



Static Electricity: Institutional and Ideational Barriers to China's Market Reforms

Michael R. Davidson^{1,2}  · Margaret M. Pearson³

Accepted: 26 April 2022
© The Author(s) 2022

ABSTRACT

China's "economic juggernaut" is often noted to have arisen from successful market reforms carried out in the context of high state capacity. In contrast, we demonstrate that crucial reforms to replace central planning with markets have stalled as a result of major barriers of two types: institutional and ideational. Focusing on the electricity sector, we find that market reforms pushed by China's central government are hindered by deep inefficiencies that arise from the legacy plan and "plan-derived" institutions of subnational governments and grid companies, against which the central state has been largely ineffective. We also uncover fascinating ideational differences of the nature and purpose of "markets" that show how they often are envisioned more as a way to extend the planner's "toolbox," or to offer "salvation" for ailing incumbent firms, rather than to induce efficiency. Our empirical focus on three prominent types of "market-oriented" experiments in the electric power sector demonstrate clear limits to state capacity, limits that emanate from state actors rather than merely industry, despite high-priority central government goals of increasing efficiency, integrating renewable energy, and reducing emissions from the electricity sector.

Keywords Market reform · China · State capitalism · Institutions · Electric power

✉ Michael R. Davidson
mrdavidson@ucsd.edu

¹ School of Global Policy and Strategy, University of California San Diego, La Jolla, CA, USA

² Department of Mechanical and Aerospace Engineering, University of California San Diego, La Jolla, CA, USA

³ Department of Government and Politics, University of Maryland, College Park, MD, USA

Introduction

China's "economic juggernaut" has spurred an unprecedented growth trajectory that brought an estimated 800 million people out of poverty and underpinned the staying power of the ruling Chinese Communist Party. After four decades of reforms, "a reasonably stable and mutually reinforcing arrangement of political and economic institutions has now emerged" (Naughton and Tsai 2015, p. 1), built on sophisticated economic governance structures (Heilmann and Shih 2013). Indeed, China is often envied for possessing an ingredient scholars have long identified as important for economic development: state capacity (Geddes 1994; Migdal 1988; Yang 2003). China now outranks other post-Communist countries like Russia and even some industrialized countries, such as Italy, on measures of "government effectiveness" (World Bank 2018). While views on the pace of recent domestic economic and political reforms vary, the Chinese state—in particular, the central state—has never had more authority to enact its policy agenda.¹

At the apex of power, the Chinese central government has embarked on an ambitious package to reform the electric power sector—commonly recognized as crucial for further economic development. The government aims to address a long list of policy priorities, including increasing efficiency of production, reducing industrial electricity prices, enhancing energy security through conservation, and reducing harmful emissions through greater use of renewable energy (Guo et al. 2020). China's electricity sector alone is responsible for approximately 13% of global carbon dioxide (CO₂) emissions, creating additional international pressure to clean up its grid (Olivier and Peters 2020). In September 2020, President Xi Jinping announced China's intention to eliminate all CO₂ emissions from the economy by 2060 coupled with an accelerated deployment of renewable energy (Xi 2020). Modeling analyses and energy policy experts confirm that electric power reform is the most important policy lever to achieve deep reductions in economy-wide emissions (Gallagher et al. 2019).

In its latest electricity reforms, the central government has singled out markets, establishing electricity exchanges in every province and at the regional and national levels, which have catapulted shares of electricity sold outside of the plan to over a third nationally—up to two-thirds in some provinces—from just a few percent prior to 2015. Yet, despite central efforts, Beijing has not achieved well-functioning markets for electricity at the provincial, regional, or national levels, and struggles to implement an international standard "spot market," which would deliver the most gains. We demonstrate that legacy institutions—at the subnational level and within powerful state-owned grid companies—as well as the ideational landscape in which market reforms are deployed are crucial barriers to achieving these aspirations. China's experience with uneven market transitions is not unique. Russia's electricity sector reforms included elements of both "liberalism" and "statism" that reflect

¹ For example, Lardy (2019) argues that the slowdown in China's economy in recent years (albeit less severe than much of the global economy) is due to weakening domestic reforms, not lack of state capacity.

compromise among the center's market efficiency goals and incumbent institutions and actors (Wengle 2012). Some of India's subnational electricity sectors embraced "hybrid statist reforms" that sought to enhance efficiency whilst retaining an active state role (Chatterjee 2018).

Furthermore, the dynamics we identify in China are not adequately explained by the extant narratives of China's market reform approaches in other sectors. In the first of three dominant narratives, China's economic transformation is attributed to the leadership's embrace of market-oriented policies to reorganize inefficient factors of production, integrate into global markets, and dramatically pare back the role of the central state as exercised through the planning system. Many point to a reform leadership in the 1980s unleashing, albeit gradually, bottom-up forces of development. Such arguments credit Beijing with a willingness to "get out of the way" of newly deployed sources of economic dynamism. These were accompanied by reforms (in a more neoliberal vein) dismantling monopolies and, in the late 1990s and early 2000s, creation of market-fostering institutions such as "regulatory" mechanisms for arms' length guidance of many industries (Yang 2004; see also Vogel 2018).

A second common narrative to explain China's market reforms emphasizes "local dynamism" and subnational officials and institutions as linchpins of China's economic transformation. Often seen to mirror the first narrative, local dynamism has been unleashed in reaction to institutional reforms such as decentralized tax collection, a system of property "rights" for local officials to retain revenues from their jurisdiction's commercial activities, and revised growth-oriented promotion metrics (Montinola et al. 1995; Oi 1999; Rithmire 2014). This reflects the fact that China's economy has long been *de facto*—if not, given the unitary Leninist political system, *de jure*—highly decentralized (Landry 2008; Rawski 1995). Local jurisdictions compete with each other for domestic and overseas investment, selecting sectors and even specific firms to support (Ang 2016; Lü and Landry 2014; Oi 1999; Xu 2011). In this narrative, local state action is helpfully embedded in the economy in a manner reminiscent of Evans' (1995) concept of embedded autonomy.² Institutionally, the local state is a supplier of key market governance functions resulting from the central state's political decentralization efforts (Doner and Hersherberg 1999). A complementary dynamic is the tradition of experimentation, by which the center asks for or tolerates experiments by local officials and, if the experiments are deemed successful, encourages national diffusion (Heilmann 2008), in contrast to, e.g., India (Bardhan and Mookherjee 2006).

Whereas the first two narratives emphasize decentralized dynamism, a third narrative focuses on the "top-down" role of central state intervention, due variously to state developmental goals (Heilmann and Shih 2013) or to factional competition (Cai and Treisman 2006). Recently, the top-down approach has more firmly echoed developmental states literatures (Amsden 2001; Wade 1990). An emergent

² Although Evans (1995) most directly discusses embeddedness of central state actors with national level firms, as in developmental states, the broader concept suggests benefits to state actors at all levels embedding in society, as well as coordinating with each other.

“state capitalism” thesis focuses on the role of an autonomous, strategically-oriented bureaucracy selecting “winners” with beneficial and targeted industrial policies (Chen and Rithmire 2020; Eaton 2015; Hsueh 2011), all of which contribute to state capacity and at the same time work in concert with market reforms (Naughton and Tsai 2015). Growth strategies of the central state have in general focused on the “commanding heights” of the economy—including network industries—as well as sectors for which industrial policy has been the norm in China (e.g., automobiles) (Pearson 2015). Moreover, recent central reform documents that highlight the importance of “markets as decisive factors in resource allocation” while holding up the leading role of state ownership in the “socialist market economy” fit within this narrative (CPCCC 2013).

