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ARTICLE

Industrial Specialization in China: Effects of Central Tools Governing Subnational Agency

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Abstract
We examine how the central government's management of subnational governments' agency influences the smartness of the latter's industrial specialization choices. Based on smart industrial specialization theory and agency theory, we hypothesize how two central government tools governing subnational governments' agency – facilitating their organizational efficacy and promoting their officials to higher ranks – explain recent industrial specialization choices by China's 31 provincial governments. We find that provincial governments with greater organizational efficacy, measured by access to better-resourced local state-owned enterprises in focal industries, make smarter specialization policies. In addition, we show that provincial governments with greater numbers of officials previously promoted to the central government make, contrary to conventional wisdom, potentially less smart specialization policies. Our research extends smart specialization theory by explaining that central government tools governing subnational agency problems can have knock-on effects making subnational governments' industrial specialization choices smart or unsmart.

摘要
本文研究了中央对地方政府代理权的管理如何影响后者产业专业化的选择。基于产业专业化理论和代理理论，本文讨论了中央管理地方政府的两种工具，即促进地方政府的组织效能和地方官员升迁，如何影响省级政府产业专业化的选择。本文发现，组织效能较高的省级政府会制定更明智的专业化政策。此外，本文还发现，与传统观点相反，有更多官员得到提拔的省级政府，其制定的专业化政策可能存在偏差。本研究通过解释中央对地方政府代理权的管理工具会产生连锁效应，并影响地方政府产业专业化的选择，从而拓展了产业专业化理论。

Keywords: agency theory; job promotions; organizational efficacy; quasi-decentralized polities; smart industrial specialization
关键词: 产业专业化; 委托代理理论; 组织效能; 职位晋升; 中央-地方分权体制

Introduction

Specialization is critical to optimizing economic performance (Romer, 1987). While firm-level specialization choices are frequently studied by management and organization scholars, specialization can also be led by governments (Capello & Kroll, 2016; Foray, 2014; Krammer, 2017; Radosevic, 2017). Governments seeking to optimize their economies' performance should make 'smart industrial specialization' policies – i.e., strategically focusing their scarce resources on a narrow selection of industries in which comparative advantages are present, in terms of relative technological capabilities and factor endowments, rather than attempting to develop all industries equally (Hirschman, 1958; Lin, 2012, 2017). Likewise, governments should avoid 'unsmart industrial specialization' policy choices – i.e., promoting industries lacking relative advantages and capabilities (Radosevic, 2017). Considering that governments warrant management and organizational research in their own right (Williamson, 1998), and that state-led industrial specialization policy significantly influences the decisions of firms (Lazzarini, 2013; Musacchio, Lazzarini, & Aguilera, 2015; Pearce, Dibble, & Klein, 2009), the industrial policy choices of governments warrant our attention.

While much has been written from an industrial organization perspective as to what makes industrial specialization choices smart (e.g., Hirschman, 1958; Lee, 2013, 2016, 2017; Lin, 2012, 2017; Mathews, 2005, 2007, 2017; Porter, 1990; Ricardo, 1821), industrial specialization policy choices are not made in a vacuum. This is especially the case in political principal-agent configurations where subnational governments (the agents) are tasked by the central-level government (the principal) to make smart industrial specialization choices – a structure called 'quasi-administratively-decentralized' (or 'quasi-decentralized' for short) polities (Ahmad & Tanzi, 2002; Tommasi & Iinschelbaum, 2007). China is a prominent example of this configuration (Knight, 2014; Naughton & Tsai, 2015) in which agency problems vis-à-vis the central government can lead provincial governments to make unsmart specialization choices (e.g., Chen & Ku, 2014).

Meanwhile, cognizant that a principle can leverage governance mechanisms to limit agency problems (Eisenhardt, 1985, 1989; Filatotchev & Boyd, 2009; Miller, 2005; Shapiro, 2005), central governments often employ public governance tools to try to limit subnational agency problems in quasi-decentralized polities. One of the most prominent of these tools is the 'organizational efficacy' that the central government affords to subnational governments. *Organizational efficacy* is the capacity of organizations to effectively cope with challenges and exploit opportunities encountered in their operational environments (Bakker, 2015; Boardman & Sundquist, 2009; Bohn, 2002). The central government can limit subnational agency problems, such as shirking, by, for example, allowing subnational governments organizational efficacy via sufficient access to and control over local capabilities and resources through state-owned enterprises (SOEs) (e.g., Binderkrantz, Holm, & Korsager, 2012; Christensen, Laegreid, Roness, & Rovik, 2007). Another equally important tool, meant to limit subnational agency problems such as goal conflict and self-interest, is the central government's *job promotions of subnational government officials* (e.g., Bo, 1996, 2002; Li & Zhou, 2005; Zhu, 2011).

