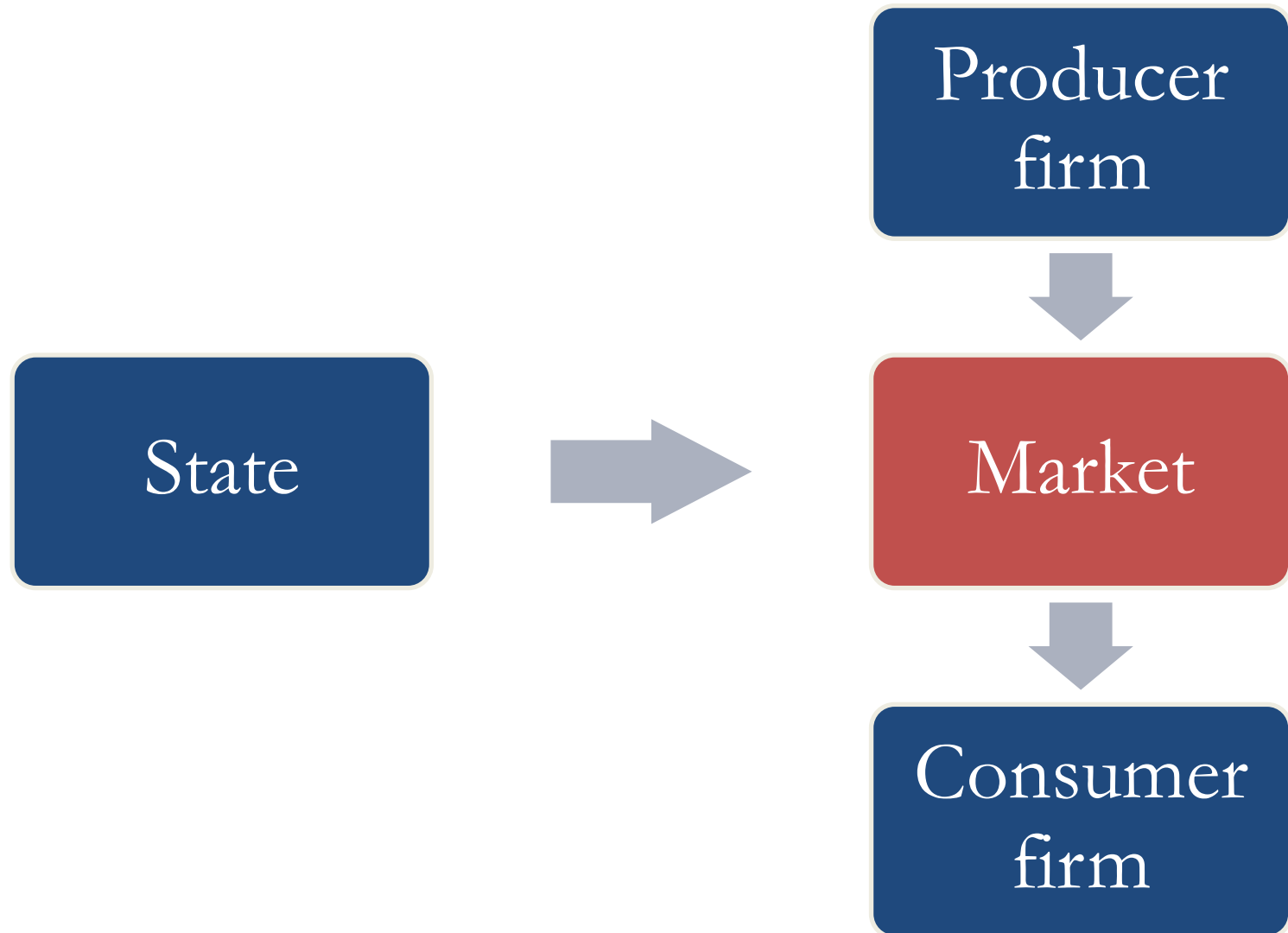**UC San Diego**

Valerie J. Karplus

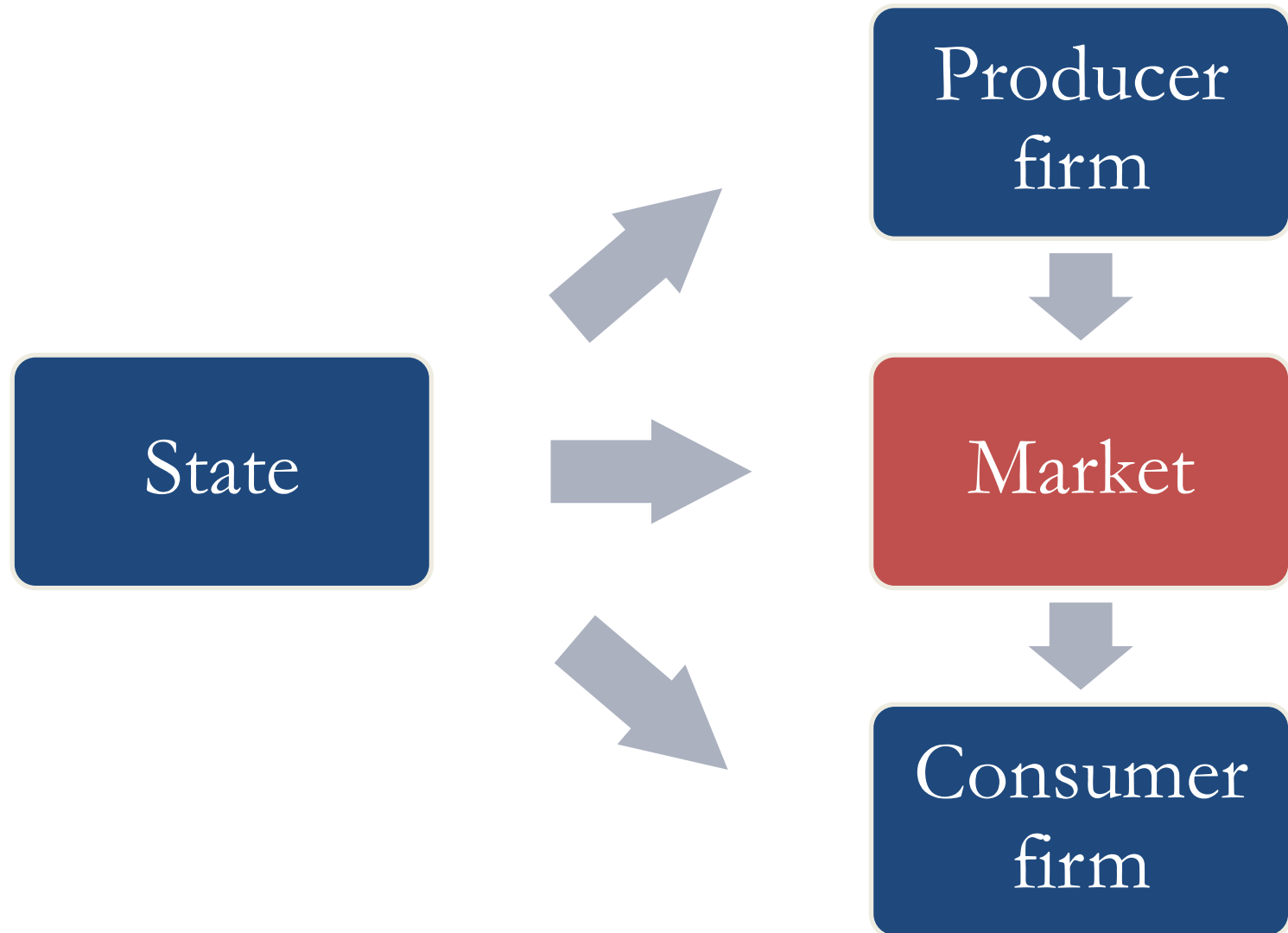**Carnegie Mellon University**

IAEE 2021

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                              Producer
                                firm
                                  │
                                  ▼
State  ──────►                  Market
                                  │
                                  ▼
                              Consumer
                                firm
```

Central
State

Local
State

?