In contrast to these explanations for the roots of China’s market success, central efforts to reform the electric power sector have met substantial challenges. In electric power, we argue that incumbent local actors and legacy planning institutions act as crucial barriers to achieving central reform goals. While decentralization often has been seen as a spur to Chinese policy innovation and growth (Ang 2016; Heilmann 2008), we show that strong subnational governments also act as a drag on non-incremental reforms. Indeed, local governments, naturally, seek to protect and expand incumbent producers as these sectors provide revenues and employment, which has negatively impacted China’s internal and external trading environments and the center’s market agenda (Mertha 2005).³ We also show that ideational disagreements over the nature and purpose of markets act as less visible and yet potent hindrances. More than just straightforward expressions of interests (Chen 2010), markets are viewed as ideational justifications to prioritize equity above efficiency or, alternatively, as a means of “salvation” for ailing incumbent firms rather than to induce entry of more efficient firms (Steinfeld 2004). In the conclusion, we point to other sectors where potentially similar dynamics are taking place.

Importantly, the institutional and ideational hindrances to the implementation of markets designed by China’s central government support the more novel idea that domestic state structures and actors are themselves an important constraint on China’s state capacity. In other words, the central government’s inability to overcome obstacles posed by institutional and ideational legacies suggests why an otherwise relatively capacious state is unable to achieve key goals (Meckling and Nahm 2021). We demonstrate that in contemporary China, constraints motivated by state actors are as important to, if not more important than, the finding of regulatory capture by industry that is most frequently cited as an obstacle to state capacity (Evans 1997; Skocpol 1985).

We elaborate three cases of market types—bilateral contracts, “excess” electricity exchanges, and markets for “peaking” power—that capture heterogeneous influences of local actors and legacy processes, and represent a wide range of reform experiences to date in China. Using novel data from fieldwork conducted in northeastern and northwestern China, in this article we focus on institutional and ideational

³ While some scholars of China’s economic reforms have noted local protectionism (Wedeman 2003), the field has generally downplayed its deleterious effects.

elements that gave rise to the design and implementation of these markets, and explain why local markets have not lived up to expectations and why regional or national integration has so far been unsuccessful.⁴

Reforming China's Electricity Sector

Governance Paradigms of Electric Power

Beginning in the 1970s, new economic theories of electricity sector organization emerged advocating competition in certain segments of historically vertically-integrated electricity monopolies, building on experiences with other monopolies such as railroads. A “textbook model” for restructuring has taken shape over several decades in virtually all industrialized and a majority of developing countries. Institutional changes include “unbundling” ownership and/or control of generators from grid companies, enhancing regulation of the “natural monopoly” positions of grid companies, creating market competition, ensuring open access to the grid and non-discriminatory system operation,⁵ and establishing or enhancing regulatory agencies to oversee the new complexities (Hunt 2002; Joskow 2008). (Figure A1 in the Appendix illustrates the traditional vertically-integrated utility, the new restructured model, as well as the situation in post-reform China, discussed in the next section).⁶

Fundamental to the textbook electricity market design theory is a “spot market,” which generates prices at regular time intervals (e.g., hourly) for specified points in the network based on bids by generators and consumers. Spot market operation is organized by the system operator, which in the textbook restructured case is independent of grid companies. Markets inform the process of “dispatch,” the responsibility of system operators (in both vertically-integrated and market systems) to match supply and demand at every instant in order to keep the lights on. A well-functioning spot market also serves as a foundation for efficiently integrating renewable energy, which we discuss later in the cases. Ancillary services, such as “reserve” generation, are also typically included in the market, providing a limited back-up in case of unexpected changes in conditions. Market operators design market rules in coordination with the regulator⁷ and stakeholders and have the responsibility to ensure their non-discriminatory application.

⁴ We use the term “market” to refer to processes through which parties compete to sell or buy electricity outside of the traditional government planning process, including spot markets, forward markets, auctions, contracts, and exchange(s), all discussed below.

⁵ Open access and non-discrimination refer to the ability for any generating firm or customer to access the regulated network and receive the same treatment as any other entity. Discrimination occurs when a network owner, system operator or market operator gives preferential treatment to some users of the grid (e.g., a utility may prefer to use its own generators, or may favor a certain type of generation).

⁶ For the remainder of the article, unless explicitly referenced otherwise, our discussion of markets and competition will refer to the generation segment of the supply chain.

⁷ Electricity regulators should facilitate easy exchanges between buyers and sellers, ensure open access to the network, and eliminate or closely monitor any potential conflicts of interest and exercise of market power. See Joskow (2008).

Besides spot markets—which should reflect the “true” value of electricity—most systems provide for other ways of contracting electricity. Electricity can be purchased up to years in advance through “forward” contracts, which in the textbook case simply hedge against volatility in the short-term market. Even for systems with large amounts of forward hedging, the spot market uniquely signals prices for efficient system operation and is thus fundamental to well-functioning forward markets.

The textbook restructuring model is relatively silent on the politics and other conditions necessary to achieve these outcomes, beyond casual reference to “transition mechanisms” to ease firms through the process. The choice of whether or not to restructure is also highly context-specific, though most industrialized countries—with the notable exception of several U.S. states—have implemented markets. Indeed, China’s stated reform goals in recent years—efficiency and competitiveness—align more with characteristic objectives of industrialized countries as opposed to developing countries, which are more concerned with unburdening public finances and forestalling shortages (Williams and Ghanadan 2006). In addition, with the exception of a complex political economy, China shares virtually none of the context that has hindered reforms in major developing countries to date, including “chronic electricity shortages, weak institutions, under-capitalization, poor operating equipment, high system losses (and electricity theft), complex political economy settings and the inability to extend access to all the poor” (Jamash et al. 2017, p. 196). Given the maturation of its grid technology, strong state capacity, and no formal federalist structure (such as in the U.S.) that might permit subnational entities to “opt out” of a central market push, China and its provinces would seem poised for markets.

Instead, we shall see that while China’s central government has aimed to incentivize efficient electricity generation and distribution through the use of market-based mechanisms, reflecting efforts to move toward the textbook market model, deep constraints on these reforms emanate from the legacy institutional role of subnational (provincial and municipal) governments, and powerful third actors and processes (grid companies), against which the central state has been largely ineffective. In short, market-building aspirations continue to be thwarted in ways that shed a skeptical light on simple conclusions about China’s market transition.

China’s Protracted Electricity Reforms

China’s central government has made repeated efforts to reform the electric power sector to meet efficiency, price and, most recently, environmental goals. These protracted reforms are generally understood as proceeding through three rounds. Up until the mid-1980s, China’s electricity sector was quintessentially centrally planned—closely controlled by a central ministry and its local government bureaus, and whose electricity officials often held twin positions in state-owned power plants and government (Zhang and Heller 2007). This top-heavy system was unable to keep up with growing electricity demand, and prompted China’s first major electricity sector reform in the 1980s. A main feature of these reforms was to open investment in generation to organizations not tied to central ministries (State Council

1985). Many of the new non-ministry generators were financed and owned by local governments, deepening their interests in protecting these assets. Even while recognizing the usefulness of decentralization in resolving electricity shortages, central officials contemporaneously foresaw conflicts with the ultimate central government goal of creating a national electricity market.⁸

Meanwhile, although local governments were free to invest in new plants, system operation and dispatch remained in the hands of the central ministry. This set up a conflict between the new locally-owned generators and ministry-owned generators over whose plants would be selected to produce (and sell). Resolving this conflict was the goal of the second major sector reorganization of the sector (1997–2002), which created two large grid companies (State Grid and Southern Grid, each with regional and provincial subsidiaries), unbundled these grid companies from generation, called for competitive generation markets, and established an independent regulator.⁹ They followed international prescriptions of the time and carried them out with the close cooperation of international institutions (Shao et al. 1997).

The second round of reforms also established a system of dispatch that directly built on legacy central planning processes. This system originally was intended as an interim solution until markets took hold. In particular, provincial government Economic and Informatization Commissions (EICs) directed the process for the highly consequential annual production allocations, in consultation with the grid company.¹⁰ Finally, provincial and regional grid companies controlled dispatch decisions at monthly and annual intervals in order to meet the allocations and inter-provincial agreements. These responsibilities—relevant to the cases discussed later—are illustrated in Appendix C1.

