



Reforming the Role of State-Owned
Enterprise in China's Energy Sector:
*An Analysis of Collective Decision-
Making Processes Using the
KAPSARC Toolkit for Behavioral
Analysis (KTAB)*

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Summary

What are the prospects for reform of the Chinese energy sector? This question is the subject of much debate both inside and outside China. Since coming to power in November 2012, China's new government has issued a series of statements on reform, clearly an important part of the country's continuing 'great revival'. Despite this, some experts have been unconvinced by the pace of economic reform. What reform means for the energy sector is even less clear. There are competing views on how, and to what extent, the energy sector and energy policy will be reformed, but they all share various potential biases resulting from incomplete data and "not knowing what we don't know".

We approach this policy question by addressing the decision-making process about whether or not to open up the upstream oil and gas market in China to competition from small, private enterprise. We examine two related aspects:

- the appetite for policy reform that would allow private enterprise to more fully compete in China's energy sector; and
- the appetite for direct reform of the Chinese National Petroleum Corporation (CNPC), limiting its market dominance to complement such reforms so as to allow smaller companies to utilize the competitive space opened up in the sector.

To analyze the direction of policy in these two aspects, we apply a framework for modeling collective decision-making processes (CDMPs): the KAPSARC Toolkit for Behavioral Analysis (KTAB). KTAB is not a model, but a platform for building models. It is a CDMP simulator that can generate insight into policy decision-making.

It allows the researcher to apply a set of rules of engagement on a question and then simulate the CDMP to understand how the advocacy and influence of actors may evolve to influence the range of plausible policy outcomes. As such, KTAB enables analysts to bring a quantitative approach to what has traditionally been a qualitative field. This technique draws on the insights of experts regarding the advocacy and interactions among decision makers and influencers, capturing expert knowledge in a methodical, consistent manner.

In this paper, we examine the interactions of actors' interests that may be driving China to reform its energy sector policies and, in particular, the structure of CNPC. The question is important. Many commentators and policy makers have suggested that adjustments are needed to reduce the constraints on the involvement of private enterprise in the Chinese upstream oil and gas sector.

Data for the KTAB model used in this paper were gathered through interviews with several experts, inside and outside China, both directly and indirectly involved in the Chinese energy sector. We combined their individual responses into a consensus expert-based view of the interests and opinions of the relevant decision makers. KTAB provides a framework to evaluate the implications of different sets of expert views (the data). Our use of what we call the consensus view data should not be taken to imply that the data provided by the experts are "objective facts" regarding the actors. Instead we argue that these data represent an informed understanding of the decision makers and therefore allow KTAB simulations to identify plausible policy outcomes, rather than predicted or forecasted outcomes, given the embedded insights of our experts.



In the case of private companies' entry into the energy markets in China, the KTAB simulations suggest that little substantive reform is likely, which would come as a surprise to many of the experts who provided data for this analysis. During the interviews with our set of experts, most anticipated substantive reform. Our analysis using KTAB, on the other hand, suggests that the inertia of key actors within the decision-making sphere holds back the potential for a significant opening up of the energy sector. In addition, despite the possible erosion of CNPC's political clout, there does not appear to be consensus among the critical decision makers in China in favor of major reform of its market position.

These insights appear robust. Scenario analysis around the baseline KTAB simulation results suggests institutional inertia limits the effectiveness of unilateral initiatives by any of the key leaders—unilateral attempts to drive reform are not sufficient to alter the outcome. Attempts to push through a wholesale reform of CNPC appear to require more concerted action by a coalition of interests than is likely to come together at present. Despite a political environment in China where significant reform appears in rhetoric, there does not appear to be much credible space for meaningful reform of private sector involvement in the Chinese energy markets.

Introduction

This paper addresses a major question facing the Chinese polity: will the energy sector continue to be reformed and, if so, how? Roughly 35 years after Deng Xiaoping set China on its course of “reform and opening up”, President Xi Jinping launched his own reform agenda at the Third Plenum of the 18th Party Congress, officially known as the Third Plenary Session of the 18th Communist Party of China Central Committee. The document that emerged, the ‘Decision on Major Issues Concerning

Comprehensively Deepening Reforms’, set out a wide range of reforms across China's economy and society, including the abolition of labor camps, along with land, market, and financial reforms. It has been variously described as a “watershed”, “Reform 2.0”, and “even more wide-ranging [than Deng's policies]”. At a time when the state sector posts returns half that of the private sector and as China sees its demographic dividend slipping away (with a workforce that shrank in 2012 for the first time since 1970), this new reform agenda is being heralded as the engine of growth for the next 10 years.

As the China analyst Michael Pettis has said, “What will determine the path China follows is the political struggle the Xi administration will have in imposing the needed reforms on an elite that will strongly resist these reforms—mainly, of course, because these reforms must necessarily come at their expense.” Regardless of the ambitions of China's current administration, the test will come in their implementation of the reforms, and it is on this question of implementation that we focus.

The Third Plenum's resolutions were unquestionably important, but they included a potentially central contradiction that has clouded analysts' expectations. While the document stated that “markets will play a decisive role”—an upgrade from their former “basic” role—it was also stressed that the “state sector remains dominant.” How this tension plays out is perhaps nowhere more important than in China's energy industry, and in particular in its upstream oil and gas sector.

China's upstream oil and gas sector is currently dominated by three massive State-Owned Enterprises (SOEs): the Chinese National Petroleum Corporation (CNPC), Sinopec, and the China National Offshore Oil Corporation (CNOOC). Of the three, CNPC is by far the largest. The company produces 54% of China's crude, 75% of the country's



gas, and manages over 70% of the pipeline network. Its workforce is proportionately large: over 1.6 million, with almost 11,000 graduates recruited in 2013 alone. In addition, Sinopec itself is one of the world's largest companies by sales, while CNOOC enjoys a dominant position in China's offshore exploration and production. What is a realistic expectation of reform given such a prominent role for the state in this sector?

In the 1990s the then Premier, Zhu Rongji, launched his now famous campaign against a state sector he saw as bloated and inefficient, with the slogan “grasp the large, release the small” (抓大放小: Zhuā dà fàng xiǎo). Thousands of mergers and liquidations saw millions left unemployed and entailed a significant reorientation for the economy. Yet, twenty years on, the same adjectives are being used once again. This time, the appetite for a similar sort of campaign appears lacking and it may not deliver the results achieved the first time around. The push now is for efficient management and a greater role for the market. However, such rhetoric should probably not lead us, analysts have warned, to unrealistic expectations of Western-style free market fundamentals being unleashed upon China's energy sector. It was not even clear from the Third Plenum if the reformists had any mind to open strategic sectors such as energy to competition. Even if market competition is the sector's future, that need not lead to a privatized energy sector.

Though partial privatization has been mentioned by the reformists—albeit usually through the euphemism of “mixed ownership”—other vehicles are being investigated. These include:

- more efficient management;
- improved governance;
- the curtailment of political privileges;
- the withdrawal of subsidized credit; and, in extremis,
- the breaking up of monopolies.

CNPC has also been criticized for the lack of transparency around its use of sub-contracts, often used as a way of giving lucrative contracts to favored groups. Yet, in a move that illustrates the difference between mixed ownership and reform, Sinopec received plaudits for its \$17.4bn sale of a 30% stake in its retail business, while in reality it ceded no control. A cynical view might be that mixed ownership is merely a way for the SOEs to raise capital while avoiding the burden of truly independent oversight.

Political ambitions and institutional inertia are not factors unique to China. Competing objectives will likely lead to compromises and only gradual progress. Even Deng Xiaoping's reforms required a reboot with his 1993 Southern Tour. Understanding these competing objectives and what compromises might result can nonetheless teach us much about China's direction in the short-term future. It is clear that China's top leadership wants to move away from a model of development increasingly seen as “unbalanced, uncoordinated and unsustainable”. Various pilot projects, and even the anti-corruption campaign, have been presented as examples of how the leadership is seeking to drive its reform agenda home.

One complication remains. The reformists must deliver two complementary strategic objectives if they are to liberalize the energy sector. They must not only overhaul policy, but also tackle the advantaged positions of the existing major market actors. Passing a law enabling private enterprise to enter the upstream oil and gas sector will not automatically lead to unleashing competitive forces, a lesson that Brazil and others learned when opening their oil and gas sectors to private enterprises. Shrinking the span of control of the SOEs to give space for the private sector to operate may also be required.



This paper will briefly describe the method used to arrive at our conclusions and will provide a more detailed explanation of the simulations that form the basis for these findings. KAPSARC developed KTAB, released in July 2015, to enable third party observers to gain a better understanding of how decision makers' perceptions and interests might coalesce in a decision-making process. In this case, we look at the interaction of actors' interests and advocacy that is pushing China to make the relevant reforms to its energy sector and to the structure of CNPC in particular.

The results presented in this paper are based on a set of inputs: the data provided through structured interviews with a group of experts. Their combined assessments provide the aggregate estimate of the characteristics of each actor in this analysis. The interactions of actors over time is simulated within the KTAB modeling framework, to evaluate viable outcomes of collective decision-making processes (CDMPs). We also evaluate the extent of the impact of the institutional inertia implied by our experts' judgements, running scenarios to analyze how different attitudes of senior politicians affect the range of outcomes.

The KAPSARC Toolkit for Behavioral Analysis (KTAB)

KTAB is a platform that enables the modeling and analysis of CDMPs. CDMPs can be distinguished from other decision-making processes in that:

- They involve more than one actor, be it an individual, institution, or identifiable group or 'bloc'; and
- A single decision is arrived at as a result of some form of coordinated interaction between a finite set of actors. The form of this interaction is different in kind to large group decision-making processes such as the market-based derivation of a price, which is the result of the uncoordinated actions of many (not finitely countable) individuals.

In this paper we will present an analysis of plausible outcomes of the collective decision-making processes China may currently be engaged in over the role of its State-Owned Enterprises in the upstream oil and gas sector. To carry out this analysis we used KTAB to construct a particular model of CDMPs, based on the Spatial Model of Politics (SMP), which we will explain below.

CDMPs, KTAB, and Scenario Planning

CDMPs occur in a wide range of situations including social, commercial, and political situations. Wherever decision-making influence is shared between actors there is a CDMP. There are at least two ways in which we can analyze CDMPs to gain an understanding of plausible decision outcomes. One approach is to employ a scenario planning process, as popularized by the Royal Dutch Shell Group in the 1960s. This applies a rigorous framework for imagining internally consistent views of viable futures—not forecasts. Another is to develop quantitative simulation models that reflect the rules of how actors in CDMPs arrive at a decision outcome. KTAB itself is not a model, but a platform for building models: it is a CDMP simulator. As such it can be used to analyze CDMPs through several different theoretical, methodological, and analytical frameworks.

A more complete introduction to KTAB, the types of models it can be used to build, the literature from which it is derived, and the data required can be found in the KAPSARC Discussion Paper 'An Introduction to the KAPSARC Toolkit for Behavioral Analysis Using One-Dimensional Spatial Models.' A fuller comparison between scenario planning and the KTAB approach will be the topic of a future paper. Our focus in this paper is to provide a brief overview of KTAB as it pertains to the questions and analyses relating to the reform of the Chinese energy sector.



Although the results we present are based on a single model, KTAB is a toolkit that enables almost limitless variant models to be implemented, based on different assumptions of how various CDMPs work. Any and all of the assumptions in this paper can be changed, and new models built through KTAB can test the consequences of these changes.

For this paper we have deliberately chosen to focus on the logic of the analysis and to present a description of the results. What this paper does not contain is a detailed technical description of the underlying model and its calculations. Interested readers are pointed to two companion papers:

1. 'An introduction to the KAPSARC Toolkit for Behavioral Analysis (KTAB) using one-dimensional spatial models'; and
2. 'Multi-dimensional bargaining using KTAB'.

Both papers are available from KAPSARC's website, specifically the KTAB portal, as is the program's source code and documentation. Please visit <http://ktab.kapsarc.org>

By separating the technical detail from this applied discussion in this way, we hope to make the discussion more accessible for what is a relatively new field to most readers.

Approach and Assumptions

When analyzing CDMPs, one way to show the preferences of, and differences of opinion between, the various actors is to represent them graphically in a technique referred to as spatial preferences. This approach forms the basis for a model we have implemented in KTAB, called the Spatial Model of Politics (SMP). We apply the SMP to the question of Chinese energy sector reform. The SMP is one of the most widely accepted models of CDMPs, both technically and informally. Even outside the field of political science, everyday language is imbued with the implicit assumptions of this model. Political

parties may be described as right or left wing; less spatially explicit, we also tend to imply a linear spectrum when describing individuals (or groups, such as political parties) as conservative or liberal, aggressive or passive. Commentators and analysts will often try to uncover the 'positions' held by politicians or other highly placed officials. For more information on the SMP we again refer readers to the two companion papers named above. Nonetheless, a brief description of the logic is given below.

The SMP formalizes this vernacular with the following nomenclature:

1. **The Set of Actors.** The actors are all the stakeholders that contribute to the resolution of the CDMP in some way. They can be individuals or aggregates of individuals. Aggregates can be formal, such as a corporation, or informal, such as loose affiliations based on interests, for example young men sharing a love of fast cars. The constraint is that it must be possible to reasonably assume that each actor is a unitary entity, speaking with a single voice.