While illuminating, these different streams of literature remain disconnected. While in quasi-decentralized polities, such as China, the two aforementioned central government tools might also significantly influence the smartness of subnational governments' specialization policies, prior literature has yet to examine these potential knock-on effects. As such, we can better understand the smartness of subnational governments' industrial specialization choices by explicitly examining if and how those choices are influenced by these two public governance tools. Research in this space can enhance our understanding of the relationship between agency theory and smart specialization theory, guide policymakers in quasi-decentralized polities toward making smarter specialization choices, and inform firms about how to most strategically respond to these choices.

The purpose of this article is to examine how, within quasi-decentralized polities, the smartness of subnational governments' industrial specialization choices is influenced by the organizational efficacy and job promotions that the central government provides them. We start our research by integrating smart industrial specialization theory and agency theory to hypothesize how these two tools might explain the smartness of industrial specialization choices made by provincial governments in China in response to the 'strategic emerging industries' initiative launched by the country's central government in 2010. Next, we test our hypotheses by examining proxies of the consequences of each governance tool and indicators of the smartness of specialization choices by each of China's 31 provincial governments. To be clear, we choose China as our country context because its central-provincial political system exhibits a principal-agent relationship and because the aforementioned two governance tools are found there. We also focus on China because smart state-led industrial specialization is critical to the country's ability to catch up to forerunners and deserves further study (Lee, 2016; Lewin, Kenney, & Murmann, 2016; Lin, 2012, 2017; Mathews, 2017).

Our research makes several contributions. Most importantly, we extend smart specialization theory (e.g., Capello & Kroll, 2016; Foray, 2014; Krammer, 2017; Lee, 2013, 2016, 2017; Lin, 2012, 2017; Mathews, 2005, 2007, 2017; Radosevic, 2017) by explaining that central government tools governing subnational agency problems can have knock-on effects making subnational governments' industrial specialization choices smart or unsmart. We show that two sets of central government tools – enabling provincial governments' organizational efficacy through resource control via local SOEs, and job promotions of provincial government officials to the central government – can have these effects. We

argue that the former tool can facilitate smarter specialization policies by incentivizing provincial government officials with access to better-resourced SOEs in focal industries to – knowing they have control of greater resources for specialization and thus can better secure returns on their efforts – more carefully design their industrial policies. Meanwhile, the latter tool can facilitate unsmart specialization by making some provincial government officials hyperattentive to replicating choices that previously resulted in job promotions to the central level. Rather than more smartly promoting some industries over others, these provincial governments may equally promote all industries allowed for specialization by the central government to send unambiguous signals about their compliance with the central government's advice. In this sense, by generally offering provincial governments organization efficacy via control of local SOEs, a central government can also mitigate shirking of smart specialization responsibilities, specifically. In contrast, promoting provincial government officials to the central government can create the unintended consequence of excessive risk aversion when making specialization policies. We also discuss other implications for how scholars and business practitioners can think about factors shaping industrial development in China.

Conceptual Framework and Hypotheses Development

Smart Industrial Specialization Theory and Agency Theory

The most fundamental tenant of industrial specialization theory is that resources are necessary to meaningfully develop any industry, and that countries have heterogeneous stocks and flows of resources (Hirschman, 1958; Porter, 1990; Ricardo, 1821). Insufficient resource endowments and insufficient capabilities to absorb and transform them are therefore the most fundamental economic constraints to specialization (Greenwald & Stiglitz, 2013). The primary solution to these challenges, which is the basis for smart industrial specialization theory, is for governments to identify and only promote industries in which comparative resource advantages exist or can be readily formed (Lee, 2013, 2016; Lin, 2012; Mathews, 2002, 2005). Further, although some room is allowed for riskier experimentation, governments will typically make the *smartest* specialization choices when *most strongly* promoting specialization in industries in which their region has the *highest* comparative advantages (e.g., Foray, 2014). In technology-intensive industries, this situation can be measured in terms of 'regional technological advantages' (e.g., Huang, 2013; Soete, 1988). Following this body of literature, we conceptualize smart specialization as the extent to which governments' industrial promotion choices are sensitive to existing comparative advantages.