Furthermore, crucial rules for the sector were governed not by market-based principles, but rather by principles of “transparency, equity and fairness” (公开, 公平, 公正)—abbreviated, *sangong* (三公) (SERC 2003). The *sangong* principles applied to local governments (responsible for allocations to generators to sell power) and grid companies (responsible for ensuring the allocations are met), leading to an “equal shares dispatch” that ensured that generators of the same type, regardless of efficiency, produce (and sell) similar amounts.¹¹ As we shall see in the cases,

⁸ Premier Li Peng articulated this position clearly (Kong 2010).

⁹ See State Council (2002). The independent regulator was abolished in 2013 and its authorities subsumed into other government bodies such as the National Energy Administration, indicating the retreat from regulatory state approaches to electric power, see Lin and Purra (2018).

¹⁰ Electricity plan allocations (*jihua dianliang fenpei* | 计划电量分配) essentially divide production rights at guaranteed government-set prices among generators. We refer to them as “allocations” to distinguish from production quotas common under central planning—a burden-sharing mechanism to achieve government production targets. The former serves a larger objective of maintaining production rights for independent competing firms when production decisions are no longer centralized. The central government sets production for very large generators.

¹¹ See Kahl et al. (2013). The *sangong* principles have been used broadly in PRC administrative law contexts to state a general goal rather than a specifically-defined process or outcome of the sort we find here. The principle was popularized in the 1990s to promote transparency in political and economic liberalization. The emphasis in the electricity sector on “fairness” as “equal treatment” therefore appears to be an adaptation of the original intention.

although *sangong* principles exist in tension with market principles, the two often are referenced in tandem. Although constrained by *sangong* dispatch principles, grid companies nevertheless continue to play an expansive role covering multiple functions: system operator, retailer, grid planner, and stakeholder in production allocation decisions (see Appendix Fig. 1).

Markets have been a key feature of central government documents beginning with the second round of reforms, spearheaded by central government reformer Premier Zhu Rongji and opposed by various actors with interests in the central planning status quo (Chen 2010). Following the successful sector reorganization, two spot markets were piloted in State Grid, first in its Northeast Grid (2005) and second in its Eastern Grid (2006).¹² Foreshadowing our cases, these spot market pilots were shut down in significant part because of the preference of local governments, generators, and grids for the status quo of government-established prices and government-guaranteed production allocations (Wen 2014).

Following a relative hiatus, high-level calls for markets in the center (2013) and decentralization of much investment approval authority (2014)¹³ reemerged, accelerating the market agenda for electricity and launching the third reform round in 2015—aimed at (finally) establishing markets and improving the regulation of grid monopolies (State Council 2015). These market-oriented efforts coincided with decentralization of permitting authority for new generators, which exacerbated conflicts between coal and renewable energy that we explore in the cases (Alkon and Wong 2020). Similar to permitting, in the new round the center gave further autonomy to the provinces, in this case to experiment and develop markets as they saw fit. While early central government drafts put forward a single market regime, these documents were later elaborated to provide more options and be less restrictive.¹⁴ Spot markets, in particular, were eventually cast as “supplementary” (*buchong* | 补充) (NDRC 2015). Central policy-makers justified this by interpreting the mistakes of prior pilots as a lack of flexibility given to provinces.¹⁵

Provincial governments overwhelmingly adopted versions of forward markets (typically, annual contracts), accounting for most of the electricity sold through market-type arrangements. These forward markets did in fact move the system toward the market model by reducing local state-directed generation allocations and allowing for some degree of competition on price. Yet as revealed in the cases presented below, provincial governments also designed them to be able to intervene in their operation to serve local goals. The center thus underestimated the *ex ante* design preferences of local governments and barriers to standard spot market adoption. In addition, as the cases below show, early stages of spot market planning—for which

¹² (Dai 2013). Also, Interview 2016-A.

¹³ For example, all new coal generation project approval was decentralized to the provincial level (State Council 2014). Decentralization, along with the equal shares dispatch policy, invites over-entry relative to an efficient market, see Ren et al. (2019).

¹⁴ Interview 2018-A, 2018-B.

¹⁵ Interview 2018-B.

there are eight ongoing pilots—are being overshadowed by the more expansive adoption of other, non-standard short-term markets that keep the allocation and forward contract institutions intact.

A parallel policy priority of the late 2000s was Beijing’s high-profile goals of increasing production of electricity from renewable resources and addressing environmental challenges. As the share of renewables produced rose, around 2012, curtailment of renewable energy—occurring when wind, solar or hydropower are not accepted onto the grid to their full availability—started to increase. In addition to technical causes, China’s curtailment challenges arise in part from inefficiencies in the *sangong* dispatch and inter-provincial trade barriers (Davidson and Pérez-Arriaga 2018).

Institutional and Ideational Barriers to Electricity Markets

As we saw in the previous section, China’s electricity sector has left behind the vertically-integrated model over three rounds of central reforms that continue until today. Still, legacy institutions from the planning era, especially at the local level, as well as new institutions generated many obstacles to adopting standard electricity markets.¹⁶ In addition, despite decades of electricity reforms, notions of what exactly constitutes a “market” and what are its goals remain surprisingly diverse. As a result, China’s electricity sector does not embrace tightly any of three common narratives for China’s market reforms. This has inhibited the achievement of efficient electricity production as well as other policy objectives. Here, we define the key institutional and ideological features that shape China’s electricity market developments in the specific cases presented below.

Decentralization of authority in the electricity sector shifted interest group pressures by creating powerful subnational institutions that serve incumbents while at the same time encouraging excess entry and limited exit of generation firms. In addition, sectoral planning institutions were transferred to newly corporatized grid companies, which perpetuated these “plan-derived” institutions throughout market reform processes, in addition to gaining new opportunities as market actors. Specifically, grid companies have historically manufactured much of the transmission equipment that they deploy, and the grid company can strategically increase its revenues by sending electricity over its high-priced lines. The grid’s size, highly specialized nature, and new responsibilities have translated into political influence, as major grid companies have successfully lobbied to alter or weaken reform measures (Xu 2016). Moreover, equal allocation of the rights of generators to produce through *sangong* “equal shares” dispatch has even been formalized.

In addition, separate from pure interest-based arguments, ideationally, we observe in the Chinese electricity reform context at least three interpretations of

¹⁶ Nahm (2017) finds that legacy institutions of central funding as well as local supply chains has aided manufacturing supply chains for renewable energy. In contrast, for the generation of electricity, patterns found in manufacturing are less relevant.

the function of markets.¹⁷ First is the gradualist approach of markets as objects to “grow out of the plan” by progressively opening up protected firms to competition in order to stimulate fluid entry and exit and increase efficiency of surviving incumbents (Naughton 1995). This view is closest to the neo-classical “market as selection,” in which markets continuously reallocate resources to facilitate entry and exit (Schumpeter 1911; Steinfeld 2004).

Second is the notion that reformers embrace markets as yet another tool in the state’s toolbox, designed to address specific problems for which traditional planning tools are ill-equipped. For example, values of equity toward market participants as expressed in *sangong* principles are used to justify what appear to be quite non-market institutions or goals. Markets, appropriately shaped, are one of a set of tools to bring about transformation of the economy. Third is the ideation of markets as “salvation” for ailing incumbent firms. In this view, markets can help support incumbent firms upon which the economy (and politicians, perhaps) relies for various goods and rents. This can equally apply to generation firms who may be beneficially pushed to improve efficiency as well as to important consuming firms in need of “nurturing” through reduced electricity prices.

These latter two state-centered ideations can be distinguished thus: markets as extensions of the state’s toolbox signal progress and reflect the value of experimentation to enhance various policy goals (which might be efficiency, but also fostering local input), whereas “markets as salvation for firms” is more about protecting a locus of political or economic value. Furthermore, as the cases will illustrate, mutually inconsistent views can surround a single market intervention. The ambiguities arising from market ideation tend to further limit the effectiveness of these markets. These institutional and ideational features are summarized in Table 1.

