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Institutional change and innovation system transformation: A tale of two academies

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ABSTRACT

This paper investigates interactions between institutional adaptation and the transformation of science and innovation systems by analysing change and adjustment in post-socialist science academies. Two leading examples are examined: the Chinese Academy of Sciences (CAS) and the Russian Academy of Sciences (RAS). A heuristic framework of institutional change markers is applied to the analysis of nanotechnology research in both countries. We draw on bibliometric sources, interviews and secondary sources. We find that while the two Academies share a common past as the dominant research agents in their respective systems, their current positions and trajectories now differ. The nanotechnology case shows that CAS has adapted to China's modernisation, engaged in central government policy initiatives, and interacted with other research performers. CAS remains central to the Chinese research system, and has rejuvenated and expanded its resource base. RAS, on the contrary, has taken a protectionist stance: it still dominates the Russian research system and has a strong nanotechnology position, enforced by its gatekeeper control over journal publication. Nevertheless, RAS has faced difficulties in internal modernisation, leading to the external imposition of reforms and further role diminishment. The paper offers comparative insights into processes of institutional adaptation and highlights how key institutions can influence system transition.

1. Introduction

The capabilities, organisational modes, and practices of public, private, and non-profit institutions, including universities, national laboratories, and academies, are central to the operation and performance of science and innovation systems (OECD, 1997; Edquist and Johnson, 2000). Understanding the strategies and consequences of adaptation in such institutions and how adaptation processes are informed and influenced is central to the study not only of science and innovation but also of broader societal change. It is reasonable to conjecture that changes in key institutions can have the capacity to transform their systems, while at the same time through feedback loops these institutions may also be changed by transition of the systems within which they are embedded. But how do such changes interactions occur and how can we conceptualise and assess the processes involved? In this paper we address these questions by analysing the dynamics of the interaction between change in the science academies of Russia and China with the respective transformation of the Russian and Chinese science and innovation systems.

Academies of Sciences are typically nationally organised associations that seek to advance science and scientific learning (Hassan et al., 2015). There are science academies in about 100 countries (IAP, 2014), although their roles vary considerably. In many countries, science academies focus on recognising outstanding achievements in science, most prominently in the case of the Royal Swedish Academy of Sciences which awards the Nobel Prizes in physics, chemistry and economics. In other countries, scientific academies directly carry out substantial shares of national scientific research with government funding and oversight. Historically, the leading example of this model was the Academy of Sciences of the USSR, which dominated public research in the Soviet Union from 1925 through to 1991. The Soviet Academy's legacy is embedded in its successor, the Russian Academy of Sciences (RAS). It also provided a model replicated by the Chinese Academy of Sciences (CAS), the National Academy of Sciences of Vietnam, the Academia Sinica of Taiwan, and science academies in Eastern Europe, among others. These research organisations oversee functions of scientific knowledge production, accreditation as well as honorary functions of appraisal for outstanding researchers (Graham, 1998).

CAS and RAS are today the largest examples of research-based national science academies. These two academies share a heritage of the

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socialist organisation of scientific research (Radosevic, 1999, 2003), yet have also undergone transformation in recent decades (David-Fox and Péteri, 2000; Liu and Zhi, 2010; Lu and Fan, 2010; Suttmeier et al., 2006) as both Russia and China pursue large-scale reforms to foster economic modernisation. Prior research that considers change in these two academies has tended to take an individual country perspective. RAS has been discussed as part of work on the influence of state-socialist models in science (for example, Graham, 1998), on the post-Soviet transformation of the entire science system (Radosevic, 2003; Yegorov, 2009), and on broad trends in Russian innovation policy (Klochikhin, 2012). The tangled reform processes of RAS have attracted topical attention, usually as short news reports on the latest developments (Clark, 2013; Pokrovsky, 2013; Yablokov, 2014). For CAS, older studies of historical developments and earlier reforms are available (e.g. Cao, 1998, 1999; Kuhner, 1984; Yao, 1989). A stream of bibliometric work highlights the role of CAS in the recent growth of scientific publishing in China (Fu and Ho, 2013; Yang et al., 2014; Yang et al., 2015; Ye, 2010), while attention has been paid to recent CAS programme initiatives (Lu and Fan, 2010; Zhang et al., 2011).

Yet, while both science academies have been subject to reform pressures, the outcomes of change have been strikingly different. CAS continues as a leading and powerful player in its research system, with increasing international reach. In contrast, in 2013 RAS saw its research status whittled away as the Russian government implemented radical reforms that facilitated a shift to a university-based setting of scientific research (UNESCO, 2015). These divergent outcomes present opportunities for comparative research to test conceptual frameworks about institutional change in transitional economies and the role of key institutions, and for study of the contrasting transformations in the two academies. In this paper, we put forward a framework that conceptualises processes of institutional modification in transitional countries and explore drivers, capacities, and enabling and constraining factors for transformation. We use indicators based on outputs of the two academies in the broad interdisciplinary field of nanotechnology, coupled with insights from interviews and secondary sources.