This approach displays clear similarities to and differences than the scenario planning process; these will be expanded upon more fully in a future paper. The point to make here is that the idea of trying to analyze CDMPs is not new, nor is the process of identifying the key actors and their voices. The contribution that KTAB makes is to turn what has previously been a largely qualitative process into a more rigorously quantitative one.

This framework can be used to understand the range of viable outcomes rather than to narrow them down to a single 'most likely' or expected outcome.

2. **A Spectrum of Positions.** This is a way of formalizing the question by mapping out the possible responses and positions actors could



take in the form of a linear continuum of possible positions. The extreme ends of the spectrum are associated with extreme positions. In the question of private participation, one end could be 'extremely limited private sector participation', the other 'a policy environment that is open and conducive to private participation'. These extremes are then labeled as 0 and 100, converting a qualitative spectrum into a numeric one where each position is given its own score. The spectrum is a scale where distance measures the change in consequences for the actors: the gap between positions corresponds to the difference in outcome. An implicit assumption is that all actors roughly agree on the consequences of positions. The consequences of moving from position 25 to position 50 would be roughly the same magnitude as moving from 50 to 75. In other words, the spectrum requires reasonable calibration.

We refer to this spectrum as the Practical Spectrum of Plausible Positions (PSPP).

3. **The Set of Positions.** With identified actors and a defined PSPP, the Position (i.e. the advocacy) of each actor can then be mapped to the PSPP with a number between 0 and 100.
4. **Measures of Influence.** Not all actors are equally powerful. Influence measures how easily the actor can shape the outcome of the CDMP, if fully motivated. This is not a measure of how likely the actor's preferred position is to win, nor is it a measure of the actor's motivation to win. It is the actor's clout, or political power, as applied to the question, assuming that the actor will bring his full resources to winning the negotiation and takes account of all his formal and informal powers.

Influence scores are relative: an influence score of 60 means that the actor is twice as influential

as one with 30. Influence scores are also additive: two actors in coalition, each with influence 30, could block an actor with influence 60. The combination of relativity and additivity can make influence the most cumbersome score to derive. Each actor's score needs to be calibrated against all the other actors.

Again, influence is scored against a range of 0 to 100. Strictly speaking, if an actor is assigned an influence score of 0 then they have no power and would not be counted as an actor.

5. **Measures of Salience.** Regardless of an actor's position and their level of influence, different actors will have different levels of interest in the question. Salience answers the question of how much an actor cares about the issue in general. How motivated are they to exert influence to produce their preferred outcome, if and when the issue arises? One way to begin answering these questions starts with the observation that each actor has a portfolio of issues to which they devote their attention. Salience identifies the importance of the specific issue in that portfolio, recognizing that people have an implicit budget constraint on exerting their influence across the portfolio. The salience scores are defined in Table 1 and range from 0 to 100.

The salience score is not the amount of time that an actor will devote to the negotiations but rather their willingness to use whatever influence they have to convince others of the merits of their own preferred position. It is not their influence, merely their motivation when the issue arises.

Once again, salience scores are relative between actors. As with influence, a salience score of 0 would indicate that the actor does not care about the issue, and that they should not be counted as an actor.



Score	Definition
0 – 10	The actor hardly cares and may not be aware of the issue
10 – 20	The issue is minor, but the actor is aware of it
20 – 40	The issue is one of many issues for this actor
40 – 60	The issue is among the top 3 or 4 for this actor
60 – 80	The issue is the most important for this actor but there are still others that need attention
80 – 100	The issue is this actor's top priority

Table 1 – Definition of salience scores

6. Exercised Power. This is a derived value, calculated in the model. As we have said, influence is an indication of the actor's political clout on the particular issue, if fully motivated, while salience indicates how much the actor actually cares about the issue. Exercised power is the product of these two values and reveals the amount of power the actor will actually bring to bear on the issue being modeled. Note that influence, salience and exercised power all map the actor's attitudes towards the overall issue as defined in the question, not individual alternative solutions to the question.

KTAB's SMP provides a simulation of how actor positions change over time. Time is captured in a series of iterations or 'turns'. The exact length of time a turn takes is an abstraction: a turn should be thought of as any period of time during which all actors can exchange information and attempt to influence each other. In the examples in this paper, the SMP simulation is run for 10 turns. There is a complicated and unresolved debate on how many turns are appropriate for a model like the SMP to run, the details of which are beyond the scope of this paper. We have chosen to simulate the SMP for 10 turns, as this number of iterations balances the two major concerns: too short a simulation risks missing the value of an iterative CDMP model, while too long a simulation risks extending the results beyond what is credible based on a single data set. The results of the simulation present the turn-by-turn

changes to actors' positions. These shifts in position are based on several different factors in the model, all operating simultaneously. Generally speaking, the behavior of individual actors can vary quite widely based on the configuration of numeric values in a particular dataset. There is no such thing as a 'rule of thumb' regarding how the simulation unfolds. Sometimes actors will move only incrementally as the turns progress, sometimes they may make much larger moves in the simulation. What follows is a brief, non-technical, description of the logic.

There are two stages within each turn of the simulation.

1. The simulation begins at the end of turn 0. At the end of each turn, actors generate a series of proposals and counter-proposals, 'voting' (i.e. lending their influence in support of, not literally taking a sequence of polls) on each until a winning outcome is reached. Actors produce proposals that improve the likelihood of achieving an outcome that is closest to their preferred outcome, while also trying to appeal to others—based on their perspective—until a 'winning' position can emerge. The final outcome of the CDMP is not necessarily one with which all actors agree: weak actors might be overruled by strong ones. The probable winning position for each turn can be described through a probability curve.



2. During the proposal and counter-proposal process between each turn, actors can seek to persuade others to shift their position, with the inducement that this may improve the chances for a generally-accepted position that is closer to their preferred outcome. These shifts may change the likely outcome of the CDMP. These attempts at persuasion may or may not succeed: the weaker actors may simply concede, counter with an offer to make limited concessions, or even make their own attempt at persuasion. The changes which are calculated by the SMP to be selected by each actor create a new set of actor positions, on which the proposal process described in stage 1 is re-started from this new set of positions. Note that while the initial input data define the positions in turn 0, remaining turns are calculated strictly based on the SMP's assessment of actor interactions.

This second stage can be thought of as containing two distinct phases.

- In the first phase, each actor tries to find some other actor to be a counterparty for effective persuasion. If any attractive counterparties are identified—there may be more than one, just one, or none at all, for any potential initiator—then the initiator will focus their efforts to exert influence on their most attractive target. Weaker actors may be targeted by multiple initiators; stronger actors may not be targeted at all. The actual shift in position made by a counterparty is determined by a calculation that considers the interactions among the entire set of actors.
- In the second phase, the assessment of how the counterparty responds may vary slightly as it is based on their perceptions and evaluation of alternative outcomes. The combination of what the initiator chooses to do, and how the counterparty will respond, results in an 'objective' calculation of the reaction. Consequently, the objective results of the second phase can differ from the subjective estimates of the first phase.

There are many calculated interactions that lead to a high degree of complexity in the set of potential results that can emerge from each turn. For instance, what drives an actor to compromise is not only their view of the options available, but also their view of the likelihood of various options 'winning'. One can imagine an actor compromising to lend support to a position that is not their most-favored outcome in order to defeat an even less desirable option. However, one benefit is that a detailed narrative can emerge for an individual actor's behavior in each simulation, itself a source of potential insight into the SMP. In this paper we will focus on the high-level outcomes calculated by the KTAB simulation, while trying to provide some explanation for the numeric calculations that result in the most interesting shifts in actor positions.

The Data Sources

The data used in this analysis were obtained from a series of interviews with experts from the upstream oil and gas industry in China and from think-tanks based outside China. KAPSARC conducted the interviews, but its primary contribution in this analysis is the SMP simulation, built with KTAB. The authors have not incorporated their own views on the actors in order to reduce any bias that we might otherwise introduce.

As with any dataset, questions are often raised over validity. Given the hidden nature of what we are attempting to model, there are two commonly asked questions regarding the data required for KTAB.

1. "How can we be sure we know what decision makers actually think?" The best we can do is to aggregate the views of experts with detailed knowledge of the question and the relevant actors to form a set of 'estimates' of their underlying characteristics. Individual readers can always query whether a particular data point is correct. However, if a range of well-informed observers all coalesce around a single set of numbers then



at the very least we are picking up on widely held beliefs about the data.

2. “How can we be sure that the data are not skewed by the observation bias of the experts?” Again, we cannot be certain. Experts can only provide information on the actors they follow and if that group is not representative of the relevantly influential spectrum of debate, then the results of the simulation will similarly be skewed. We attempt to mitigate this by combining the knowledge of experts with a range of different focus areas and backgrounds.

The experts may or may not be correct, though they are well-positioned to provide an informed judgment. At the very least, our analytical framework can deliver insight in the form of plausible policy outcomes, if the paradigm articulated by the experts, and widely held by others, is generally accurate.

The data from the various experts interviewed were combined to form a collective view of the actors and their characteristics. We start with our aggregated dataset based on the input of all the experts, which we call our ‘baseline’ dataset, for each of the two PSPPs covered in this paper. We then run various scenarios to estimate the degree of institutional inertia in the face of different positions advocated by senior politicians.

Defining the Question

Critical to properly formulating the SMP is a clearly defined question. The approach requires being able to set out the actors’ positions on a single linear PSPP which maps ranked, coherent responses to a single question. The question must be framed narrowly enough such that experts can identify a clear set of actors, and give each one a position without saying “it depends...” Balanced against this is the need to keep the questions broad enough to remain of interest.

The overall topic of ‘reform of the energy sector in China’ is clearly much too broad. The energy sector is much too complicated to be encapsulated in a single response. Many of the actors that have the ability to influence a discussion on one part of the industry—say, oil and gas—are likely different from those who will influence the outcome of reforms in another, such as the nuclear or renewable sectors. Not only might the actors be different, but their positions, along with their influence and salience scores, will also likely change—as they may independently attach different priorities to different sectors. An actor with high influence in a debate regarding one segment might have much reduced influence over policy-setting in another. In addition, while favoring one position with regard to one segment, such as competition in electric power generation, the actor might hold quite a different position with regard to a second, such as natural gas pipelines. As outlined in the introduction, our focus here is on the upstream oil and gas sector, in particular “what space is there for the private sector in the upstream oil and gas sector in China?”

The expert interviews clarified that the question should be addressed in two dimensions:

- The policy dimension: What, if any, are the likely reforms of the various policies that regulate the private sector’s involvement in this aspect of the energy sector?
- The competitive dimension: If private sector penetration—regardless of stated policy—is limited by the legacy positions of the SOEs, in particular CNPC, even in segments where private industry is permitted or encouraged, what are the likely reforms that might curtail CNPC’s dominance?

In the rest of this paper we analyze these two sub-questions separately. Though both refer to the role that private industry plays in Chinese energy development, they reflect different aspects of the



same debate, and actors take a slightly different perspective on each. The former is more broadly focused on policy reform in China that might open up space for private industry activities in Chinese energy. The latter is more narrowly focused on the ways CNPC's specific dominance over the upstream oil and gas sector in China might be reduced.

We will address the results of the simulations of these data sets using KTAB's SMP in the next two sections.

The Policy Dimension: What is the Appetite for Reforming Government Policy Towards Private Sector Involvement in the Upstream Oil and Gas Sector in China?

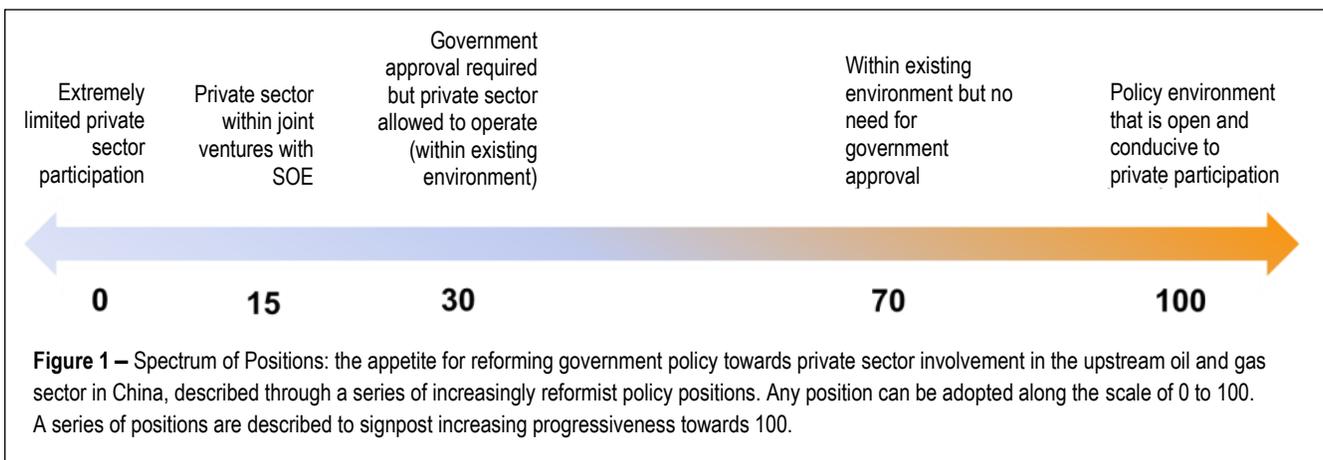
Our analysis begins by describing the PSPP that covers the range of positions that actors might take, describing the policy reform options related to private sector involvement in the energy sector.