Cases

No Chinese province has yet fully implemented a spot market.¹⁸ Instead, electricity designated to be sold out of the plan is distributed through a variety of alternative market types. We examine three cases in particular—bilateral contracts, “excess” electricity exchanges, and a market for “peaking” power to accommodate renewable energy—which represent either potentially complementary (bilateral contracts) or completely distinct (“excess” exchanges, peaking market) approaches to spot markets. In these, institutional features and ideational differences combined to thwart the center’s market reform goals. Besides implications for efficiency, production

¹⁷ Chen (2010) argues that reference to “markets” was a political tool in 2002 electricity reforms, with electricity officials paying lip-service to market-conforming views while actually opposing them. We regard this as a functional use of the rhetoric of markets, rather than ideation per se. As our cases below explore, there is substantial evidence that alternative uses of the term “market” are not simply rhetorical devices to win a policy.

¹⁸ Of the eight designated spot market pilots, all have begun some form of trial implementation. Guangdong, in southern China, is the site of the most advanced pilot (Guangdong Electricity Exchange 2020).

rights, and ideation of markets, we also show that these experiments have the potential to hinder the national policy to reduce curtailment of renewable energy.¹⁹

Much of the literature on the political economy of China's market reforms in general has focused on the eastern, coastal regions, emphasizing the positive and negative roles played by exogenous factors, such as foreign direct investment (FDI) and export-led growth (Chen 2018). In this study, we examine instead electricity market developments in the northeastern and northwestern regions (see Fig. 1). This choice of observations for our market cases is driven by two considerations. First, we are particularly focused on barriers to regional and national market integration, for which laggard provinces embracing markets is a necessary condition, whereas foreign financial flows and foreign exports are less critical. This focus allows us to explore in depth the dynamic underlying barriers to classic market development.

Second, the handful of provinces that are further along in spot market development are highly non-representative of the rest of country along a number of important dimensions.²⁰ In contrast, the northeast and the northwest areas in our cases face significant local economic challenges that are representative of large swaths of China. The coal and mineral-rich northeastern region, consisting of Liaoning, Jilin and Heilongjiang provinces, was the site of early industrialization in China going back to the 1950s; however, it lost ground to other regions during the 1990s and has since failed to recover. Due to its plentiful coal deposits, 80% of installed generation capacity is coal-based (CEC 2017). The Northeast Grid—a regional subsidiary of State Grid—covers these northeast provinces, as well as the eastern part of Inner Mongolia.²¹ The northwestern region, consisting of Xinjiang, Qinghai, Gansu, Ningxia and Shaanxi provinces, is more remote and early economic development primarily relied on exporting natural resources, including coal, to other provinces as well as developing hydropower potential along the Yellow River. Following the launch of the “Develop the West” campaign (*xibu dakaiifa* | 西部大开发) in the 1990s to address regional disparities, northwestern provinces began to grow their own energy-intensive industries, rapidly scaling up local generation capacity and increasing exports to other provinces. It is in this context that the experiments we discuss in our three cases appear.

Bilateral Markets: Conflicting Central and Local Interpretations

The dominant mode of electricity sector market transactions is the bilateral contract between generators and large consumers. This model began in a handful of pilots and has spread across the country since 2015. Central guidelines established the

¹⁹ Sources of data for these cases are archival government and grid documents, contemporaneous media accounts, and interviews conducted in 2015–2016 and 2018. Details on methodology and data sources are in Appendix A and B. For further analysis related to these cases, see Davidson (2018).

²⁰ Coastal provinces (e.g., Guangdong, Jiangsu, Zhejiang) and provincial-level municipalities (e.g., Beijing, Shanghai, Tianjin) consistently score highest in the country for degrees of marketization, as measured by development of the private sector, government-market relations, etc. (Gang et al. 2018).

²¹ Western Inner Mongolia is part of the Inner Mongolia Grid Company.

contracts as voluntary, typically one-year agreements, to be implemented by the grid company (SERC 2009). Beyond this, Beijing has given wide latitude to provinces to establish and oversee contract negotiations. Even with this latitude, in the case of bilateral contracts in Gansu Province we find that provincial leaders interpret the meaning of markets much differently from what was intended by the center. Moreover, we observe that local actors and the grid operator sought successfully to protect energy-intensive industrial consumers and maintain equitable allocation between generators in fulfilling that demand.

Gansu province in the northwest was an early adopter of annual bilateral contracts. Its remote location and reliance on energy-intensive industry puts particular pressure on officials to keep electricity prices low. According to local respondents, Gansu's industry became particularly dependent on subsidies following the 2008–9 financial crisis, transitioning the electricity sector informally to a role of “nurturing consumers” (*yang yonghu* | 养用户).²² Because bilateral contracts would reduce prices relative to the benchmark price administered by the central government (i.e., outside of provincial control), Gansu officials were reportedly over-zealous in pursuing bilateral markets, proceeding in 2010 without central approval and prompting the center to temporarily call it to a halt before resuming in the third round of reforms (SCEO 2015).

Bilateral contract designs have institutionalized a number of key subnational government priorities, embracing a “planner’s toolbox” ideation of markets, i.e., aimed to achieve specific political aims as opposed to creating efficient price signals. Bilateral contracts for renewable energy are nominally designed to support Gansu’s efforts to address persistent curtailment by pushing down renewable prices (Gansu DRC 2016). At the same time, however, the Gansu government incentivizes excess electricity consumption by key industries through the establishment of a “market multiplier” that actually forces consumers to purchase additional coal electricity. The basic process as set by provincial government/regulators is as follows (Gansu Electricity Exchange 2016):

1. Provincial government determines (in consultation with the grid) the total allowable amount of electricity from coal and wind to be handled in bilateral contracts, denominated in monthly or seasonal totals.
2. Renewable energy generators find consumers and agree bilaterally on contract price and quantity. Prices are typically much lower than the government-set benchmark tariff for renewables.
3. Renewable energy generators also coordinate a contract between coal generators and consumers—negotiated at a different price from renewables—with quantity equal to a multiple of four times the contracted renewable energy.

The market element of this program lies in the bilateral negotiation between generators and consumers over price and quantity, reducing the role of system operator allocation. But, foreshadowing the idea that the market is a tool in the planner’s toolkit, provincial government actors obviously have a strong hand. By establishing

²² Interviews 2016-B, 2016-C.



Fig. 1 Major grid regions (red borders) and provinces (red shading) of State Grid referenced in the market cases. All-caps labels refer to other grid companies

Table 1 Institutional and ideational features that inhibit market development

Institutional barriers	Diverse market ideation
Subnational governments: <ul style="list-style-type: none"> • Encourage excess firm entry with varied ownership structures • Limit exit and trade to protect incumbents Legacy plan-derived institutions: <ul style="list-style-type: none"> • State allocation of production rights • Fairness-based participation principles (<i>sangong</i>) 	Market as: <ul style="list-style-type: none"> • Tool for efficiency • Extension of “planner’s toolbox” • “Salvation” for ailing incumbents

the coal-renewable multiplier, the provincial government incentivizes electricity-intensive industries in the province to over-produce and waste as firms complained that they have no need for so much electricity.²³

These bilateral contract markets also represent an evolution in the interpretation of the equity principle in *sangong*. Under the old system, similar generating types should receive similar generation allocations. The new system focuses on facilitating competition (through the quantity and price negotiations) among

²³ Interview 2016-B.

similar generating types and meeting contracted amounts within a small deviation.²⁴ However, competition does not extend to generators of different types—wind and coal do not directly compete and, through the multiplier, among other practices, are explicitly not treated “equally.”

Moreover, it is unclear the extent to which these markets achieve the central goals of inducing additional renewable energy production that would have otherwise been curtailed.²⁵ This is because these markets operate within the constraints of legacy processes of grid companies—which assume allocations on timeframes of a month or longer—over which available renewable energy generation is unpredictable. Changes from month to month and from farm to farm may be attributable to either the wind resource or to differences in dispatch as a result of the market. In addition, the markets are not truly voluntary: some farms at first refused to participate and were reprimanded by provincial officials and punished with lower plan totals in the subsequent year.²⁶

In response, the central government has attempted to limit renewable energy’s forced participation in discriminatory markets by local governments. Beginning in 2016, the National Energy Administration enhanced its policy of mandatory “full purchasing” of wind and solar electricity by prescribing minimum capacity factors by resource for each province.²⁷ Regulations specify renewable energy up to the minimum capacity factor must be paid at the feed-in-tariff (FIT), i.e., the full benchmark tariff, only beyond which can renewable energy be sold through market-based mechanisms (NDRC and NEA 2016). FITs are multi-year guarantees by the government given to generators of certain new energy types to provide revenue certainty. Abrogating these amounts to breaking a contract upon which renewable generators have made substantial investment.