Producer
firm

Market

Consumer
firm
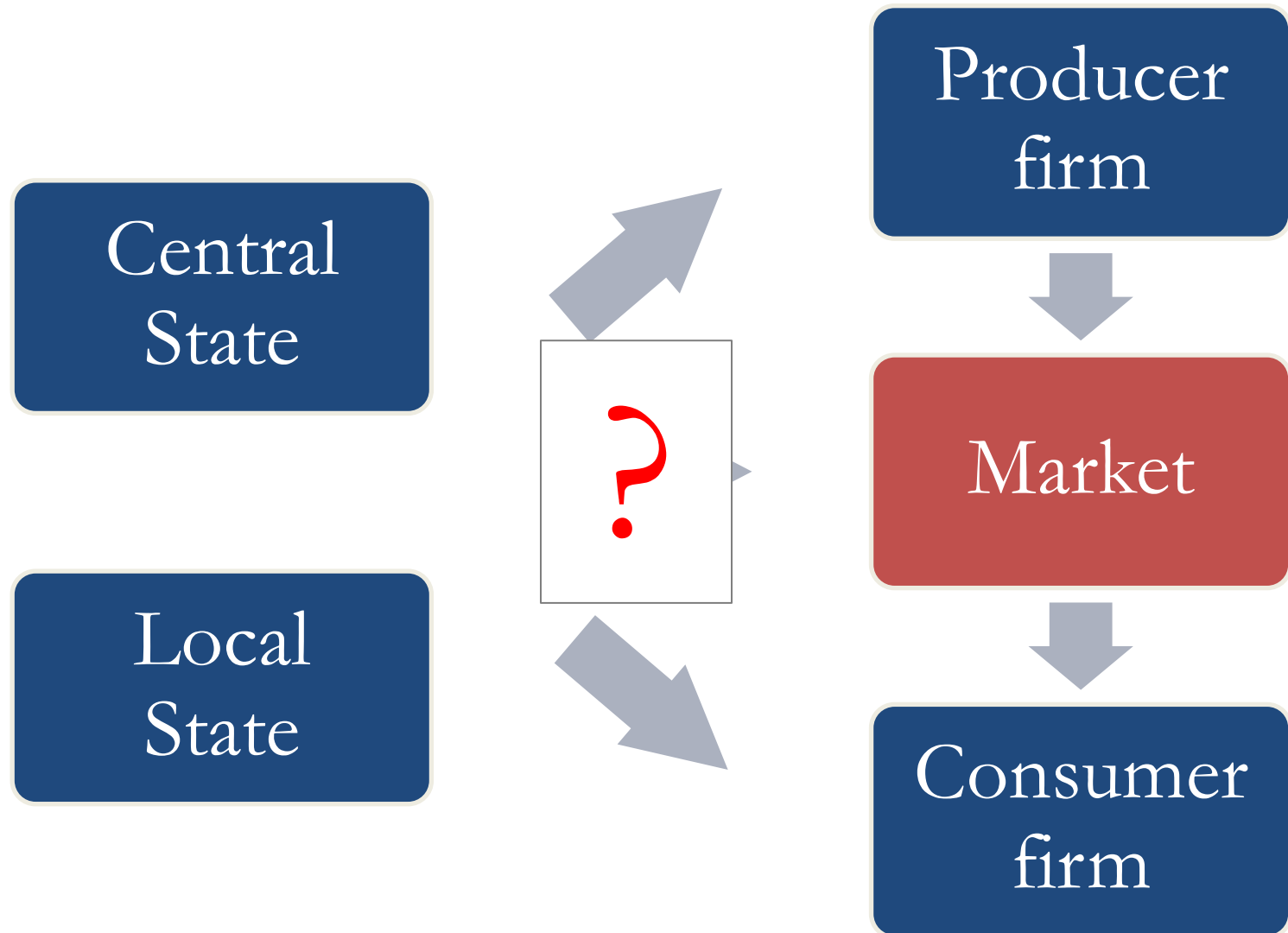
- Throughout 1980s and 1990s, relaxing of central state planning institutions put local governments at center of new market reforms via (Oi, 1999; Jin, Qian, & Weingast, 2005; Landry, 2008):
  - Local firm ownership and revenue sharing
  - Fiscal decentralization
  - Growth-oriented bureaucratic incentives
  - Experimentation with wide array of levers
- Local governments experimented with a range of levers, which if successful could be diffused nationally (Heilmann, 2008)
- Nevertheless, growth outcomes vary, in part due to "fundamental differences in regional political arrangements, economic institutions, and relations with the center" (Rithmire, 2014)

- The firm is essential actor in market opening strategy
- *Ideal (state-led) model*: market pressures force state-owned enterprises (SOEs) to compete and "grow out of the plan" (Naughton, 1995)
- *In practice,* SOEs face:
  - Weak profit-oriented managerial incentives (Steinfeld, 1998) (a.k.a. soft budget constraints (Kornai, Maskin, & Roland, 2003))
  - Strong state control in strategic sectors, including energy (Pearson, 2015)

(Brief) History of China's electricity reforms

(Reform #3): No. 9
Provincial experiments:
• Generation markets
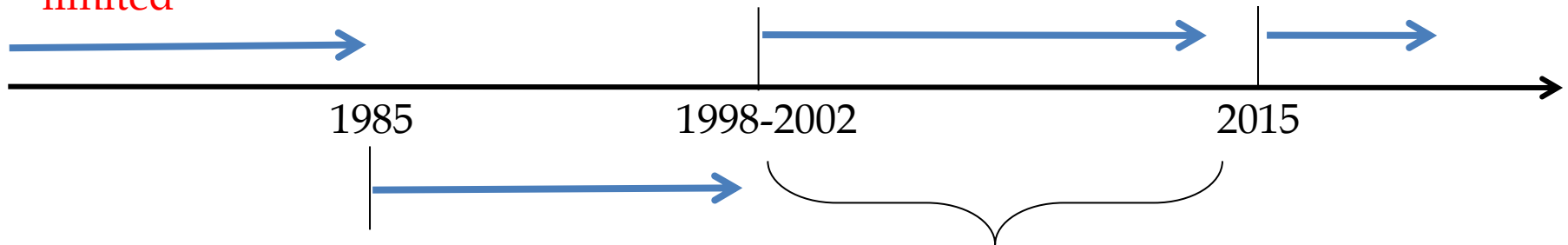• Retail competition
• Grid regulation

(Pre-Reform):
Vertically-integrated
state-run utility
✧ State finances
  limited

(Reform #2): Corporatization,
separation of generation &