The two extremes for this policy spectrum are the Positions of 0 and 100. At the far left, the Position of 0 is described as a policy that provides extreme limits on private sector participation in the upstream oil and gas sector in China. At the far right, Position 100 represents a policy that is extremely open and conducive to private participation in the upstream oil

and gas sector. Once again, moving from the left to the right suggests shades of gray that reflect policy environments that foster increasing openness to private participation. A Position of 15 would allow the private sector to participate so long as it is in a joint venture with a State-Owned Enterprise. A Position of 30 suggests a more ad hoc approach, where the private sector could operate in the current environment by exception, i.e. with government approval, while keeping the overall restrictions on private entry into the energy sector. A Position of 70 reflects a large political change, where the policy environment is not changed substantively but the private sector is able to participate in a limited fashion, though without government approval.

As with the data for individual actors, the position descriptions and scores along the PSPP are based on the expert interviews and represent a plausible understanding of policy possibilities. Depending on the exact subsector, current policy reflects something near Position 15 on the scale, but with investments in unconventional energy sources being nearer 30.

The data for the policy spectrum described in Figure 1 are presented in Table 2. This table aggregates the values assigned to actors by the group of experts and assumes that they have identified the correct set of actors: some may have been omitted, some included when they should not have been.





These caveats notwithstanding, the data represent a consensus view held by several observers of the industry. If nothing else, our analysis of these data lends insight to plausible future policy outcomes, if this shared, observed understanding is correct. Our approach provides logical and coherent outcomes derived from the paradigm presented.

Utilizing these baseline data, we use KTAB to generate a set of simulation results applying a SMP. These simulation results can be seen as a logical conclusion of the subjective data inputs. This allows us to make inferences about the broader policy reform debate, as defined by our panel of experts, that limits private company involvement in the energy sector in China. On the one hand, policies which define the role of private enterprise could remain extremely limiting, as captured on the left hand side of the scale at Position 0. On the other hand, the policy environment could be open and even conducive to private participation, as captured on the right hand side of the scale at Position 100. Rather than pointing to one particular policy that would reduce limits on private activities, or promote private sector involvement, this scale describes the broader mix of policies that create an environment that is more or less open for private industries to participate in the Chinese energy sector.

Figure 2 provides the first visualization generated with the data from our experts. This diagram, known as a Sankey diagram, allows us to observe the simulation results of all of the actors in the data set (identified in Table 2) as they shift their positions from one turn to the next. Turn 0 is the initial condition described in Table 2, while the remaining turns 1-10 present results from the KTAB simulation. Based on the interactions, and the responses of actors' calculated interactions, positions can change between turns based on the actors' perceived interests and coalition building.

The range of Positions from 0 to 100 is shown on a color gradient, ranging from blue to green to yellow to red, as shown in the key on the right hand side of the figure. The vertical axis loosely corresponds to the color gradient in terms of physical distance, but the color shading is a more precise indication of the positional location of actors. This figure clusters actors who hold the same position (after rounding to the nearest 5) into a single weighted line, the thickness of which reflects the exercised power (the combination of the collective influence and salience) of actors holding that position in a particular turn or turns. Individual actors are marked on the left hand side of the figure with a short naming legend consistent with Table 2.

The diagram represents the increase and decrease in support accruing to particular policy positions as the CDMP simulation runs through the 10 turns. The color of lines shows the position being advocated; the thickness of each line denotes the weight of the support. The legend translates the color of the line into numerical and qualitative policy descriptions. Where two lines merge, one actor is joining another. Where lines split, a particular position is losing a supporting actor. The simulation leads to a narrowed range of positions. These are the plausible outcomes of the CDMP.

By turn 10, the actors have converged on a narrowed range of plausible negotiated outcomes. Although it is not our intention to speculate on exact reasons for the rise and fall of coalitions, it may be instructive to explain a single movement among actors. It can be seen that the first actor to adjust its position is the US Government, which jumps from a Position of 100 to just 20 in the first turn. The US Government is routinely held to be one of the strongest in the world. Why would it abdicate so swiftly and so completely? Despite its overall power, in this particular policy question its influence is severely



Actor	Legend	Group	Position	Influence	Saliency	Exercised Power
Xi Jinping	XJ	Politburo Standing Committee	30	100	30	30
Li Keqiang	LK	Politburo Standing Committee	45	65	65	42
Zhang Gaoli	ZG	Politburo Standing Committee	30	35	40	14
Ma Kai	MK	Central government	45	35	25	9
Liu He, Deputy Director of DRC	LH	Central government	50	40	70	28
Xu Shaoshi, Director of NDRC	XS	Central government	15	20	40	8
National Energy Administration	NEA	Central government	20	15	40	6
Ministry of Land and Resources	MLR	Central government	60	25	70	18
Ministry of Environmental Protection	MEP	Central government	30	20	30	6
Ministry of Finance	MOF	Central government	45	35	50	18
Shanxi	SHX	Provincial government	50	20	70	14
Heilongjiang	HLJ	Provincial government	20	20	70	14
CNPC and PetroChina	PC	CNPC	15	15	75	11
CNPC old guard	COG	CNPC	10	50	80	40
CNOOC, Wang Yilin	WY	SOEs	15	40	80	32
Sinopec	SPC	SOEs	15	45	80	36
Shanxi Yanchang (provincial mining SOE)	PSOE	SOEs	60	15	60	9
China Petroleum and Chemical Industry Federation (CPCIA)	CPCIA	SOEs	40	20	80	16
CUCBM Company, partner with PetroChina	CUCBM	SOEs	45	10	60	6
US Government	USA	Foreign competitors	100	8	50	4
US Chamber of Commerce	USCC	Foreign competitors	90	8	50	4
EU COC	EUCC	Foreign competitors	90	5	50	3
IOCs	IOC	Foreign competitors	90	10	75	8
Mao Yushi, Unirule Institute	MY	Advisors	75	10	75	8
Zhou Dadi, former NEA; still influential adviser	ZD	Advisors	30	15	50	8
Zhang Guobao, former NDRC; still influential	ZGB	Advisors	20	15	50	8

Table 2 – Expert-based Data for the Policy Reform of the Policy Dimension, or the appetite for reforming government policy towards private sector involvement in the upstream oil and gas sector in China.

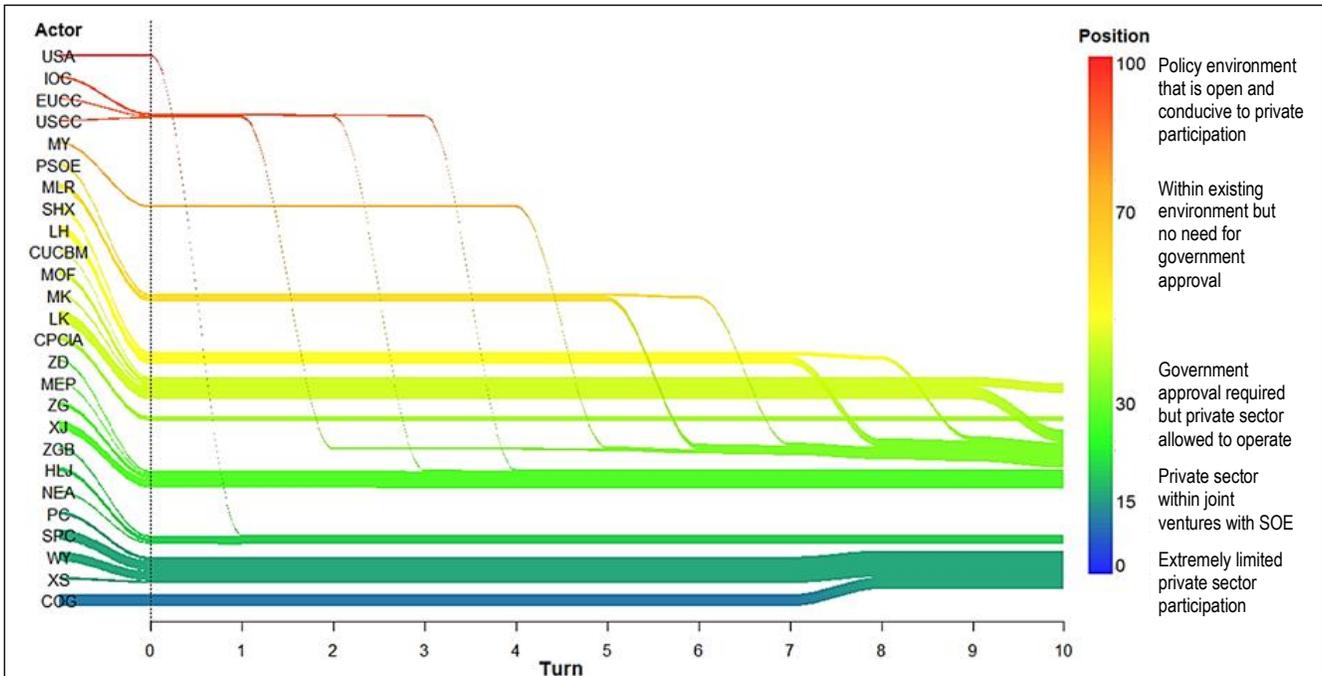
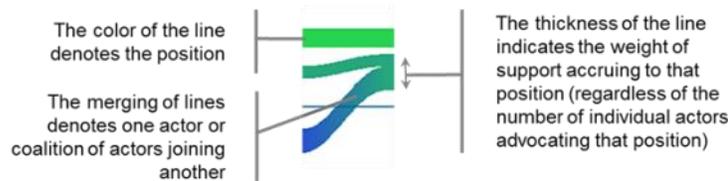


Figure 2 – Sankey Diagram of Position and Exercised Power by Turn: the policy dimension, or the appetite for reforming government policy towards private sector involvement in the upstream oil and gas sector in China.

How to read this figure:



limited. Its ability to interfere with and guide the formation of China's domestic commercial policy is highly constrained. Despite the relative importance of the issue, it is not the USA's top priority and this leads to an extremely low exercised power of 4. The USA also appears to take the most extreme initial position; it may well be that as the CDMP commences the US Government realizes the weakness and isolation of its position and adopts what it views as a most likely outcome which still ensures some progress.

Three rough groupings of actors are apparent in turn 0. These are: (1) two closely-proximate clusters of actors in the light green to yellow gradient, roughly covering Positions 40-50; (2) a cluster of actors in the green gradient, roughly covering a Position of 30; and (3) another cluster in the blue to dark green

gradient, roughly covering Positions 0-15. President Xi Jinping (XJ in the figure) anchors the middle cluster of actors, Premier Li Keqiang (LK) anchors the top cluster of actors, and CNOOC Chairman Wang Yilin (WY) anchors the lowest cluster along with the more conservative, senior managers from CNPC, who represent what we have termed the 'CNPC old guard' (COG).

As the simulation progresses, the set of actors that support the most limits to private sector participation, closer to a Position of 0, consolidates in its range of positions. The actors in the least restrictive cluster, starting around Position 40-50, reduce their advocacy of an enhanced role for private industry as the simulation progresses, and by the final turn support a position closer to the Xi-led grouping. Overall, the simulation suggests that there



is little prospect for a policy outcome that provides more operating room for private industry in the energy sector in China. Even the foreign advocates of a greater role for private sector, such as the United States Government (USA) and the international oil companies (IOC), drastically moderate their position during the simulation, perhaps reflecting a realization on their part of the limits of their own power to meaningfully affect a domestic policy decision of the Chinese.

Let us turn now to an alternative visualization of the simulation results in Figures 3 and 4. Figure 3 presents the left hand side (turn 0) of the Sankey diagram with additional information. Figure 4 presents the right hand side (turn 10) of the Sankey diagram, again with additional information, to provide a different perspective of the distribution of actor positions.

Figures 3 and 4 are bar charts which display the distribution of actors' positions over the spectrum, in turn 0 and turn 10 respectively. As noted previously, the turn 0 values are not generated by the KTAB model. They reflect the data collected from the group of experts prior to any model calculations. Each actor is represented as a segment of a bar on this figure. The location of the bars on the horizontal axis indicates the position that they take. For simplicity, when actors take roughly the same position they are stacked on top of each other and rounded to the nearest interval. The height of the bars represents exercised power. Remember that exercised power is calculated by multiplying influence and salience, so that the influence applied to the actor's position is discounted by its salience. In other words, if an actor is both very influential and cares a lot about the question (has high salience), then it will be represented by a much larger bar than an actor which has the same influence but low salience (i.e. cares less and uses less of its influence).

The different segments represent different actors, color coded to reflect groups of similar actors: for example, a Politburo Standing Committee (PBSC) member in red, or a State-Owned Enterprise (SOE) in purple. The height of the different segments reflects the actor's exercised power, with the overall height of the bar showing the power in support of that position from the collection of actors advocating that position.

In Figure 3, the distribution of actors' positions, weighted by their exercised power, is dominated by two large clusters with smaller groups of actors interspersed around them. This view of the turn 0 data in Figure 2 illuminates a more nuanced distinction among the three apparent clusters of actors than was visible in the Sankey diagram.