In fact, central minimum capacity factor targets were largely aspirational, and virtually all provinces failed to meet them. Reflecting the primacy of local authority in this space, there were no repercussions from the center (NEA 2017). In Gansu, however, conflicting local and central government intentions with respect to markets led to a rare public rebuke by the NEA of local policy. The Gansu government established minimum capacity factor targets roughly a third of the central mandates, and within weeks the NEA forced Gansu to retract them (Xiao 2016). Given the realized generation, and with one estimate that roughly 60% of all renewable energy was settled through bilateral contracts that year,²⁸ the local rules ultimately prevailed: the *de facto* “full purchase” amount paid at the full FIT was indeed around the province’s target.

Gansu’s example therefore illustrates why local governments adopt bilateral contracts, China’s dominant electricity market type: ideologically, these market

²⁴ Interview 2016-D, 2016-E.

²⁵ In the next case, we discuss an ideal market setup from the perspective of wind generators.

²⁶ Interview 2016-C.

²⁷ Capacity factor measures utilization of a plant with respect to its theoretical total potential. The NEA prescribed capacity factors of 20–23% for wind in northeastern and northwestern, while wind capacity factors in China have historically been around 15%.

²⁸ Interview 2016-C.

instruments are tools for particularistic state goals, such as encouraging industrial electricity consumption, not efficiency or other market-building goals. In addition to specifying which generators may participate, local governments have autonomy to specify discriminatory contract terms such as “market multipliers.” The clear primacy of local initiatives over central aims illustrates the institutional constraints that such efforts must navigate in achieving these aims (e.g., legacy *sangong* allocations).

Exporting “Excess” Electricity: Localities Redefine Market Roles

The supply of electricity outstrips demand in most areas in northern China (particularly relative to the rapid growth period of the 2000s), leading to pronounced coal plant overcapacity driven in part by legacy subnational institutions embedded in earlier reforms.²⁹ In response, the China Electricity Council, the electricity industry’s main association, as early as 2011 sought to frame certain regions as having “excess” or “surplus” (*fuyu* | 富余) capacity, in order to encourage greater inter-provincial trade (CEC 2011). The central government for decades has envisioned large-scale inter-provincial energy transfers and eagerly established guidelines for trading this “excess,” relying on a mechanism known as an “excess electricity exchange.”

Beginning in 2012, the Northeast Grid and North Grid agreed to trade the Northeast’s “excess” coal and wind electricity through a “market-based mechanism based on principles of equality and voluntary participation.”³⁰ The exchange procedure, typically conducted semi-annually, begins with sending and receiving governments and grid companies deciding on a total trading amount (e.g., Northeast Electricity Exchange 2016). The price is fixed by the central government at a level below the prevailing tariffs in the sending region, sufficient to incentivize reticent receiving provinces to accept imported power. Approved wind and coal plants in the sending region bid into an exchange operated by their grid company (Northeast Grid). In this manner, generators who face oversupply may access additional consumers, though at a reduced price. Based on a review of the results of excess wind auctions in 2015 and 2016, nearly all farms participated, reflecting the large curtailment pressure faced by northeast wind suppliers. Roughly 31% of all wind electricity generation was sold through these exchanges over one winter (NECG 2015).

However, in contrast to bilateral contracts, the excess exchanges do not allow for competition on price. When more generators wish to participate than the trading amount negotiated by governments and grids—frequently the case—regulations dictate that export quantities be split evenly according to plant capacity, essentially reverting to a *sangong*-like sharing mechanism (Northeast SERC 2013).

In practice, the “excess” exchanges thus represent only a minor departure from the legacy processes for inter-provincial trade of electricity negotiated directly

²⁹ Overcapacity is further exacerbated by a number of factors brought forth in our analysis. Given guaranteed tariffs and yet continued equity-based production allocation, provincial governments actively encourage entry by generation firms, even when they generate excess, while simultaneously limiting firm exit and competition from imports from other provinces.

³⁰ See Northeast SERC (2013). The Inner Mongolia Grid established a similar exchange the year prior.

among governments. As one official put it: “markets are created to solve a problem, not to increase efficiency.”³¹ Markets, in which lower prices lead to greater market shares and incentivize exit of inefficient generators, is not an attractive or permitted option and instead existing generators gain protection for sub-optimal supply. Formally, moreover, not only are these transactions negotiated by provincial governments and the regional grids—not firms themselves³²—even physical locations of the vast majority of wind farms are not taken into account in the exchange process, irrationally giving a wind farm in southern Liaoning close to the border with the importer (North Grid) the same treatment as one in the far north of Heilongjiang, though the costs of transmission differ widely. Furthermore, providing similar treatment to all wind farms weakens the link between participation in the market and the benefits of greater production.³³

The excess exchange case highlights the effects of entrenched “plan-derived” institutions—i.e., monthly and longer timeframes for power allocations—as well as ideational differences of central and local governments on the operation of inter-provincial markets for electricity. Central respondents contended that minimum capacity factors should be set so that renewable energy generators earn sufficient revenue, and markets could be engaged for additional revenue.³⁴ Wind farm managers preferred a system along these lines as well, setting aside a basic amount for firm survival and welcoming markets to absorb any “excess.”³⁵ By contrast, local government respondents envisioned a larger role for markets, as lower tariffs are seen as necessary to address the curtailment challenge.³⁶

“Peak Regulation”: Markets to Cope With A Rigid Legacy System

Legacy system operation practices in China entail essentially two processes: monthly or longer horizon production allocations to generators, and their within-month implementation through dispatch by the grid company. In the above two cases, markets are used to reallocate rights to produce on the longer time horizon. However, increasing efforts to integrate intermittent renewable energy, whose production cannot be planned in advance, have produced conflicts among generators over dispatch carried out by the grid. For example, in northern China, wind energy curtailment primarily occurs at night when demand is low and coal plants—already producing at low outputs and facing declining revenues and the danger of forced market exit—are unwilling to further reduce production.

Even prior to the emergence of renewable energy challenges, implementing rigid production allocations through daily dispatch—taking into account the variations in demand—led to the establishment of the novel concept of “peak regulation

³¹ Interview 2016-A.

³² Interview 2016-F.

³³ Interview 2016-A.

³⁴ Interview 2016-G.

³⁵ Interview 2016-B.

³⁶ Interview 2016-H.

ancillary services” (*tiaofeng fuzhu fuwu* | 调峰辅助服务), a term wholly unique to China.³⁷ Under this legacy system, power plants are required to provide some “peak regulation” free of charge according to grid dispatch instructions: to increase output when demand is high but also, counterintuitive to the nomenclature but the focus of this case, to reduce output when demand is low. Spot market prices can facilitate such changes in output, as low demand periods result in low (or negative) profits for production. However, the peak regulation system in China instead compensates (mainly) coal generators for not producing during periods of very low demand.

Several problems with this earlier system became apparent in the Northeast. Some plants complained about discrimination, receiving less favorable minimum outputs in the dispatch process compared to other firms.³⁸ At the same time, regulators recognized that the fixed peak regulation prices did not reflect the changing value in real time of the service, particularly when both demand and renewable energy were varying (again, a feature for which spot prices are most apt). Additionally, governments could easily overcompensate or undercompensate generators due to information asymmetries (Song 2019).

To address this issue, the Northeast Grid beginning in 2014 piloted a market-based compensation scheme to encourage coal plants to participate more in peak regulation. The rather complex peak regulation market operates as follows. The regulator assigns generators of different types a minimum output. On a daily basis, coal generators determine their willingness to reduce production below that minimum the following day and bid how much compensation they want if called upon by the grid company to do so. When the system operator anticipates that wind will be curtailed, the highest bid of the coal generators forms a single market price for all participating generators. Wind, nuclear and other coal generators operating above their minimum outputs are responsible for paying those coal plants at the cleared price (see Appendix C2). While adding flexibility, peak regulation in most cases is not supposed to change a plant’s annual allocation or generation totals (Northeast ERO 2016).