grid, central market designs
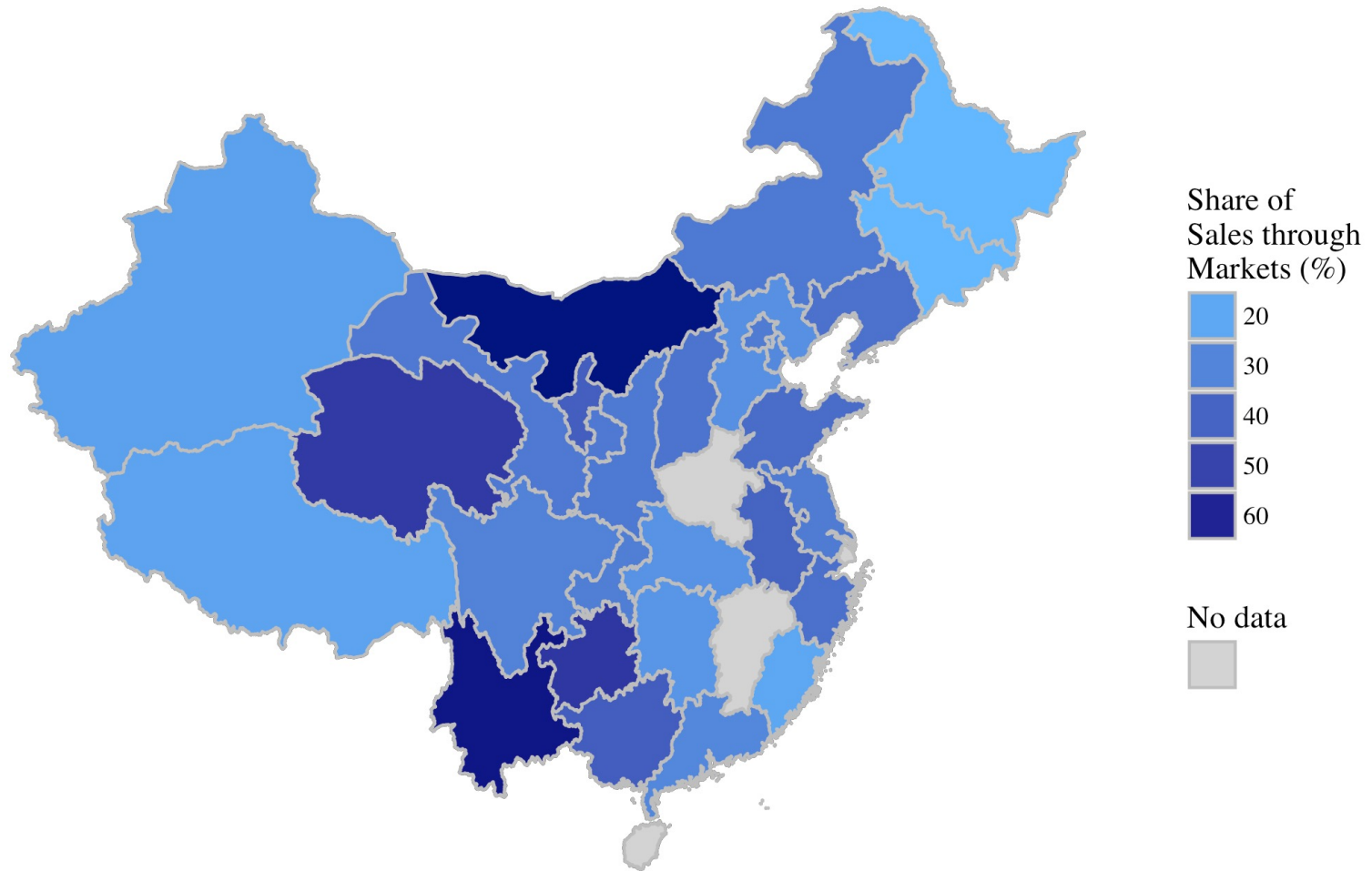
1985   1998-2002   2015

(Reform #1): Local govs and
private firms allowed to invest
in generation
✧ Inefficient & discriminatory
  plan allocation

✧ Failed market pilots
✧ High electricity prices
✧ Over-capacity

(Zhang & Heller, 2007; Andrews-Speed, 2013)

Marketization rates by province

Share of
Sales through
Markets (%)

20
30
40
50
60

No data

- Empirical evidence limited:
  - Xie, Xu, & Pollitt (2020) examine typical industrial bills in Guangdong and Zhejiang, finding reductions mostly attributable to administrative changes
  - Zheng, Menezes, & Nepal (2020) use average annual prices pre- and post-reform to conclude reforms reduced coal power prices in eastern region only
- None to our knowledge using sub-annual market data at the province or firm level to understand causes and consequences of provincial heterogeneity

1. What explains provinces' different embraces of electricity markets?

2. To what extent do provinces' market outcomes differ in terms of efficiency, and what is the cause?

- Market reforms fundamentally alter established institutions (i.e., central planning) affecting many actors

- Markets will **accelerate** when coordination costs are **low**:
  - Small number of firms
  - Firms and governments have shared interests
  - Governments own affected firms

- Alternative hypothesis: regulatory capture implies that large, well-connected firms may co-opt or delay marketization process