Two members of the Politburo Standing Committee, Xi Jinping and Zhang Gaoli, occupy a position of 30, slightly in favor of the less reform-minded cluster, between two groups of actors that hold more exercised power in aggregate. Not surprisingly, State-Owned Enterprise (SOE) actors, shaded a light purple color, are skewed toward the left on this spectrum and comprise the bulk of the influence of the actors at Position 20. Members of the Politburo Standing Committee (PBSC, shaded in red in the figure), along with Central Government actors (shaded in green), generally take a slightly more favorable view of very moderate reforms within the existing environment. This set of actors, at the Position of 50, is to the right of President Xi's position in support of requiring government approval, but falls well short of removing the need for government approval. In reality, it is not a large difference of position. A few minor actors adopt positions favoring greater openness for private industry, but their political clout (exercised power) is limited. President Xi occupies the median position in terms of the weighted distribution of power.

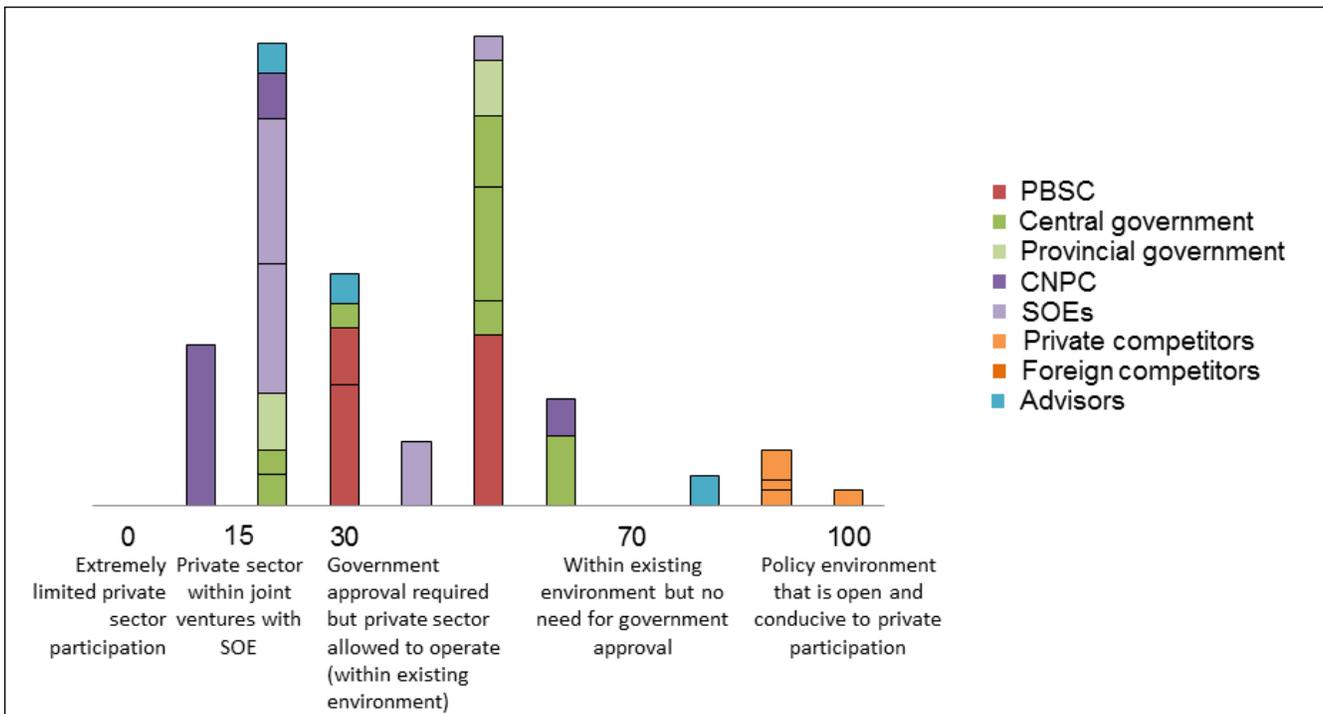
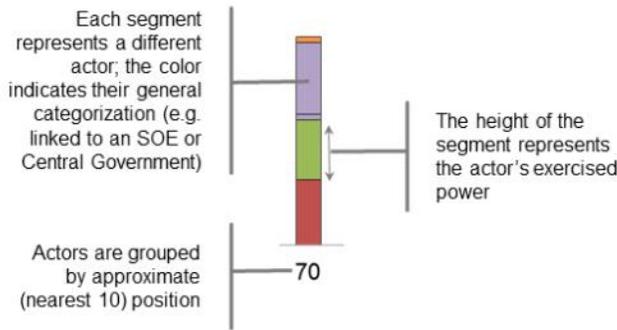


Figure 3 – Turn 0 Distribution of Positions and Exercised Power: the policy dimension, or the appetite for reforming government policy towards private sector involvement in the upstream oil and gas sector in China.

How to read this figure:



The different segments represent different actors, color coded by their type: for example, a Politburo Standing Committee (PBSC) member in red, or a State-Owned Enterprise (SOE) in purple. The height of different segments indicates the actor's exercised power; the overall height of the bar shows the power accruing to that position.

Figure 4 shows how the actors' positions have changed after 10 turns of interactions. The SMP suggests actors will settle on the new positions reflected in this figure. Again, for simplicity, actors whose positions are very similar are rounded to the nearest ten-point interval. The consolidation of positions across the actors in the simulation is more striking in this figure than in the Sankey diagram. The strength of President Xi's position—where all

the modelled Politburo Standing Committee members now cluster—along with a slightly more conservative cluster of actors, suggest that reformist alternatives seem quite unlikely.

The experts who provided the data for our analysis assessed Xi Jinping as the closest to a singular decision maker (in that he has the greatest power), though one could argue that in a consensus-based



system like China he remains the first among many. In the baseline data set, President Xi was given a Position of 30, and the simulation indicates that this is a position to which he holds firm over the course of 10 turns.

One question that arises is whether or not senior leaders such as Xi Jinping position themselves in the center of consensus, or whether consensus forms

around them. We cannot test this explicitly, but we can try to evaluate the weight of institutional inertia, and to what extent senior leaders are able to drag the consensus to their preferred position. In doing so we are also asking about whether it matters if our experts have misjudged the position of the senior decision makers. Does it make any difference? Is the ratio of influence between the senior leaders and the rest such that the individual influential voices are

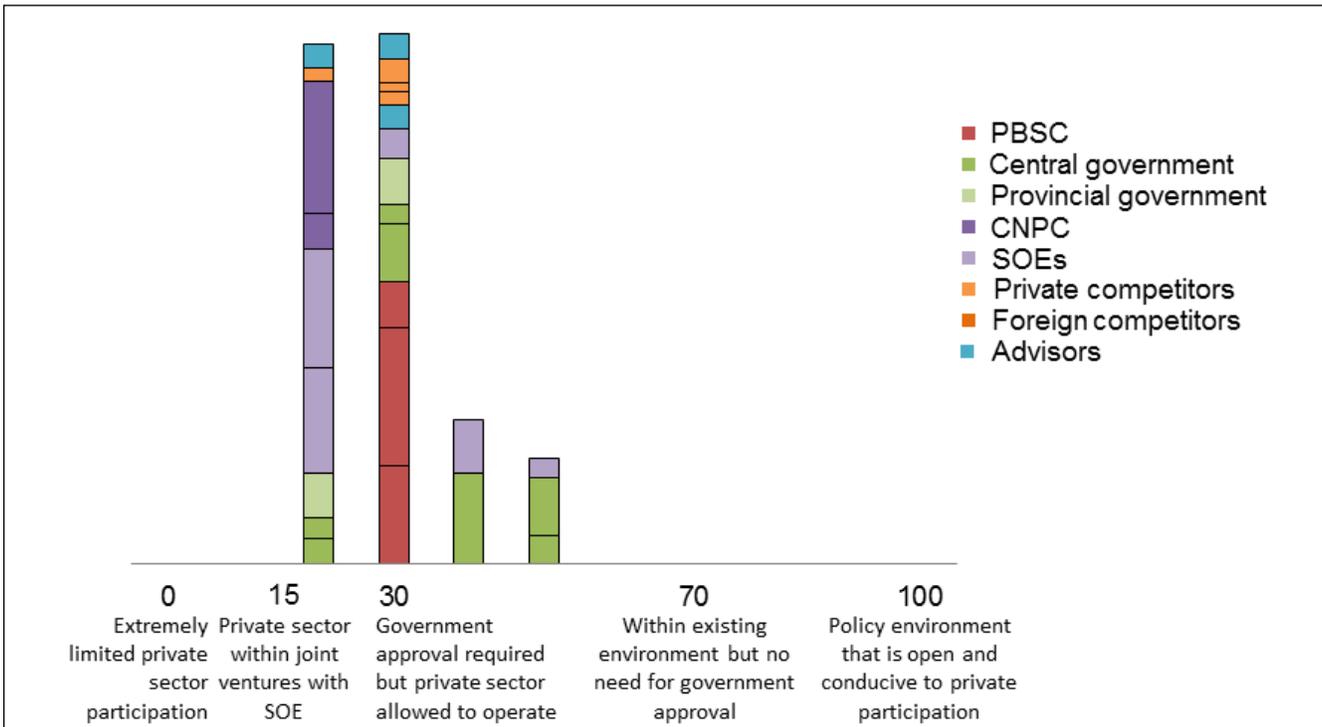
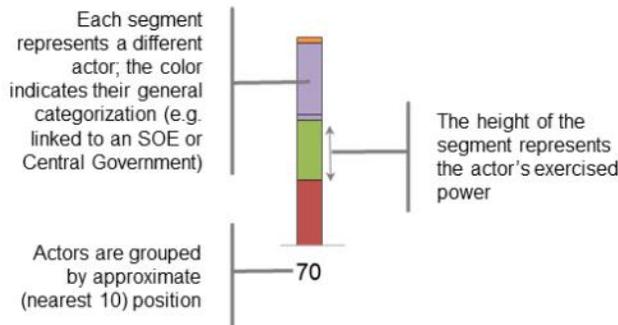


Figure 4 – Turn 10 Distribution of Positions and Exercised Power: the policy dimension, or the appetite for reforming government policy towards private sector involvement in the upstream oil and gas sector in China.

How to read this figure:



The different segments represent different actors, color coded by their type: for example, a Politburo Standing Committee (PBSC) member in red, or a State-Owned Enterprise (SOE) in purple. The height of different segments indicates the actor's exercised power; the overall height of the bar shows the power accruing to that position.



drowned in the backdrop of competing interests? At a very simple level we can compare the ratio of exercised power: Xi Jinping has 30, Li Keqiang, 42; the total is 400.

We can also construct a series of scenarios to evaluate these differences: setting the positions of President Xi and Premier Li to range from anywhere between 0 and 100. In other words, we can assess how the overall simulation performs if a specified actor is assumed to be less in favor of allowing private activity in the energy sector, or if he actively advocates a policy environment that is open and conducive to private activities, or anywhere in between. Figure 5 displays the range of simulation results with these varied assumptions regarding President Xi's or Premier Li's starting position.

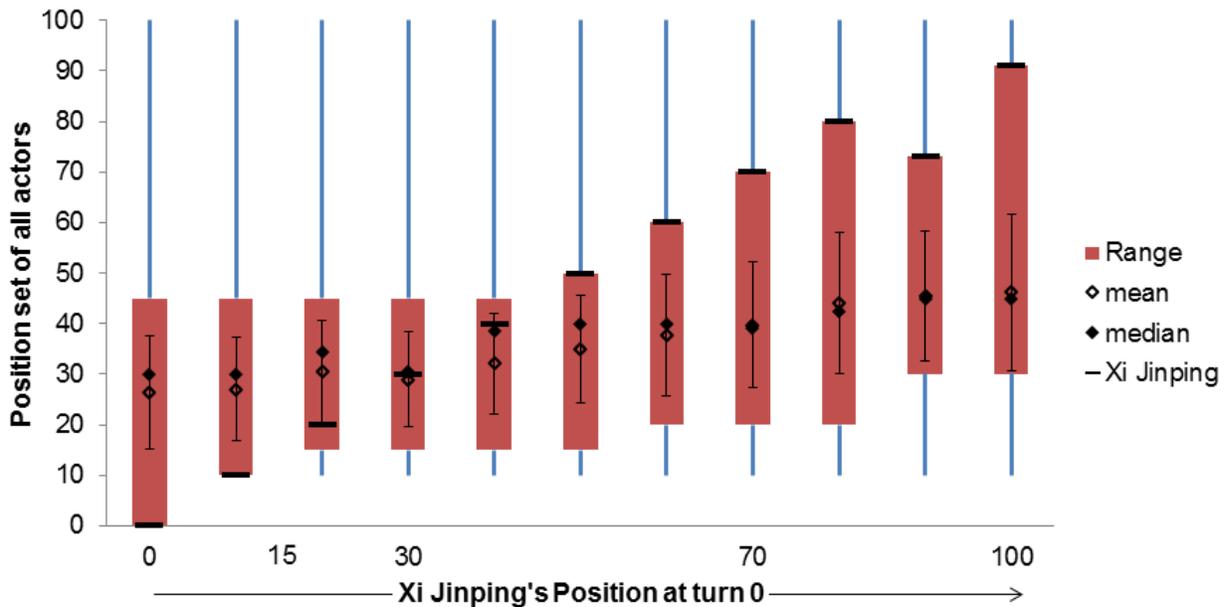
For each actor, 11 simulations were completed, with 10 turns each, given a starting position for each of the two senior leaders of 0, 10, 20, and so on through a position of 100. The figure displays five pieces of information for turn 10 of each of these simulations. The black bar mark indicates the senior leader's position at the end of the tenth turn of the simulation. The black, solid diamond indicates the median position of all the actors, i.e. that position which has an equal distribution of exercised power on either side of it. The outline diamond indicates the mean position of all the actors; the error bars the standard deviation. Finally, the red block indicates the range, from low to high, of positions for all actors in the 10th turn of the simulation. Each of the 11 simulations is displayed from left to right, with the senior leader's starting (turn 0) position increasing by 10 points along the x-axis. The thin blue lines show the range of positions for all actors at turn 0.