Although it attempts to move away from the rigid administrative system, the peak regulation market is in most respects unrecognizable compared to a traditional spot market.³⁹ A spot market considers all supply and demand together (i.e., is non-discriminatory) and generates a uniform clearing price for delivering energy. When there is the potential for curtailment (i.e., low demand and high renewables), prices drop—possibly to zero or negative values—reflecting the low marginal cost of production. By contrast, the peak regulation market ignores demand and instead segments the electricity supply into those that can provide regulation by reducing production (e.g., coal) and those that must offer compensation (e.g., wind, nuclear and other coal)—simultaneously, a discriminatory and non-voluntary mechanism. When there is curtailment potential, prices rise, reflecting not the marginal cost of production but desired compensation for producing less.

³⁷ The term “peak regulation” (*tiaofeng* | 调峰) falls outside international conventions for “ancillary services” and has no direct analogue in international power systems.

³⁸ Interview 2016-F.

³⁹ A detailed analysis of the efficiency penalties is beyond the scope of this paper.

The basic design of the peak regulation market was therefore constrained by the presence of legacy production allocation institutions. But the design and implementation process also revealed clear latent interests of local governments in protecting against exit of incumbent (usually coal) firms and in solidifying the state's driving role at the expense of efficiency concerns. Modeling studies conducted at the request of regulators sought to adjust key parameters—minimum outputs and price caps—in order to limit payments through the market to be comparable to that given under previous measures.⁴⁰ Price caps, in fact, were frequently hit, in which case the system becomes *de facto* an administrative pricing system.⁴¹ Finally, the design separately limits total payments that might be required from coal and nuclear generators at a level substantially lower than renewable energy generators (Northeast ERO 2016). Taken together, these market design choices result in very high prices and compensation for coal plants relative to the actual costs of reducing output.⁴²

This experiment demonstrates that reforms in the electricity sector were designed to foster markets, but with a different goal than a spot market. The peak regulation market addresses a particular problem (wind curtailment) by introducing heavily constrained and discriminatory market-based mechanisms into a set of legacy institutions. It goes well beyond the first two cases, however, in modifying “plan-derived” grid dispatch processes through the implementation of a daily—not monthly or longer—market. Proponents of the peak regulation market consider it successful relative to the old administrative system because of the enthusiastic participation of coal generators, who would otherwise face the prospect of declining revenues and possibly market exit. Moreover, some estimate the overall improvements in flexibility resulted in an additional 11 billion kWh of wind electricity over its first two years, roughly one-tenth of total wind generation, helping meet an important policy goal (Liu et al. 2017). It is now being adopted in multiple provinces and regional grids (Qu and Lei 2019).

Conclusion

Scholars of China—and other transition economies—have long recognized that legacy institutions of local actors intersect reform efforts (Ang 2016; Nahm 2017; Oi 1999) and that while Chinese policy-makers have discovered neoclassical market reforms, these tend to proceed incrementally as opposed to a dramatic reversal of long-held planning institutions (Naughton 1995). While we agree that the three dominant narratives of China's market reform process—Beijing's embrace of market-oriented policies, local dynamism, and central state intervention—variously have traction for explaining the institutional changes underlying economic growth,

⁴⁰ Interviews 2016-F, 2016-A.

⁴¹ See Liu et al. (2017). Detailed market outcomes are not public. However, frequent hitting of price caps was confirmed by several respondents. Interviews 2016-A, 2018-C.

⁴² Coal plants lose some efficiency when they operate at lower outputs, but costs are relatively minor. See Appendix C.2.

our purpose is to show that for a linchpin of China's economy, the electric power industry, the dominant narratives are limited. Legacy institutions and practices, some of which were organic to the central planning system, remain hugely important. Images of China as a dynamic, flexible economic powerhouse overseen by a strong state must be tempered by the understanding of choices by political actors, especially in the local sphere, that limit reform efforts. Indeed, efficiency, albeit seen as a desirable outcome of markets, takes a back seat to other political and policy priorities. We are struck, in particular, by the use of equity-oriented *sangong* principles in allocating shares (rights to produce) to all participants, regardless of their efficiency. Even important policy initiatives driven by other priorities, notably integration of renewable energy needed to address air pollution, are challenged by the factors we highlight.

Moreover, throughout the design and discussion of market experiments in northeast and northwest China we find several ideational interpretations of the function of "markets." The desire to facilitate more neo-classical values by "growing out of the plan" is evident. But the observation made by Steinfeld (2004) that markets can be used to save incumbent firms remains. Furthermore, all cases reflect visions in which markets are add-ons to extend traditional planning tools, employed both by the central government and by local governments. Although we cannot discount that the use of market rhetoric is sometimes employed strategically to co-opt policy debates (Chen 2010), our cases provide much evidence that there are genuinely divergent ideations of markets. We demonstrate the presence of these institutional and ideational dynamics in the design and implementation of three types of electricity market experiments across the case regions. These institutional and ideational factors are summarized for each case in Table 2.

These observations on the ideational underpinnings of markets have material implications for market design in China. First, given the pervasive view among designers that the role of markets is not to cause firm exit, market reforms have generally distorted price signals in order to protect incumbents. An alternative structure that guards against uncompensated exit is to set aside more explicit "transition" funding mechanisms as a complement to typical market functions which can then be allowed to operate according to traditional market logics. Second, while policy-makers may approach markets from the perspective of expanding their toolbox, there are opportunities for greater debate and analysis on how well-functioning markets can achieve multiple objectives and how to minimize trade-offs among market and other state goals.

How unique is the mixture of "market" meanings we have shown in China's electric power sector? Although a lengthy discourse comparing China's economic sectors is beyond the scope of this article, brief reflection on other important sectors and recent trends is instructive. First, there is a documented history of heterodox market institutions in China even when nominally adhering to articulated liberal market norms such as fostered by entry into the WTO (Tan 2021). Second, the idea of "market as salvation," in which market tools are used to protect ailing incumbent firms, was a core justification for the creation in 2003 of the State Asset Supervision Administration Commission (SASAC) to oversee the financial modernization of the state sector. SASAC was established to oversee selected strategic "winners" in the

Table 2 Institutional and ideational features across market cases

Experiment	Legacy/local institutions				Ideation of market		
	Limit market exit	Production rights allocation	Third actor (grid) processes	Fairness-based principles	Grow out of plan	Extend planner's toolkit	Protect incumbent's "salvation"
Bilateral contract	0		0	0	0	0	
"Excess" electricity exchanges	0	0	0	0		0	
Peak regulation markets	0	0		0		0	0

SOE sector, those firms that in essence were “too big to fail.” SASAC’s brief has been to maintain the value and protect the assets of these big firms at the same time as encouraging increased market orientation (Pearson 2005).⁴³

More recent examples of alternate uses of market tools occur in China’s financial and technology sectors. The Chinese state has increasingly wielded tools of “financialization”—the use of monetized investment positions such as stockholding or investment in share funds as additional points of control over private and mixed-ownership firms (Rithmire 2022; Wang 2015). Utilization of traditional capitalist market tools such as stock purchases and capital investments as levers of state control constitute clear examples of the use of markets to expand the state’s toolkit. Finally, China’s central government has increasingly deployed laws and rhetoric of “anti-monopoly” to challenge the market power of large private technology companies such as Alibaba and Tencent (Zhang 2021). While the motives are multifaceted, it is evident that one goal is to apply a nominally pro-competitive stance to control the scope of firm activities, a stance taken not on behalf of new entrants or incumbents but, rather, as an expansion of the planner’s toolkit.