- Cost pass-through **–** the extent to which changes in input prices are reflected in market prices

- Two simultaneous factors:

  - <u>Market structure</u>: Local governments may alter design or intervene in operation to favor firms

  - <u>Firm bidding behavior</u>: Varying degrees of budget constraints imply differential response to cost pass-through of market

Main hypotheses

		Electricity producer local ownership	
		High	Low
Electricity consumer local ownership	High	High marketization rate Cost pass-through depends on relative shares and distribution of local government support	Moderate marketization rate Highest cost pass-through **(Shandong)**
	Low	Moderate marketization rate Lowest cost pass-through **(Guangdong)**	Low marketization rate Cost pass-through depends on relative shares and distribution of local government support

- Marketization rates (quarterly, province): China Electricity Council

- Prices, quantities (monthly, province)
  - Coal index: CCTD
  - Electricity plan: NDRC
  - Electricity market: provincial exchange centers
  - Electricity auction quantities (*firm-level*): provincial exchange centers

- (Pre-reform) ownership
  - Power plant ownership[1]: Global Energy Monitor, MEP
  - Manufacturing ownership[2]: 2013 industrial census

1: Hand-coding based on parent companies. For joint ownership (JV), we assign a value of the highest government level of ownership: thus, a central-provincial SOE is categorized as central, and a provincial SOE-private JV is categorized as provincial.