The comparison across these scenarios suggests that the senior leaders cannot, on their own, drive consensus among the actors in the baseline simulation and that their high levels of influence do not translate into an ability to dominate the CDMP.

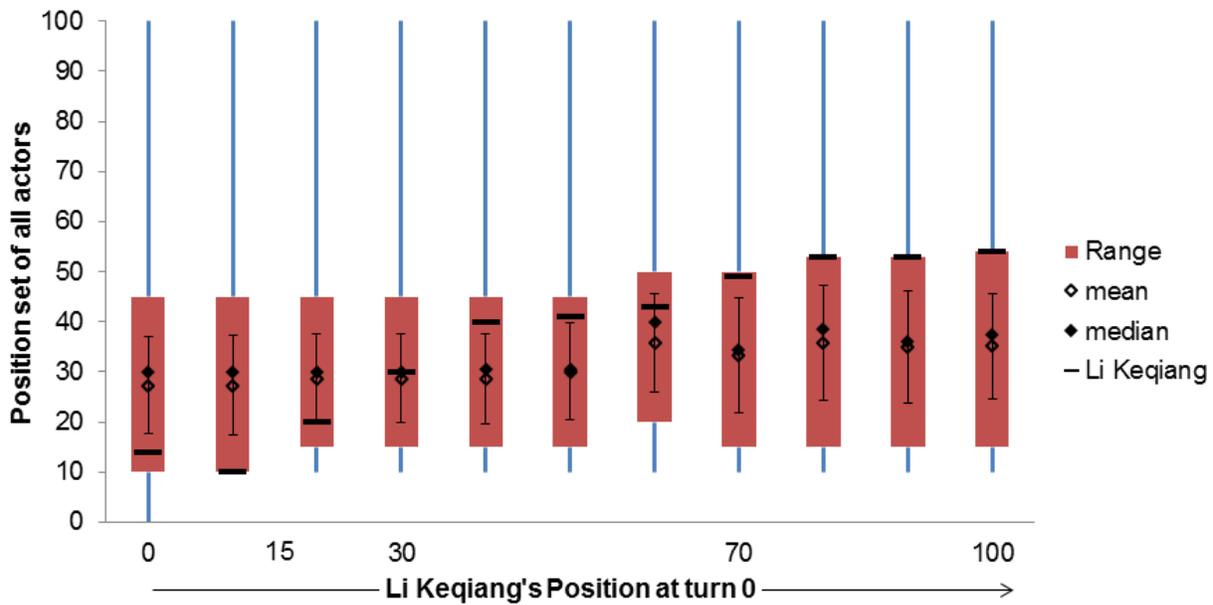
If either Xi Jinping, who is routinely held by our experts to be the most influential political leader, or Li Keqiang, the actor given the highest exercised power in our simulation, were such a driver, then the consensus would emerge around his initial position, whatever it might be. For these simulations, this is clearly not the case. The range of actor positions, indicated by the red blocks, appears to be relatively fixed over an interval between 15 and 45 by turn 10 in each of the simulations.

However, in the simulations where President Xi is outside this range, he sets a new lower or upper bound. When he is either at 0 or 10 on the left hand side of the figure, the mean and median of the overall simulation do not shift—together these are good approximations of the center of exercised power for the simulation outcome—and President Xi sets the lower bound of the range of actor positions. When he has started the simulation with a position of 50 or greater, moving from the center of the figure to the right hand side, again the mean and median do not vary appreciably, and President Xi sets the upper bound of the range of actor positions. Li Keqiang also does not appear to shift the consensus and is less able to maintain an extreme position, suggesting that despite his higher exercised power he is also a partner in greater coalition building.

Xi Jinping's starting Position (30), as assigned by our experts for the baseline data, appears to be the likely ending point of the bargaining simulation, regardless of whether either of the senior leaders start at this position or not. Thus, if the baseline data identified by our experts for President Xi are correct, this suggests that either his natural instinct is aligned with the consensus on the issue or he has identified the likely locus of exercised power and has situated himself in support of this position. In the end, we do not need to know which proposition holds because his positioning does not significantly affect the outcome of the simulation, given the asymmetry of influence and the weight of institutional inertia.

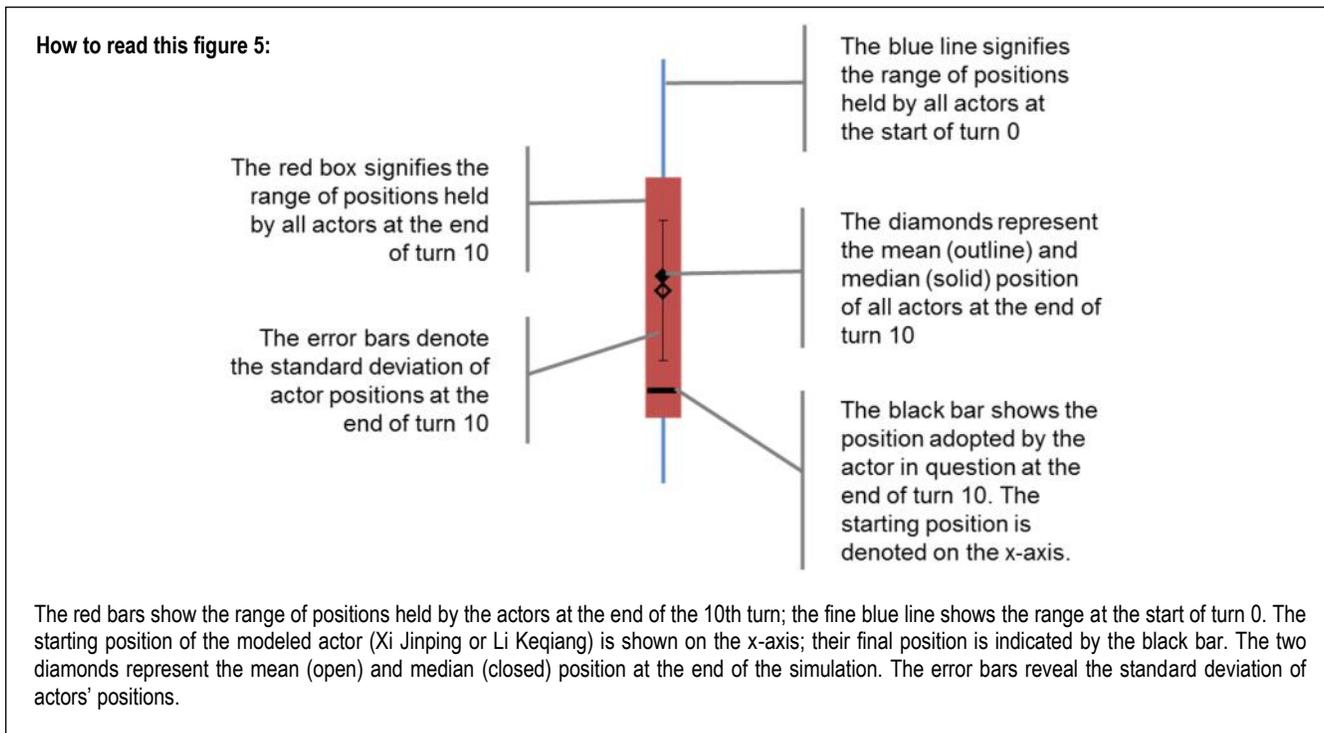


Extremely limited private sector participation Private sector within joint ventures with SOE Government approval required but private sector allowed to operate (within existing environment) Within existing environment but no need for government approval Policy environment that is open and conducive to private participation



Extremely limited private sector participation Private sector within joint ventures with SOE Government approval required but private sector allowed to operate (within existing environment) Within existing environment but no need for government approval Policy environment that is open and conducive to private participation

Figure 5 – How Strong is the Modeled Institutional Inertia? Simulation results for President Xi Jinping's and Premier Li Keqiang's position: the policy dimension, or the appetite for reforming government policy towards private sector involvement in the upstream oil and gas sector in China.

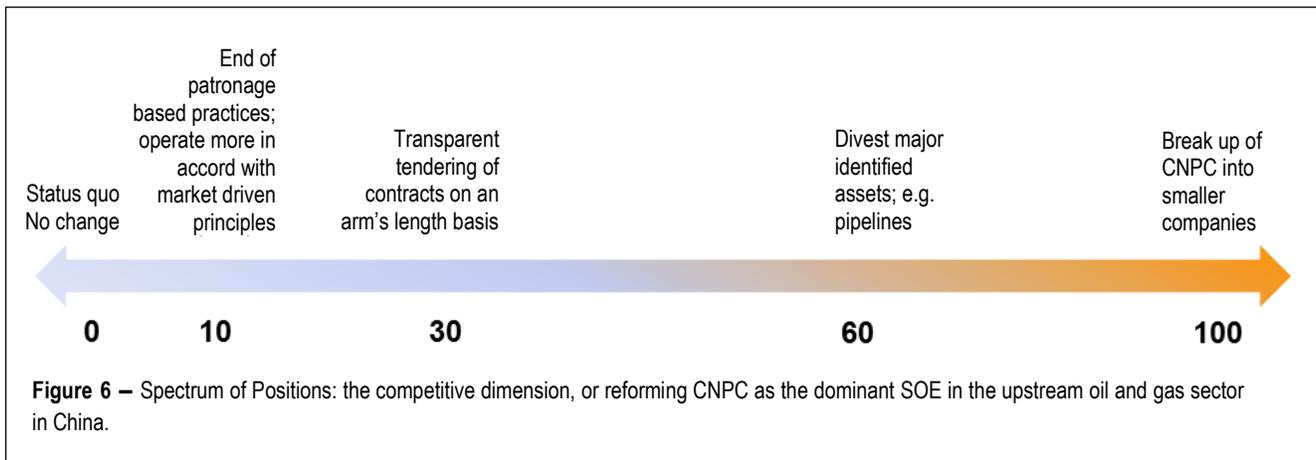


The Competitive Dimension: What is the Appetite for Reforming CNPC as the Dominant SOE in the Upstream Oil and Gas Sector in China?

In this section we address the second question, the political debate over the competitive dimension in China. In particular, we assess the appetite for reforming CNPC as the largest SOE in the country's oil and gas sector. Once again, we start with a definition of the spectrum of possible outcomes that actors might adopt as positions. Figure 6 presents the spectrum for this second question.

This figure provides a range of possible outcomes that address possible methods of reducing CNPC's role in China's energy markets. Again, the position descriptions and values were identified by our experts during structured interviews. We use the data as an indication of widely held beliefs regarding the possible ongoing policy discussions.

One extreme of the array of positions represents no change, or the status quo, assigned a Position of 0. At the other extreme is the drastic act of breaking CNPC into smaller pieces, which reflects the most wide-reaching and aggressive approach, assigned a Position of 100. Points in between these two extremes reflect shades of gray as we progress along the spectrum. A Position of 10 represents a more symbolic gesture, still meaningful but not expected to reduce CNPC's dominance in the sector. Advocacy of this position reflects support for the application of market-driven principles in CNPC's business practices in ways that are not fundamental to its business operations, such as a reduction or end to patronage-based practices. Farther to the right on the spectrum, a Position of 30 reflects more meaningful reforms. In this case, representative of this more substantive position is the notion of transparent tendering of service contracts, where CNPC is required to create a level playing field for bids to be won on their merits, rather than retaining favored vendors for these services. Much farther



along to the right is a Position of 60, which reflects a much more substantive and meaningful change, i.e. the required divestiture of major CNPC assets, such as pipelines to be run on an open access basis. Although we identify 0 as the status quo, current rhetoric hints at 10, 30, and even 60, though these more reformist positions have not been formalized or institutionalized yet.

These identified points along the spectrum were an attempt by our experts to capture the range of possible advocacy and illustrative actions that would reform CNPC and reduce its span of control within China. In reality, a range of possible alternatives is implied by the points surrounding and in between these discrete options. The identified positions

simply act as markers to reflect the substantive meaning of the PSPP. The same experts who provided data for the first spectrum also provided data for this second spectrum; once again, we aggregated their individual inputs to form the baseline data set that we present in Table 3.

The Sankey diagram in Figure 7 captures the simulated change in positions of actors over time, along with the associated variation in cumulative exercised power that clusters around certain positions over the 10 turns of the SMP simulation. As before, the gradient colors reflect the range of potential positions for the actors. The thickness of the lines reflects the collective strength of actors' exercised power around a position over the course of

Means, medians and ranges

Throughout this paper we will refer to the mean, median, and range of the positions held by various actors in the CDMP. We do this in a non-technical way, without the explicit assumption that the distribution of positions is single-peaked.

The range of positions is a straightforward way to get an understanding of the extremes of the distribution, but it says nothing about where the weight of exercised power lies across the distribution, or where the majority of the actors are.

The median describes the position with 50% of the exercised power on either side of it. This is true whatever the distribution of support, be it single-peaked as in Figure 4, or double-peaked as in Figure 3.