While the conceptual roots of smart specialization policy are well established, insufficiently guided agency may restrain subnational governments in quasi-decentralized polities from actually pursuing the smartest industrial specialization policy choices. Insufficiently guided agency problems are fueled by risk aversion, shirking, self-interest, and goal conflict (Eisenhardt, 1989; Shapiro, 2005). Risk aversion is an agent's reluctance to take chances even though taking risks is in line with the interests of the principal (Nicholson-Crotty, Nicholson-Crotty, & Fernandez, 2016). Shirking is avoidance of responsibility (Shapiro, 2005). Self-interest is an agent's inherent desire to act according to its own preferences (Ross, 1973). Goal conflict is when an agent's interests conflict with those of the principal (Fama & Jensen, 1983). Information asymmetries and bounded rationality enable and exacerbate these agency problems (Eisenhardt, 1989).

Insufficiently guided agency problems may manifest themselves in several ways in the industrial specialization context. For example, in terms of risk aversion, self-interest, and goal conflict – subnational governments may invest in local industries but support less innovative firms that have more certain sales because they prefer to secure more certain tax revenues in the near-term (generally, see Young (2000)).[1] Subnational governments may also invest in local industries but support incapable firms with political connections primarily because there is more information readily available about those firms or because they are easier to control (Fuller, 2019; Jaros & Tan, 2020; Thun, 2006). In addition, subnational governments may invest in local industries but support local firms with political connections due to self-interest, namely with a view to engage in corrupt practices such as receiving kickbacks (e.g., Rodrik, 2008).

Central Government Tools and Subnational Governments' Specialization Choices in China

In the remainder of this section, we further integrate smart industrial specialization theory with agency theory to conceptualize how China's central government tools governing provincial governments' agency problems may influence the smartness of the latter's industrial specialization choices. In doing so, we broadly follow prior literature, such as Boivie, Lange, McDonald, and Westphal (2011), by examining how governance tools act as moderators of agents' performance. Figure 1 summarizes our hypothesized relationships.

Baseline organizational efficacy in specialization policymaking

As mentioned, organizational efficacy is the capacity of an organization to effectively cope with challenges and exploit opportunities it encounters within its operational environment (Bohn, 2002). It is most apparent in organizations that empower their staff with adequate resources to realize their missions (Boardman & Sundquist, 2009) and control the outcomes associated with organizational spending (Bakker, 2015).

Depending on the industry, China's central government affords the country's provincial governments differing levels of organizational efficacy for industrial specialization policymaking. For some industries designated by the central government, provincial governments must significantly promote them (Ling & Naughton, 2016; Naughton & Tsai, 2015). In other words, even if provinces lack advantages in these industries, they nonetheless will be compelled to unsmartly specialize in them.

However, sometimes China's central government allows the country's 31 provincial governments significant agency *to choose exactly which industries they want to promote and to what extent* (Naughton & Tsai, 2015). This is especially the case for industries with no natural monopolies and comparatively limited national security concerns (Pearson, 2015). Industries falling into this category include, for example, the seven 'strategic emerging industries' (SEIs) recommended by China's central