The next section introduces our conceptual framework in the context of a broader literature review. We then describe the methodology and data used in our empirical analysis. We then discuss recent initiatives in both countries in promoting nanotechnology. This is followed by a presentation of evidence related to the institutional change markers for the two academies. The last parts of the paper discuss findings and conclusions.

2. Institutions and transition: understanding and demarking change

An 'institution' is defined by its 'hard' components, which can be described as 'the rules of the game' (North, 1990) or 'schemas', and 'soft' components - resources, or social networks, which sustain the 'hard' components (Clemens and Cook, 1999). Much scholarship has been produced on institutions and how they are structured, function, and change. Understanding the scale and scope of institutional transformation requires the concept of a wider 'systems of institutions' (Roland, 2008) that share 'complementarities' (Aoki, 2008). There is interdependence between institutions and the systems into which they are embedded (Hira and Hira, 2000; Peters, 2005; Pierson, 2004). Comparisons of systems of institutions can lead to wider interpretive models, for instance, in work on the varieties of capitalism, which highlights how comparative differences in institutional and political dynamics contribute to distinctive paths of growth and distribution (Acemoglu and Robinson, 2015; Piketty, 2014).

Country-level approaches to the study of institutional change have tended to differ. In developed countries, institutions are usually seen as mature, with a focus on continuous and incremental institutional modification (Crouch and Keune, 2005; Vogel, 2005). In contrast, in developing countries there is more attention to institutional building, institutional disruption, and interactions of formal and informal institutions (Estrin and Prevezer, 2011; Grzymala-Busse, 2010; Slater, 2010). Institutional change in the developing world is typically viewed in a paradigm of discontinuous change that occurs as a consequence of exogenous shocks to unstable institutional environments (Slater, 2010; Weyland, 2008). We note, however, recent calls to reconcile these perspectives on abrupt/discontinuous change and incremental/continuous change (Mahoney and Thelen, 2010; Streeck and Thelen, 2005).

Post-socialist transformations have been a special case in the stream of research on institutional change as new institutional schemas were introduced into post-socialist contexts (Appel, 2004; Boettke et al., 2008; Crouch and Keune, 2005; Kornai, 2008; Smallbone and Welter, 2012). Major ruptures in system trajectories and frameworks have occurred, for example, the collapse of the Soviet Union, which precipitated the formation of current-day Russia. Yet, institutions have proven to be deeply embedded. Institutional change remains a core problem for post-socialist economies. Russia, still heavily reliant on natural resources (Puffer and McCarthy, 2007), seeks modernisation of institutions that could promote broader economic innovation. China struggles to find balance between external pressures, extensive accumulative growth and new technological priorities, under central government direction (Bell and Feng, 2007; Gabriele, 2002). In both countries, there are challenges of shaping new institutions, dealing with institutional inertia (Chen, 2008), and transforming existing institutions so they work more effectively (Amable, 2000). The issues become ever more pressing in the context of the global shift to innovation-based models of development, where strong science and technology systems influence the competitive advantage of national economies (Archibugi and Pietrobelli, 2003; Fagerberg et al., 2007; Fagerberg and Srholec, 2008; Porter, 1998).

Understanding institutional change has also been important for the study of innovation (Hage and Meeus, 2009; Hollingsworth, 2000). The institutional analysis of research and innovation has increasingly drawn on the national innovation systems (NIS) concept (Edquist and Johnson, 2000; Lundvall et al., 2009), itself rooted in an evolutionary perspective on institutional change (Nelson and Winter, 1982). National systems of innovation are comprised of institutions, organisational forms and interactions between them (Etzkowitz and Leydesdorff, 2000). NIS research recognises the role of learning and path dependence in institutional change (Hollingsworth, 2000) and the complex relationships between a 'system of institutions' and 'key' institutions within this system. Yet, other approaches appear more readily able to deal with cases of change in a dominant institution. For example, Powell and DiMaggio (1991) and, more recently, Mahoney and Thelen (2010) devise modular frameworks to understand institutional change, although with a focus more on outcomes than process. Clemens and Cook (1999) focus on the institution itself, with relatively less attention to the environment.

To bridge these approaches to understanding how institutions change in the context of system transition, we devise a conceptual framework that integrates change within a system-defining dominant institution and the system it is embedded into (in a national research system context). While we posit relationships between institutional actors and transformative change, our approach is an exploratory and grounded effort, which marshals a range of relevant qualitative and quantitative evidence to identify key factors and the scale and direction of their influence. This 'institutional change markers' framework draws on concepts used to understand institutional change, including path dependency, agency, learning, and interaction (Bell, 2011; Berk and Galvan, 2009; Lawton-Smith, 2006; van Waarden and Oosterwijk, 2009), and consolidates them into four categories. From this framework, we demarcate indicators that highlight the nature of change and which can be used to track continuities and discontinuities within institutions and in the environment. The four markers of change and their subcomponents are as follows (see also Table 1).

Outputs and Performance considers the research accomplishments of the institution and potential challengers and competitors in the system.