The mean describes the normal arithmetic average, and as such it takes account of extreme outliers in a way that the median fails to. In distributions that are not single-peaked, the mean need not have actual supporters. In Figures 5 and 12, we use the difference between the mean and median to show the effect of extreme positions held by single actors on the rest of the group. If the mean moves but the median does not, it suggests a skewed distribution.

Reforming the Role of State-Owned Enterprise in China's Energy Sector



Actor	Legend	Group	Position	Influence	Saliency	Exercised Power
Xi Jinping	XJ	Politburo Standing Committee	20	100	60	60
Li Keqiang	LK	Politburo Standing Committee	65	55	60	33
Wang Qishan	WQ	Politburo Standing Committee	20	80	40	32
Zhang Gaoli	ZG	Politburo Standing Committee	15	35	90	32
Ma Kai	MK	Central government	45	35	60	21
Liu He, Deputy Director of NDRC	LH	Central government	65	40	75	30
Xu Shaoshi, Director of NDRC	XS	Central government	10	20	40	8
National Energy Administration	NEA	Central government	15	15	40	6
NDRC, Pricing Department	Price	Central government	20	25	40	10
Zhang Yi, SASAC	SASAC	Central government	60	25	95	24
National Audit Office	NAO	Central government	20	30	70	21
Ministry of Land and Resources	MLR	Central government	50	25	80	20
Ministry of Environmental Protection	MEP	Central government	15	20	20	4
Ministry of Finance	MOF	Central government	40	35	65	23
Shanxi Provincial Government	SHX	Provincial government	50	20	75	15
Heilongjiang Provincial Government	HLJ	Provincial government	30	20	60	12
CNPC Senior Leadership	CNPCL	CNPC	20	50	90	45
CNPC Middle Managers	CNPCM	CNPC	30	30	60	18
CNPC Employees	CNPCE	CNPC	45	10	75	8
CNPC, PetroChina/Overseas Branches	CNPCO	CNPC	50	15	80	12
CNPC Service Providers	SP	CNPC	0	5	70	4
Fu Chengyu, Sinopec Chairman	FC	SOEs	65	45	80	36
Sinopec	SPC	SOEs	45	10	45	5
Wang Yilin, CNOOC Chairman	WY	SOEs	60	40	75	30
CNOOC	CNC	SOEs	60	7	55	4
Shanxi Yanchang, provincial mining SOE	PSOE	SOEs	65	15	20	3
Offtake companies, Provincial SOEs	PSOES	SOEs	30	2	20	0
China Petroleum and Chemical Industry Federation (CPCIA)	CPCIA	SOEs	55	10	70	7
CUCBM Company, partner with PetroChina	CUCBM	SOEs	55	10	70	7
Competitors, Private domestic; good access	PDGA	Private competitors	0	5	60	3
Competitors, Private domestic; poor access	PDPA	Private competitors	60	2	80	2
Competitors, Foreign (Supermajors)	IOC	Foreign competitors	75	15	50	8
Shell	SH	Foreign competitors	90	10	50	5
Competitors, Foreign (Small-Medium)	FSM	Foreign competitors	70	5	60	3

Table 3 – Expert-based Data for the Competitive Dimension, or reforming CNPC as the dominant SOE in the upstream oil and gas sector in China.



the simulation. Again, individual actors are marked on the left hand side with a short naming legend, consistent with Table 3.

The diagram represents the increase and decrease in support accruing to particular policy positions as the CDMP simulation runs through the 10 turns. The color of lines shows the position being advocated; the thickness of each line denotes the weight of the support. The legend translates the color of the line into numerical and qualitative policy descriptions. Where two lines merge, one actor is joining another. Where lines split, a particular position is losing a supporting actor. The simulation leads to a narrowed range of positions. These are the plausible outcomes of the CDMP.

Compared with the Sankey diagram for the broader policy question reflected in Figure 2, the final range of positions in Figure 7 is much wider. This reflects a more significant, sustained disagreement over the correct answer regarding CNPC's future. The simulation results suggest that there are more highly divergent, but well-entrenched, interests at play in this CDMP as compared to the CDMP around overall policy reform. Given the more concrete effects of a corporate restructuring versus a policy update, with more immediate and clear winners and losers, this may not be a surprise.

Figure 7 makes the point that the largest block of power (in green) remains around Xi Jinping's position over the course of the simulation and this

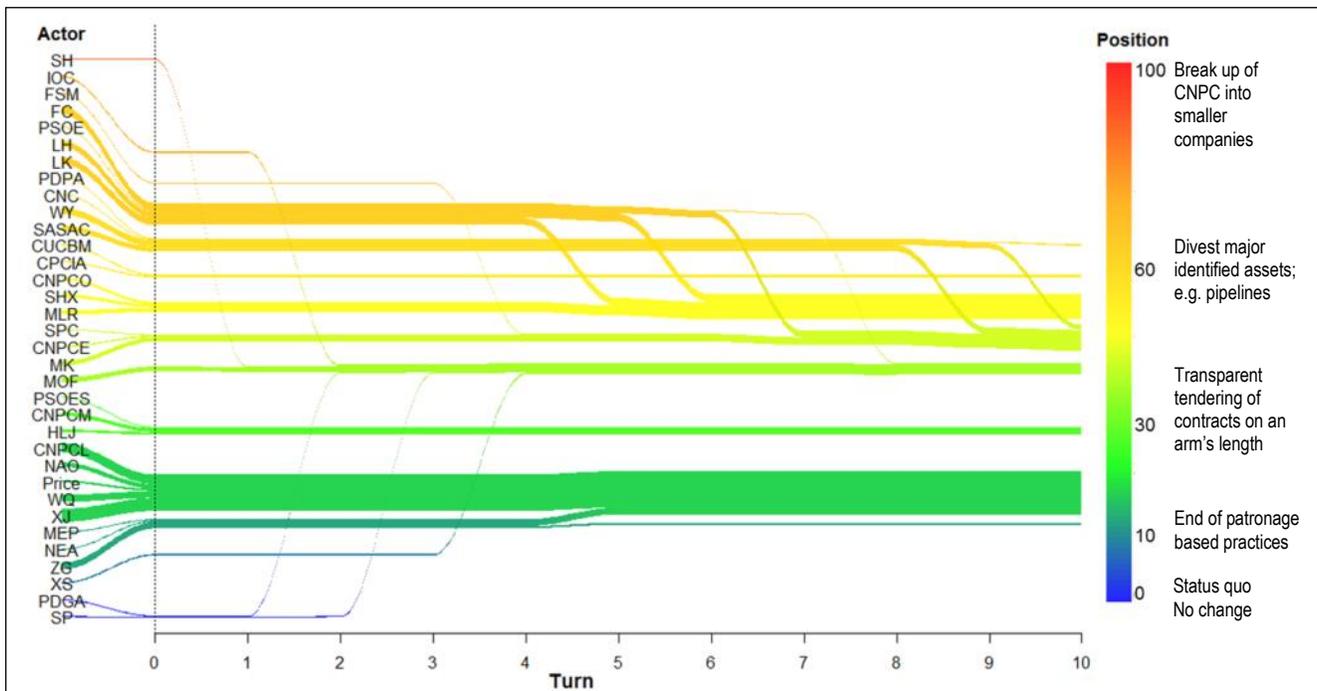
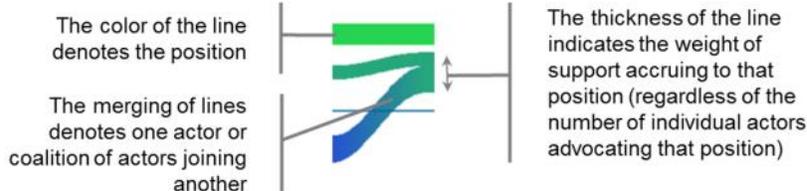


Figure 7 – Sankey Diagram of Position and Exercised Power by Turn: the competitive dimension, or reforming CNPC as the dominant SOE in the upstream oil and gas sector in China.

How to read this figure:





cluster is unyielding in the face of efforts to promote greater reform at CNPC. Once again, actors are clustered into lines along the Position spectrum, which is shaded from blue to red to reflect gradations from 0 to 100. The width of lines reflect the cluster of exercised power for actors at a given position. Changing positions of ‘coalitions’ of actors are captured by changing position on the y-axis, as the turns progress. Individual actors are marked on the left hand side with a short naming legend, consistent with Table 3.

This is a surprising finding given the expectations of the experts we interviewed. In general, there was a belief among our experts that reform of CNPC is forthcoming. In the context of the corruption scandals facing CNPC, and the frequent reports of

the arrest of senior executives, there is an expectation that substantive reforms are imminent for the company, either as a side effect of the corruption scandals, or as a partial motivation for the removal of CNPC leadership. This is not borne out by the SMP simulation.

For the other actors, there is some moderation in their position, but much disagreement remains. Figures 8 and 9 reinforce this story of limited consensus and limited reform. While our base case is an amalgam of all our experts’ views, Figures 8 and 9 show the simulation results if we use only a subset of the expert data. By using component data sets from individual experts we can reinforce an important point. Despite some divergent views among our experts, the simulated outcomes are surprisingly consistent.

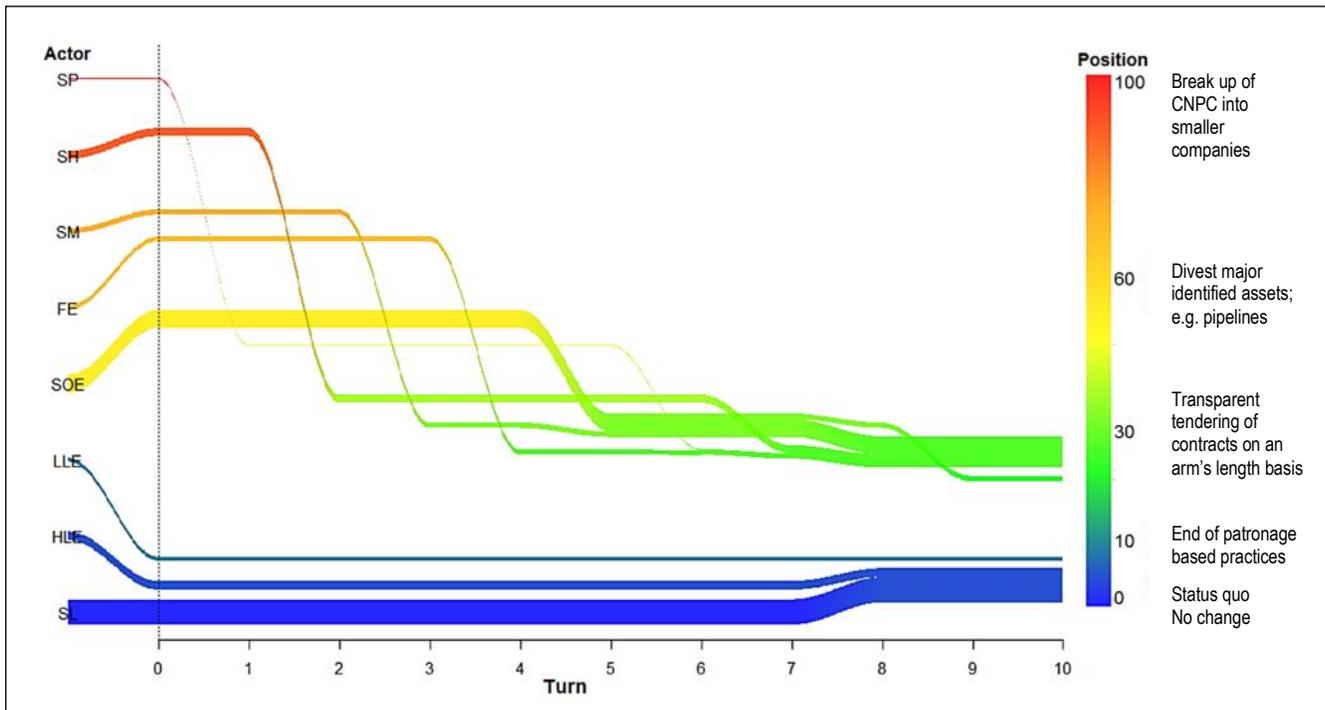


Figure 8 – Sankey Diagram of Position and Exercised Power by Turn: the competitive dimension, or reforming CNPC as the dominant SOE in the upstream oil and gas sector in China (using an individual expert data set).

SL: CNPC senior leadership; HLE: CNPC higher-level management; LLE: CNPC low-level employees; SOE: other SOEs (Sinopec and CNOOC); FE: small foreign enterprise; SM: super-majors; SH: Shell; SP: small private players. Again, note that position is denoted by color (not by y-axis) and the thickness of the line indicates the combined exercised power accruing to that position.