Our findings about the electricity sector, and our brief observations about other sectors, do not undercut the view that China’s political economy reforms have been highly “adaptable” as a result of local processes (e.g., Tsai 2006), but, rather, show inherent limitations in both formal and informal adaptive changes in achieving either unfettered markets or state domination. Non-classical views of the function of markets are highly salient at the local level, where they represent multi-faceted barriers to more integrated national market systems. Use of market tools as deployed by SASAC suggests that at the central government level salvation of incumbents is salient, while recent trends in finance and technology industries suggest the continued presence of market tools in the planners toolkit. Ironically, these tools may increasingly be used to further enhance state capacity.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s12116-022-09358-9>.

Acknowledgements We thank UC San Diego 21st Century China Center affiliates, attendees at the American Political Science Association Annual Meeting, and Stephan Haggard for comments on earlier drafts of the paper, the anonymous reviewers for their helpful suggestions on the manuscript, and the many interviewees in China who gave their time and expertise. Funding was generously provided by the MIT-Tsinghua China Energy and Climate Project, MIT MISTI, and the Harvard Kennedy School Belfer Center for Science and International Affairs.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons licence, unless indicated otherwise in a credit line to the

⁴³ SASAC oversees assets of a select (and decreasing) number of centrally-owned SOEs, while provincial level SASAC offices are responsible for similar goals for provincially-owned SOEs. Steinfeld (2004) offers examples of PRC “markets as salvation” approaches from efforts in the 1980s and 1990s to deal with corporate debt and non-performing loans.

material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Alkon M, Wong A. Authoritarian Energy Transitions Undermined? Environmental Governance Cycles in China's Power Sector. *Energy Res Soc Sci*. 2020;68:101531.
- Amsden AH. The rise of "the rest": challenges to the west from late-industrializing economies. Oxford University Press; 2001.
- Ang YY. How China Escaped the Poverty Trap. Cornell University Press; 2016.
- Bardhan P, Mookherjee D. Decentralization and Local Governance in Developing Countries: a Comparative Perspective. Cambridge, MA: The MIT Press; 2006.
- Cai H, Treisman D. Did Government Decentralization Cause China's Economic Miracle? *World Politics*. 2006;58(04):505–35.
- CEC. This Year's Electricity Supply and Demand Forecast and Recommendations [Internet]. China Electricity Council; 2011 [cited 2019 Jun 27]. Available from: <http://www.cec.org.cn/hangyeguogangjiao/meitijujiao/2011-04-01/52138.html>
- CEC. Power Generating Equipment Capacity (1994–2016). China Electricity Council; 2017.
- Chatterjee E. The politics of electricity reform: Evidence from West Bengal. *India World Dev*. 2018;104:128–39.
- Chen L. Playing the Market Reform Card: The Changing Patterns of Political Struggle in China's Electric Power Sector. *China J*. 2010;64:69–95.
- Chen H, Rithmire M. The Rise of the Investor State: State Capital in the Chinese Economy. *St Comp Int Dev*. 2020;55(3):257–77.
- Chen L. Manipulating Globalization: The Influence of Bureaucrats on Business in China. Stanford University Press; 2018.
- CPCCC. Third Plenary Session Communiqué: Major Issues in Comprehensively Deepening Reform. Communist Party of China Central Committee; 2013.
- Dai J. Northeast electricity market reform experiments. *Energy* [Internet]. 2013 Jul 18 [cited 2014 Nov 19]; Available from: <http://finance.sina.com.cn/leadership/mroll/20130708/141916049734.shtml>
- Davidson MR. Creating Markets for Wind Electricity in China: Case Studies in Energy Policy and Regulation (Ph.D. Thesis). Cambridge: Massachusetts Institute of Technology; 2018.
- Davidson MR, Pérez-Arriaga I. Modeling Unit Commitment in Political Context: Case of China's Partially Restructured Electricity Sector. *IEEE Trans Power Syst*. 2018;33(5):4889–901.
- Doner RF, Hershberg E. Flexible production and political decentralization in the developing world: Elective affinities in the pursuit of competitiveness? *St Comp Int Dev*. 1999;34(1):45–82.
- Eaton S. The Advance of the State in Contemporary China: State-Market Relations in the Reform Era. Cambridge, UK: Cambridge University Press; 2015.
- Evans PB. Embedded Autonomy: States and Industrial Transformation. Princeton, NJ: Princeton University Press; 1995.
- Evans P. The eclipse of the state? Reflections on stateness in an era of globalization. *World Pol*. Cambridge University Press; 1997;50(1):62–87.
- Gallagher KS, Zhang F, Orvis R, Rissman J, Liu Q. Assessing the Policy gaps for achieving China's climate targets in the Paris Agreement. *Nat Commun*. 2019;10(1):1256.
- Gang F, Ma G, Wang X. Marketisation in China from 1997 to 2014. In: Garnaut R, Song L, Fang C, editors. China's 40 Years of Reform and Development. ANU Press; 2018. p. 257–70.
- Gansu DRC. Gansu Renewable Energy Local Integration Pilot Plan. Gansu Dev Reform Comm. 2016.
- Gansu Electricity Exchange. 2016H1 Gansu Direct Electricity Exchange Market Announcement. Gansu Electr Exch Cent; 2016.
- Geddes B. Politician's dilemma: Building state capacity in Latin America. University of California Press; 1994.
- Guangdong Electricity Exchange. Guangdong Electricity Market 2019 Annual Report. 2020.

- Guo H, Davidson MR, Chen Q, Zhang D, Jiang N, Xia Q, et al. Power market reform in China: Motivations, progress, and recommendations. *Energy Policy*. 2020;1(145):111717.
- Heilmann S. From Local Experiments to National Policy: The Origins of China's Distinctive Policy Process. *China J*. 2008;59:1–30.
- Heilmann S, Shih L. *The Rise of Industrial Policy in China, 1978–2012*. Cambridge, MA: Harvard-Yenching Institute; 2013. p. 25.
- Hsueh R. *China's Regulatory State: A New Strategy for Globalization*. Ithaca, NY: Cornell University Press; 2011.
- Hunt S. *Making Competition Work in Electricity*. New York: John Wiley & Sons; 2002.
- Jamasb T, Nepal R, Timilsina GR. A quarter century effort yet to come of age: a survey of electricity sector reform in developing countries. *The Energy J*. 2017;38(3):195–234.
- Joskow PL. Lessons learned from electricity market liberalization. *The Energy J*. 2008;29(2):9–42.
- Kahrl F, Williams JH, Hu J. The political economy of electricity dispatch reform in China. *Energy Policy*. 2013;53:361–9.
- Kong J. Part III: Electricity Industry Management Reform. *China Public Services Management Reform*. Beijing: China Financial and Economic Publishing House; 2010.
- Landry PF. *Decentralized Authoritarianism in China: the Communist Party's control of local elites in the post-Mao era*. Cambridge University Press; 2008.
- Lardy NR. *The State Strikes Back: The End of Economic Reform in China?* Washington, DC: Peterson Inst Int Econ; 2019.
- Lin K-C, Purra MM. Transforming China's electricity sector: Politics of institutional change and regulation. *Energy Policy*. 2018.
- Liu Y, Zhang M, Li Q, Wang Z, Li Z, Zou P, et al. Design and Practice of Peak Regulation Ancillary Service Market for Northeast China Power Grid. *Autom Electr Power Syst*. 2017;41(10):148–54 (Chinese).
- Lü X, Landry PF. Show Me the Money: Interjurisdiction Political Competition and Fiscal Extraction in China. *Am Polit Sci Rev*. 2014;108(03):706–22.
- Meckling J, Nahm J. Strategic state capacity: how states counter opposition to climate policy. *Comp Political Stud*. 2021;55(3):493–523.
- Mertha AC. China's "soft" centralization: shifting tiao/kuai authority relations. *China Quarterly*. 2005;184:791–810.
- Migdal JS. *Strong societies and weak states: state-society relations and state capabilities in the Third World*. Princeton University Press; 1988.
- Montinola G, Qian Y, Weingast BR. Federalism, Chinese style: the political basis for economic success in China. *World Politics*. 1995;48(01):50–81.
- Nahm J. Renewable futures and industrial legacies: Wind and solar sectors in China, Germany, and the United States. *Bus Polit*. 2017;19(1):68–106.
- Naughton B. *Growing out of the plan: Chinese economic reform, 1978–1993*. New York, NY : Cambridge University Press, 1995.; 1995.
- Naughton B, Tsai KS. State Capitalism and the Chinese Economic Miracle. In: Naughton B, Tsai KS, editors. *State Capitalism, Institutional Adaptation, and the Chinese Miracle*. Cambridge University Press; 2015. p. 1–24.
- NDRC. *Implementing Opinion on Promoting the Creation of Electricity Markets*. Nat Dev Reform Comm 2015.
- NDRC, NEA. *Notice Regarding Implementing Wind and Solar Full Purchase Safeguard Management Work*. Nat Dev Reform Comm 2016.
- NEA. *2016 National Renewable Power Development Monitoring and Evaluation Report*. National Energy Administration; 2017.
- NECG. *Northeast Grid 2015Q1 Electricity Market Information Report*. State Grid Northeast Region; 2015.
- Northeast Electricity Exchange. *Notice Regarding Commencing 2016H1 Northeast Excess Wind Electricity Uni-Lateral Exports to North China Grid*. Northeast China Electricity Exchange Center; 2016.
- Northeast ERO. *Operating Measures for Northeast Electricity Ancillary Services Market (Provisional)*. Northeast Energy Regulatory Office; 2016.
- Northeast SERC. *Temporary Measures for Northeast Excess Wind Electricity Exports to North Grid*. State Electricity Regulatory Commission Northeast Office; 2013.