2: Majority state ownership (国有控股) and level of government hierarchy (机关级别)

MARKET EXTENT

$$M_{it} = \alpha + \beta \; ProvBelowManuf_i + \gamma \; NonCentralCoal_i + \lambda \; CoalPrice_{it} + \epsilon_{it}$$

- M_{it} is the marketization rate (share of electricity consumption sold through markets) in province i and quarter t

- $ProvBelowManuf_i$ is the revenue share of enterprises with provincial or sub-provincial state ownership in the manufacturing sector in province i

- $NonCentralCoal_i$ is the capacity share of coal generators in province i with no central ownership

- $CoalPrice_{it}$ is coal price index in province i and average over quarter t

Marketization rate

Local ownership on both producer and consumer sides tends to increase marketization

	Marketization Rate
ProvBelowManuf	0.238***
	(0.066)
NonCentralCoal	0.280***
	(0.069)
coalprice	0.0003**
	(0.0001)
Constant	-0.073
	(0.082)
Observations	99
R^2	0.236
Adjusted R^2	0.211
F Statistic	9.756*** (df = 3; 95)
Note:	***$p < 0.01$

MARKET EFFICIENCY

Coal price pass-through

$$P_{it} = \alpha + \lambda\, CoalPrice_{it} + \epsilon_{it}$$

- P_{it} is electricity auction price in province i and month t
- $CoalPrice_{it}$ is coal price index in province i and month t

	Guangdong	Shandong
Coal price	-0.145**	0.092***
	(0.057)	(0.030)
Constant	49.896	332.594***
	(35.173)	(18.051)
Observations	21	17
R^2	0.253	0.382
Adjusted R^2	0.213	0.341
F Statistic	6.423** (df = 1; 19)	9.269*** (df = 1; 15)
Note:	***p<0.01	

$$\log(Q_{jt})$$

$$= \alpha + \beta \log(CoalPrice_{j,t-1})$$

$$+ \gamma \, Oversight_j * \log(CoalPrice_{j,t-1})$$

$$+ \epsilon_{it}$$

- Q_{jt} is quantity of market participation (cleared) for firm j in month t
- $Oversight_j$ is ownership dummy of firm j (central SOE = reference)
- $CoalPrice_{jt}$ is coal price index of firm j (constant over province) in month t

Firm ownership and market participation

| | All | Log(Auction Quantity) | |
		Guangdong	Shandong
Log(leading coal price)	12.573***	2.471	-0.758
	(1.034)	(2.561)	(1.227)
OversightPrivate	35.933**	60.983**	5.117
	(14.774)	(26.168)	(24.094)
OversightProvincial	44.118***	40.424*	28.326
	(11.905)	(21.094)	(20.132)
Log(leading coal price) * OversightPrivate	-5.552**	-9.523**	-0.789
	(2.299)	(4.061)	(3.777)
Log(leading coal price) * OversightProvincial	-6.753***	-6.273*	-4.418
	(1.852)	(3.273)	(3.158)
Constant	-71.095***	-5.254	13.541*
	(6.626)	(16.502)	(7.837)
Observations	1,710	1,072	638
R^2	0.167	0.022	0.008
Adjusted R^2	0.164	0.018	0.001
F Statistic	68.133*** (df = 5; 1704)	4.881*** (df = 5; 1066)	1.065 (df = 5; 632)
Note:	***p<0.01		

Shandong has higher cost pass-through, no apparent preference to non-central generators, and firm bidding behavior reflecting this reality

Discussion

1. Central government appears to support power sector reforms to realize efficiencies. Central SOEs are less exposed financially to market reforms.

2. Varied provincial government interests influence the pace of the "bottom-up" market processes. Strong local ownership among consumers may propel reforms forward, both in market extent and efficiency.

3. If the reforms aim to encourage the utilization of large, more efficient generators, central architects might consider whether they would be willing to share the spoils—or at least keep local governments whole.

Thanks for your attention. Questions?

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