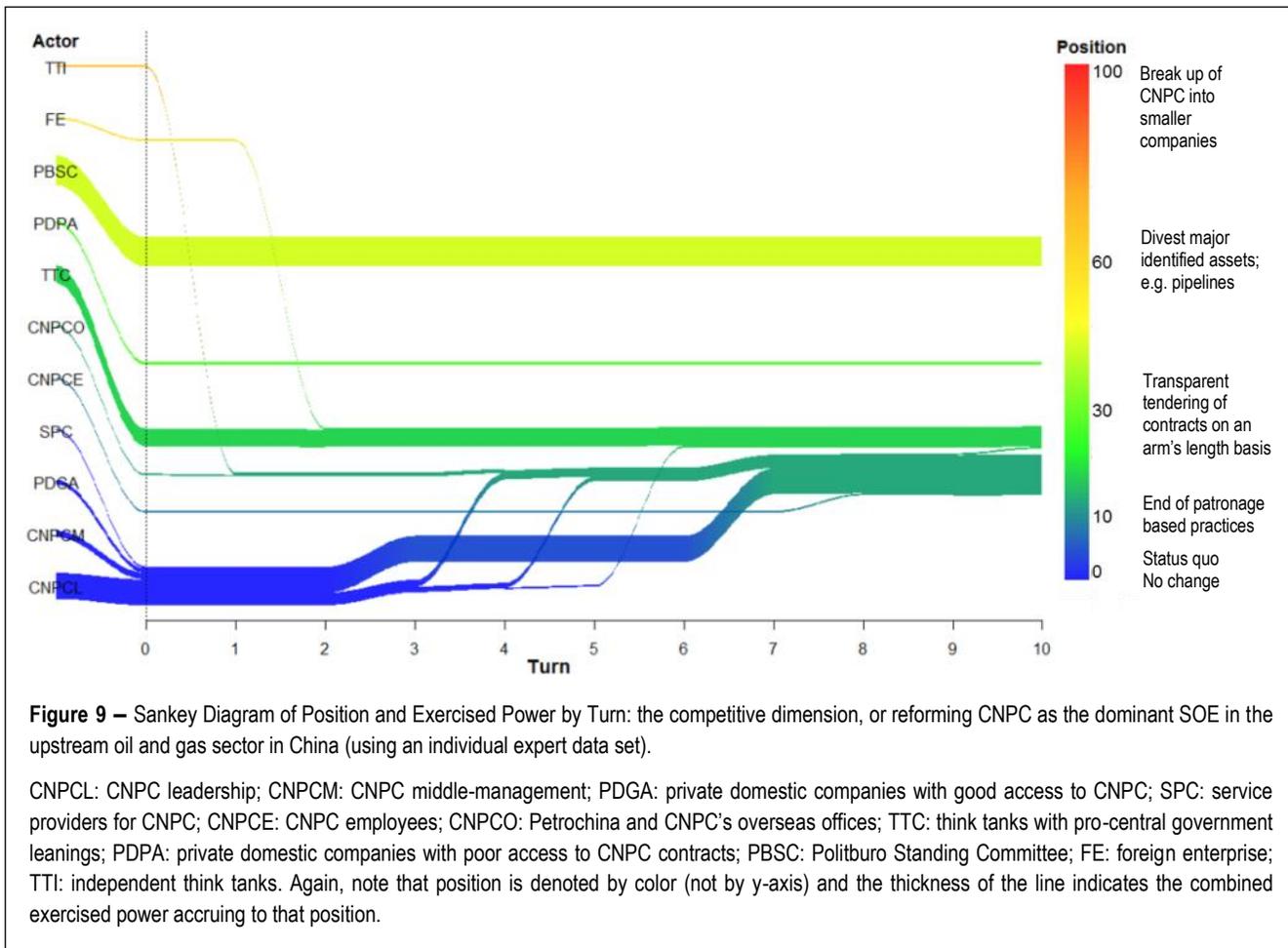


Figure 8 contrasts the positions within CNPC with those held by its competitors, domestic and foreign. The two groups never reach consensus. CNPC barely budges from a highly conservative position. Its competitors coalesce around a call for very minor reforms, a significant shift from their initial positions.

Figure 9 compares CNPC's position with what could be described as satellite companies, contrasting both with central government and assorted think tanks. Again, little consensus is achieved; there remains a persistent disconnect between a conservative CNPC and the companies whose economic interests are best served by the status quo on the one hand, and the government on the other hand. In any case, significant reform (like the divestment of assets) of CNPC does not appear politically feasible.

Returning to the base case, Figure 10 returns to the first of the two bar charts that showed either end of the set of turns represented in Figure 7's Sankey diagram. Once more, each of the bars reflects the position of the actors on the spectrum according to the labels on the horizontal axis. The height of each actor's bar again reflects the combination of influence weighted by salience, or the exercised power of the actor. The overall figure summarizes the position each actor takes, and the degree of political clout that will be applied to support the position that they take on this question.

Figure 10 shows that there is no clear consensus in favor of any position on the spectrum. Once more, for the initial state, at each position (x-axis) the cumulative exercised power of the individual agents holding that position (the stacked colored blocks,

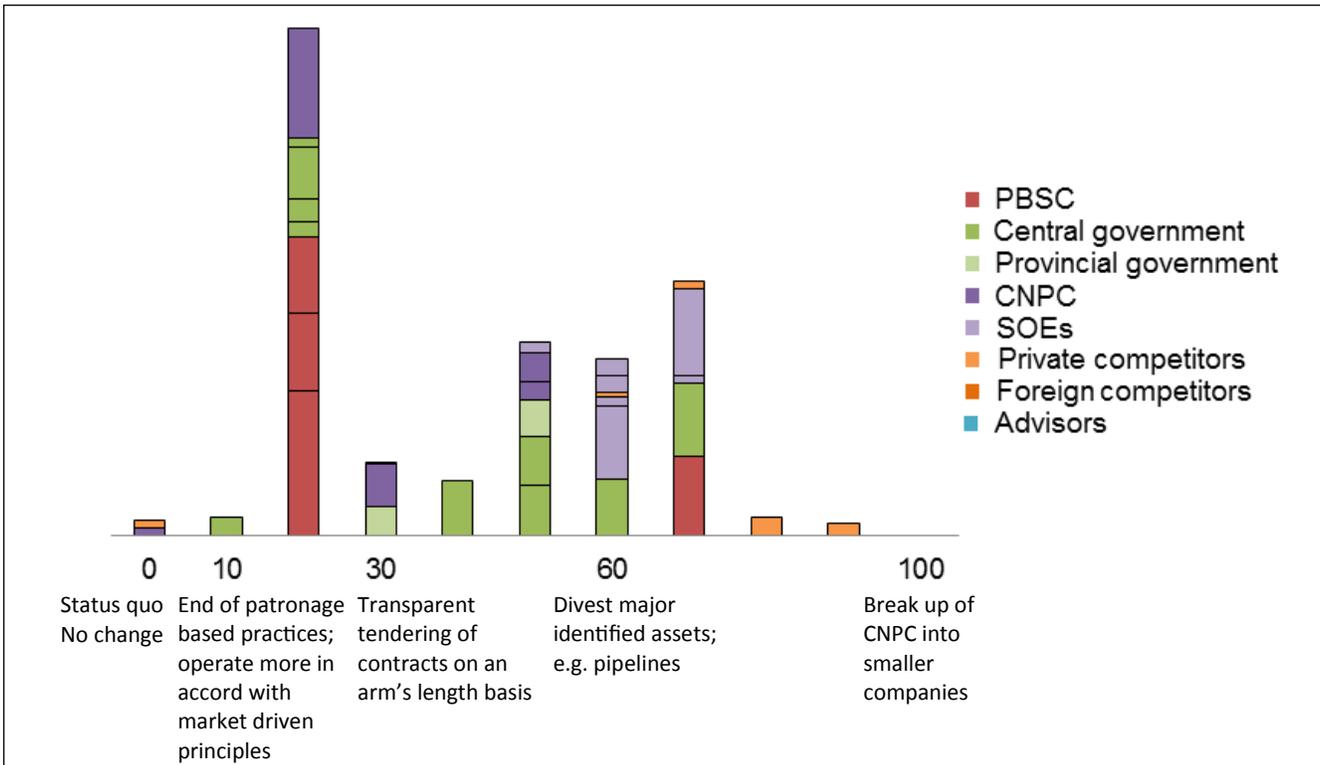
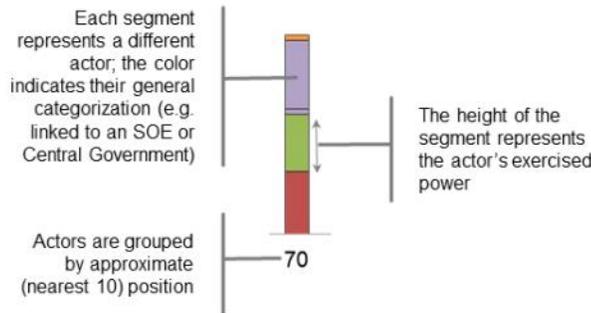


Figure 10 – Turn 0 Distribution of Positions and Exercised Power: the competitive dimension, or reforming CNPC as the dominant SOE in the upstream oil and gas sector in China.

How to read this figure:



The different segments represent different actors, color coded by their type: for example, a Politburo Standing Committee (PBSC) member in red, or a State-Owned Enterprise (SOE) in purple. The height of different segments indicates the actor's exercised power; the overall height of the bar shows the power accruing to that position.

color scheme as before) is shown. The largest block of influence supports very superficial changes to CNPC's role in the Chinese energy sector. Xi Jinping, notably, and other actors support a Position of 20. A few less influential actors support even less reform of CNPC. More reform-oriented actors do not have a consensus view on how to reform CNPC, with smaller blocks of influence distributed from a Position of 30 up to a Position of 70. All things

being equal, as the leader of China, President Xi is widely viewed as the driver of any sort of change in observed outcome. His position is a useful reference point for the expected outcome in this case.

Figure 11 displays the same information as in the previous figure, but is the result of 10 turns of interactions among the actors. After 10 turns have passed, with the consequent shifts in position by



individual actors taking place each turn, the SMP suggests actors will settle on the new positions reflected in this figure. Once again, for simplicity, actors whose position is very similar are rounded to the nearest interval.

As noted in Figure 11, Xi Jinping remains at a Position of 20 after 10 turns of interactions. Indeed, the set of actors in this block of influence appears to

be largely unchanged. This suggests that the only reforms to CNPC, as calculated by the SMP, will be superficial. Notably, the more progressively-minded actors from turn 0 have all exhibited some moderation. The realization that substantial reform is likely not possible has caused these actors to adopt a less reform-minded position over the course of the turns simulated, and so they have arranged themselves in clusters grouped around Positions of

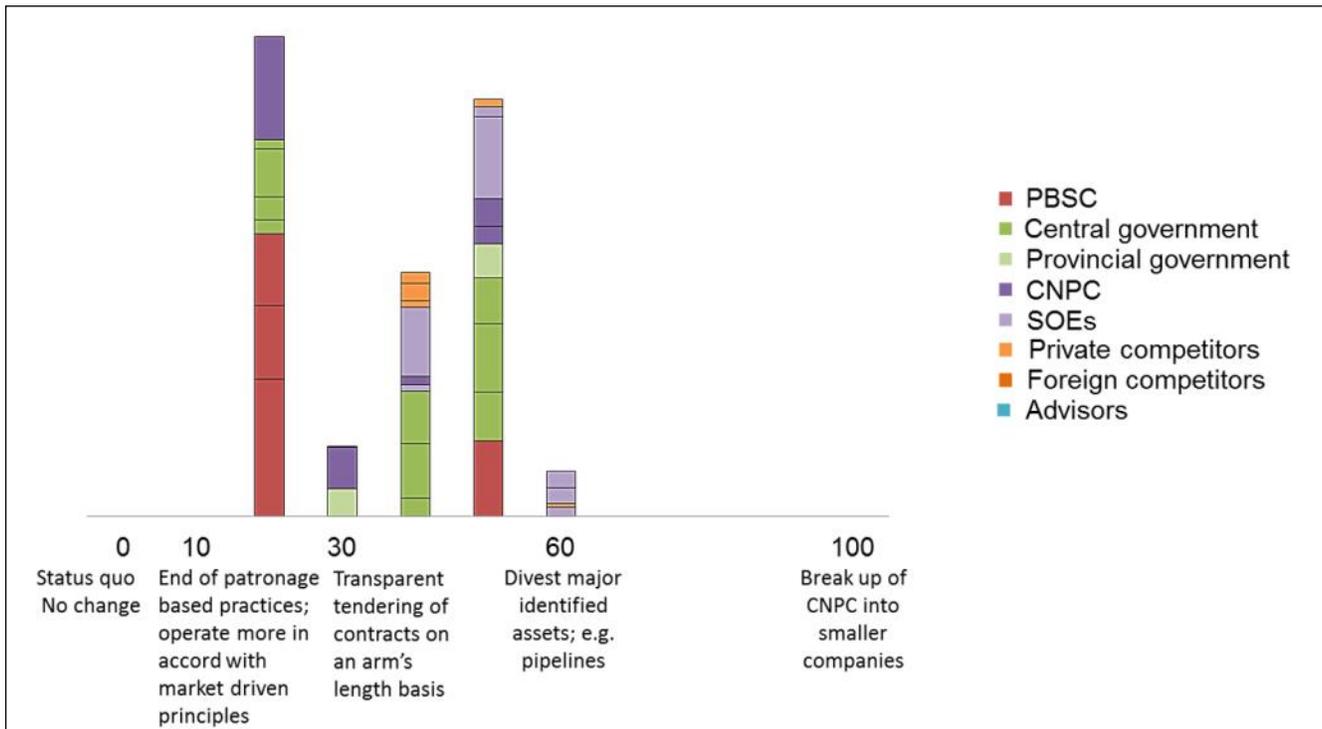
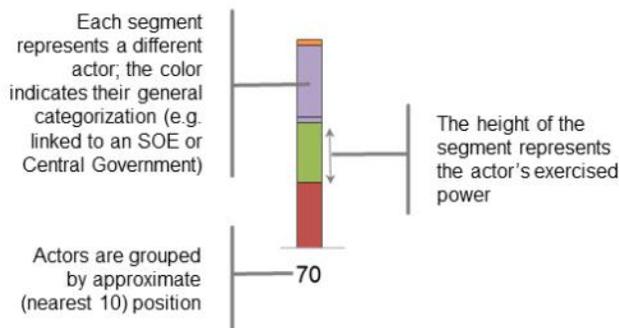


Figure 11 – Turn 10 Distribution of Positions and Exercised Power: the competitive dimension, or reforming CNPC as the dominant SOE in the upstream oil and gas sector in China.