- Oi JC. Rural China takes off: institutional foundations of economic reform. Berkeley: University of California Press; 1999.
- Olivier JGJ, Peters JAHW. Trends in Global CO₂ and Total Greenhouse Gas Emissions: 2019 Report. PBL Netherlands Environmental Assessment Agency; 2020.
- Pearson MM. The Business of Governing Business in China: Institutions and Norms of the Emerging Regulatory State. *World Politics*. 2005;2:296.
- Pearson MM. State-Owned Business and Party-State Regulation in China's Modern Political Economy. In: Naughton B, Tsai KS, editors. *State Capitalism, Institutional Adaptation, and the Chinese Miracle*. Cambridge University Press; 2015. p. 27–45.
- Qu H, Lei X. China's Electricity Ancillary Service Market is Improving Daily. State Grid News [Internet]. 2019 [cited 2019 Jun 28]; Available from: <http://shoudian.bjx.com.cn/html/20190625/988300.shtml>
- Rawski TG. Implications of China's Reform Experience. *China Quarterly*. 1995;144:1150.
- Ren M, Branstetter L, Kovak B, Armanios D, Yuan J. Why Has China Overinvested in Coal Power? *Nat Bur Econ Res*; 2019.
- Rithmire ME. China's "New Regionalism": Subnational Analysis in Chinese Political Economy. *World Politics*. 2014;66(01):165–94.
- Rithmire M. Going Out or Opting Out? Capital, Political Vulnerability, and the State in China's Outward Investment. *Comp Polit*. 2022;54(3):477–99.
- SCEO. Intersection: Gansu Bilateral Contracts Difficulties. *South China Energy Obs*. 2015.
- Schumpeter JA. *Theory of Economic Development*. Cambridge, MA: Harvard University Press; 1911.
- SERC. Temporary Measures for Transparent, Fair, and Just Electricity Dispatch. State Electricity Regulatory Commission; 2003.
- SERC. Basic Guidelines for Electricity Consumers and Generator Direct Exchange Pilots (Provisional). State Electricity Regulatory Commission; 2009.
- Shao S, Lu Z, Berrah N, Tenenbaum B, Zhao J, editors. *China: power sector regulation in a socialist market economy*. Washington, D.C: World Bank; 1997.
- Skocpol T. Bringing the state back. In: Evans PB, Rueschemeyer D, Skocpol T, editors. *Strategies of analysis in current research*. Cambridge University Press; 1985. p. 3–38.
- Song W. A Survey of the Northeast Peak Regulation Ancillary Services Market. Electricity Decision and Public Opinion (Chinese) [Internet]. 2019 Apr 12 [cited 2019 Jun 28]; Available from: <http://news.bjx.com.cn/html/20190509/979458.shtml>
- State Council. Notice Regarding Provisional Guidelines for Encouraging Electricity Investment and Implementing Multiple Electricity Tariffs [Internet]. 1985 [cited 2017 Nov 14]. Available from: <http://law.npc.gov.cn/FLFG/flfgByID.action?txtid=2&flfgID=100481&showDetailType=QW>
- State Council. Electricity Sector Reform Plan. State Council; 2002.
- State Council. Notice of Catalogue of Government Approvals for Investment Projects (2014 version) [Internet]. 2014 [cited 2018 Apr 11]. Available from: http://www.gov.cn/zhengce/content/2014-11/18/content_9219.htm
- State Council. Opinion Regarding Deepening Electricity Sector Reform [Internet]. State Council; 2015. Available from: <https://www.pkulaw.com/chl/58f5139dbe0648a3bdfb.html>
- Steinfeld ES. Market Visions: The Interplay of Ideas and Institutions in Chinese Financial Restructuring. *Political Stud*. 2004;52(4):643–63.
- Tan Y. *Disaggregating China, Inc.: State Strategies in the Liberal Economic Order*. Cornell University Press; 2021.
- Tsai KS. Adaptive informal institutions and endogenous institutional change in China. *World Politics*. 2006;59(1):116–41.
- Vogel SK. *Marketaft: How Governments Make Markets Work*. Oxford University Press; 2018.
- Wade R. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*. Princeton, NJ: Princeton University Press; 1990.
- Wang Y. The rise of the 'shareholding state': financialization of economic management in China. *Socio-Economic Review*. Oxford University Press; 2015;13(3):603–25.
- Wedeman AH. *From Mao to Market: Rent Seeking, Local Protectionism, and Marketization in China*. Cambridge University Press; 2003.
- Wen H. East China Electric Market Experiment Beginning to End. *Southern China Energy Observer* [Internet]. 2014 [cited 2015 Feb 18];1. Available from: <http://hvdc.chinapower.com.cn/news/1036/10367311.asp>

- Wengle SA. Post-Soviet Developmentalism and the Political Economy of Russia's Electricity Sector Liberalization. *St Comp Int Dev*. 2012;47(1):75–114.
- Williams JH, Ghanadan R. Electricity reform in developing and transition countries: A reappraisal. *Energy*. 2006;31(6–7):815–44.
- World Bank. Worldwide Governance Indicators [Internet]. World Bank. 2018 [cited 2020 Sep 15]. Available from: www.govindicators.org
- Xi J. Statement by H.E. Xi Jinping President of the People's Republic of China At the General Debate of the 75th Session of The United Nations General Assembly [Internet]. Ministry of Foreign Affairs of P.R.C. 2020 [cited 2021 Jan 12]. Available from: https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1817098.shtml
- Xiao Q. Gansu Renewable Energy Purchase Safeguards Policy is Halted. *China Energy News* [Internet]. 2016 Aug 29 [cited 2016 Oct 9]; Available from: http://paper.people.com.cn/zgnyb/html/2016-08/29/content_1708657.htm
- Xu C. The Fundamental Institutions of China's Reforms and Development. *J Econ Lit*. 2011;49(4):1076–151.
- Xu Y. *Sinews of Power: The Politics of the State Grid Corporation of China*. Oxford: Oxford University Press; 2016.
- Yang DL. China's Changing of the Guard: State Capacity on the Rebound. *Journal of Democracy*. Johns Hopkins University Press; 2003;14(1):43–50.
- Yang DL. *Remaking the Chinese Leviathan: Market Transition and the Politics of Governance in China*. Stanford University Press; 2004.
- Zhang AH. *Chinese Antitrust Exceptionalism*. Oxford: Oxford University Press; 2021.
- Zhang C, Heller TC. Reform of the Chinese electric power market: economics and institutions. In: Victor DG, Heller TC, editors. *The political economy of power sector reform: the experiences of five major developing countries*. Cambridge: Cambridge University Press; 2007.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.