How to read this figure:



The different segments represent different actors, color coded by their type: for example, a Politburo Standing Committee (PBSC) member in red, or a State-Owned Enterprise (SOE) in purple. The height of different segments reveals the actor's exercised power, the overall height of the bar, the power accruing to that position.



40 and 50. This outcome would imply that there will be some meaningful reform to CNPC that would include the fair and transparent tendering of services to third parties. However, as President Xi—along with other members of the Politburo Standing Committee—will need to agree to, and potentially even drive, reforms in this context, his position is perhaps more informative. It is likely, based on the model outcome, that some level of reform will occur, but the SMP suggests that the nature of reform will reflect a Position between 20 and 40.

To further explore this issue, we take a careful look at Xi Jinping's position and see to what extent he alone as leader is able to overcome the institutional inertia our experts have implied through the ratio of influence between the President and the rest. In the baseline data set, President Xi adopts a Position of 20, and the simulation indicates that this is a position to which he holds firm over the course of 10 turns. But to what extent is President Xi able to force consensus regardless of his position? After all, his exercised power is a very high 60, but against a total of 551. In asking this question we can test our experts' perceived weight of institutional inertia in China, and evaluate whether the precise Position value accorded the President by our experts actually matters for the final output.

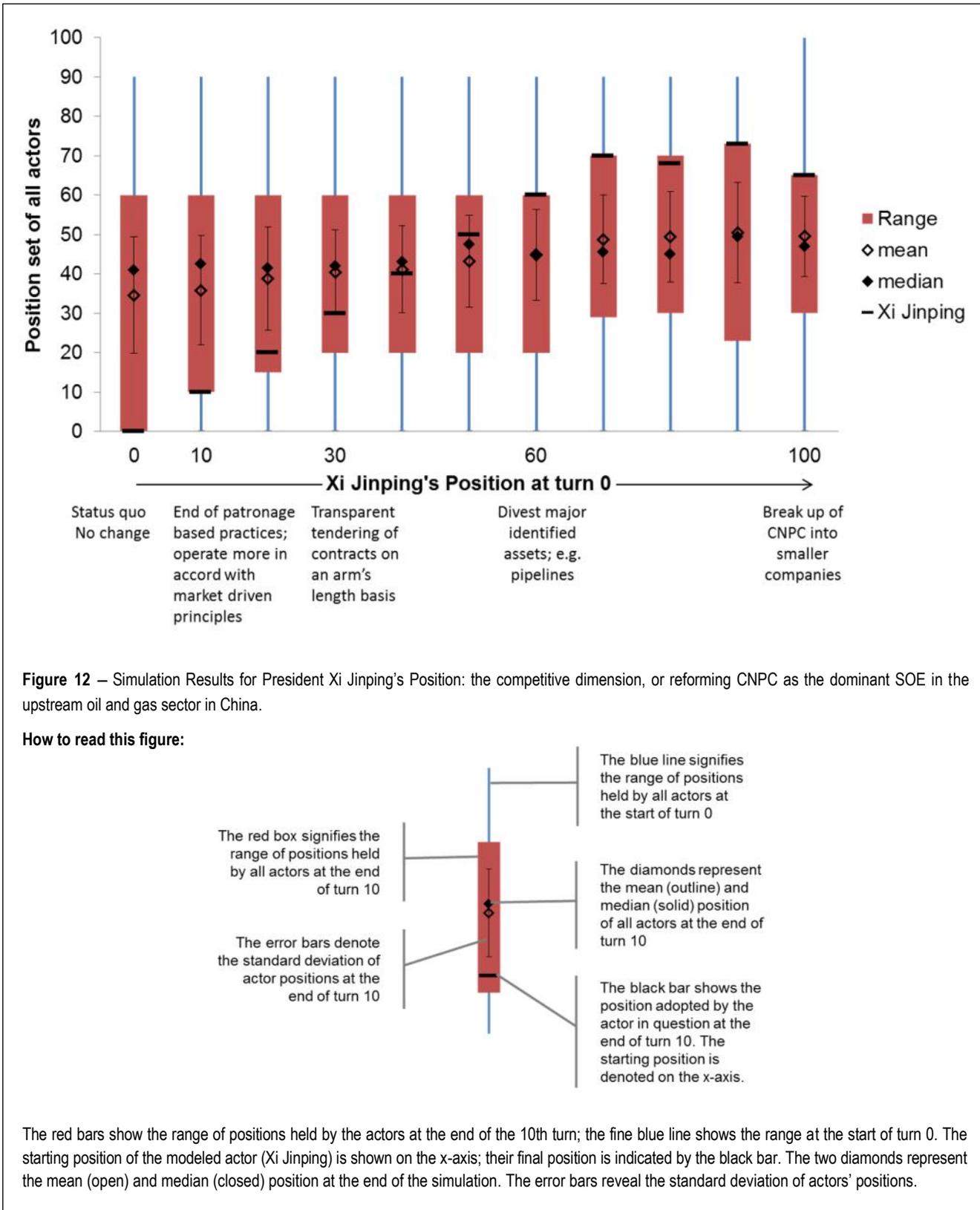
We can test this by allowing Xi Jinping to take Positions ranging from anywhere between 0 and 100. In other words, we can assess how the overall simulation performs if the President is assumed to be less in favor of CNPC reform, or if in fact he actively advocates a breakup of CNPC, or anywhere in between.

Figure 12 displays the range of simulation results with these varied assumptions as to President Xi's starting position. In total, 11 simulations were completed, with 10 turns each, given a starting position for President Xi of 0, 10, 20, and so on through a Position of 100. The figure displays five

pieces of information for turn 10 of each of these simulations. The black tick mark indicates Xi Jinping's position in the 10th turn of the simulation. The black, solid diamond indicates the median position of all the actors at the end of the simulation, i.e. that position which has an equal distribution of exercised power on either side of it.

The outline diamond indicates the mean position, the error bars the standard deviation. Finally, the red block indicates the range, from low to high, of positions for all actors at turn 10 of the simulation. Each of the 11 simulations is displayed from left to right, with President Xi's starting (turn 0) position increasing by 10 points. Again, the thin blue line shows the positions of all the actors at turn 0.

This figure reinforces the surprising finding from the baseline simulation results. Even in the extreme case where Xi Jinping is assumed to begin the simulation by advocating a breakup of CNPC, there is not enough support for such drastic action to prevail. Indeed, no actor, including the President, ends the simulation with a Position higher than 70 in any of the simulations. The mean position, a reasonable indicator for the center of the distribution of actors and their power, varies only between 35-50. The median position, an alternative indicator of the center of the distribution of actors, varies over an even narrower interval. At the far right hand side of the figure, where President Xi's starting Position is assumed to begin between 70-100, he concludes the simulation at Positions higher than 60. However, he does not manage to persuade a group of stakeholders to support more drastic reform of CNPC and does not remain an advocate of these positions over the course of the simulation. These results reinforce the notion that the maximum reform one could expect of CNPC would be centered around the 30-50 range, as in the baseline data. The majority of political clout in the Chinese system, based on President Xi's position but not dependent on it, supports only limited reforms to CNPC's role in the energy sector in China.





Limitations in Interpreting KTAB Output

Beyond those already mentioned involving the input data, it is important to note a few caveats that will help in appreciating the strengths and limitations of KTAB output.

In this case, we are focusing on simulation results that are derived using the SMP. This is a modeling approach with a good track record, but it is ultimately still a simplification of the world captured in a mathematical structure. This ensures that logically consistent results flow from the variety of inputs we provide, assuming the mathematics are correct, but does not result in a perfect prediction capability. Rather, with no comments on the accuracy of the input data, we use KTAB as a tool to facilitate discussion about plausible alternative outcomes that result from a CDMP based on the insights of experts experienced about the Chinese energy sector.

This leads to a question about the process used to construct models. In a scientific approach that attempts to validate models against empirical data, the KTAB framework faces several challenges. Nevertheless, the theories underpinning KTAB have been used successfully in the past and we are working to mitigate the risks that emerge from validation issues in order to build greater confidence in KTAB simulations, both our own and those of users outside KAPSARC.

First, for the SMP simulations, a perfect validation process would replicate the position data over time ex ante, and check the turn-by-turn output of the simulation against the empirical data ex post. Given the difficulty in generating data for a single baseline data set, this approach would quickly become overly cumbersome and impractical. KAPSARC is exploring several methods to automate or semi-automate the data collection process through natural language processing techniques. If a computational

approach could rapidly collect data, then a validation exercise would be feasible. This process remains at an early stage.

An alternative approach to validation might identify an 'outcome' that can be inferred from the simulation results. The outcome would need to be concrete and observable, with some degree of specificity. This outcome would be shared ex ante, and then compared against actual observed events ex post. There have been thousands of initiatives by researchers in the commercial, government, and academic communities to validate SMP-like models with this approach. The main challenge is that both the judgment of a simulation modeled outcome, as well as the observed outcome, are often the products of a subjective interpretation. This interpretative element introduces bias, and can easily be skewed — not necessarily on purpose—to produce false positives, which reinforce the belief that the model is valid. That said, it can be a useful exercise to gain confidence in these types of models. KAPSARC is using KTAB models to identify plausible outcomes, not iron-clad predictions. Gaining some confidence that the simulation results 'seem right' and have some level of validity reinforces the notion of plausibility in this approach.

Unrelated to the notion of validation or confidence in simulation results is another limitation of the SMP approach, based on the way data are collected. SMP-style data capture a set of singular numeric values for each actor. This represents a specific moment in time, even though the 'moment' may in fact endure with some half-life. In reality, the influence of actors changes over longer periods of time as their roles, responsibilities, and power base change as the result of any number of factors. The salience they assign to any one question will change as well, based on what else is happening in the world. Even their position may change, with enough churn around their world and with the passage of time, based on purely exogenous factors.



In other words, the data collected for SMP are a snapshot in time. In order to simulate outcomes, we have to assume that no fundamental and drastic changes to the actors' descriptive parameters are likely because of some external or exogenous source of causality. Small changes to the political landscape are not likely to change these parameters meaningfully. The fluidity of daily events does not fundamentally alter the priority of issues for an actor or modify their political power base. However, with enough time and shocks to the system, the data will certainly change.

In this paper we have attempted to mitigate the impact of exogenous changes on the analysis by performing some scenario analyses on the positions of the most critical actors in the data set. This analysis is by no means exhaustive, and thus the outcomes of the simulations should be treated with appropriate caution.

Conclusions

In drawing conclusions from KTAB simulations it is important to remember not only the limitations of models, but of what KTAB-style models should be used for in the first place. The model results and simulations presented here are not narratives about what individual actors, named or unnamed, will do. Instead, the analysis applies a methodology that can interpret how a set of actors will behave within a broad range of CDMPs, and provides a framework for us to understand what is plausible and what is not plausible.

The particular values assigned by experts to the actors, even the list of actors itself, is not what is most important, though they make explicit a set of input assumptions utilized by KTAB. Nor should the simulation results for individual actors be seen as a representation of the future. Through these KTAB

simulations, we have brought a structured, analytical approach to widely held beliefs about what different groups in China are really calling for, and we outline a set of logically-derived conclusions.

Contrary to the expectations of our experts—and KAPSARC's own researchers—prior to this exercise, the SMP indicates that substantive change to the oil and gas sector should not be anticipated. Despite a number of developments which have raised observers' expectations that major changes to the policy and practice of the energy sector may be imminent, the simulations suggest there is significant resistance to either adjusting the role played by CNPC or to opening up the policy dimension for private competition.

In addition, analysis of the data regarding China's senior leadership, generally believed to be the most powerful and important actors for this CDMP, as compared to the weight of institutional inertia, supports the conclusions drawn from the baseline data sets. The simulation results suggest that, even if there are errors in judgment in the inputs based on the views of our experts regarding particular actors (even the most critical ones), individual leaders will not unilaterally force consensus on a greater level of reform of CNPC's role in the sector or rolling back policies that constrain private entry into the energy sector. The data we have collected and the KTAB simulations suggest that major reforms of this nature are implausible.

Xi Jinping's Third Energy Revolution has begun in earnest. But it is not clear that this revolution will extend toward a new and critical role for the private sector in the energy domain. Rather, in the near term we believe that major moves toward marketization of the energy SOEs, or scaling back the influence of CNPC over the sector, are unlikely to occur because the political will to push through such changes does not exist.



Notes



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About the team



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About the Project

KAPSARC is developing the KAPSARC Toolkit for Behavioral Analysis (KTAB), an open source software platform, to support modeling and analysis of collective decision-making processes (CDMPs). KTAB is intended to be the standard platform for analyzing bargaining problems, generalized voting models, and policy decision-making. It is our intent to use KTAB to assemble the building blocks for a broad class of CDMPs. Typical models in KTAB will draw on the insights of subject matter experts regarding decision makers and influencers in a methodical, consistent manner; and then assist researchers to identify feasible outcomes that are the result of CDMPs.