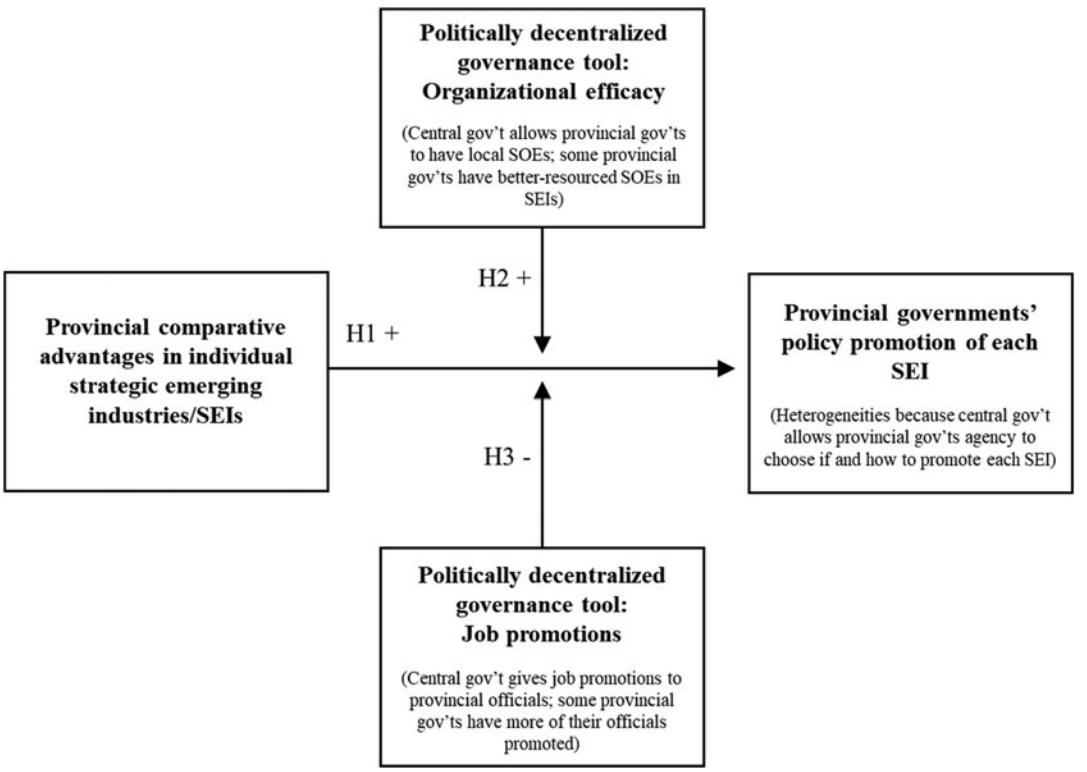

Figure 1. Summary of hypotheses

government as of 2010 (Miao, Fang, Sun, Luo, & Yu, 2018; Naughton & Tsai, 2015; Prud'homme, 2016a, 2016b; Teece, 2019). These seven SEIs include the energy conservation and environmental protection (ECEP), new generation IT (NGIT), biology/biotechnology (BT), high-end equipment manufacturing (HEEM), new energy (NE), new materials (NMs), and new energy automobiles (NEVs) industries. While China's central government recommends that provincial governments consider the seven SEIs for their own specialization initiatives, it does not mandate which ones they must chose and how much, if at all, they should promote each (Naughton & Tsai, 2015; Pearson, 2015; Song, Wan, & Reng, 2010). Of course, such agency in specialization policymaking is intended not to be abused; quite the contrary, the central government expects that provincial governments will leverage it to make policy choices that will expeditiously lead to technological and ultimately economic development (Knight, 2014, 2016; Wen, 2009).

In this sense, the agency afforded by China's central-level government to provincial governments to specialize in SEIs may offer the latter helpful organizational efficacy for specialization policymaking in those specific industries. It seems likely that provincial governments will, on average, leverage this efficacy while generally minding the central government's expectations to smartly promote SEIs. Based on these concepts, our baseline prediction is that provincial governments will most significantly promote SEIs in which they have greater local comparative advantages:

Baseline_Hypothesis 1(H1): Provincial governments in China will, on average, make smart specialization choices in SEIs.

Moderating effects of organizational efficacy via local SOEs

Another source of governmental organizational efficacy in China is access to and control of productive resources via *local SOEs*. SOEs afford public organizational efficacy to government officials by providing them a concrete way to closely control the everyday commercial activities that they envisage should be carried out when governing their economies (Binderkrantz et al., 2012; Christensen et al., 2007). This affords government officials a greater sense of self-efficacy and therefore motivation to leverage those SOEs as instruments to implement industrial policymaking (Christensen et al., 2007: 118–119, 153–154). In turn, this makes the officials more likely to substantively engage in the industrial policymaking process rather than shirking their responsibility to do so (Christensen et al., 2007: 118–119, 153–154).

In the Chinese context, provincial government officials can more closely guide everyday usage of industrial resources by managers of local SOEs compared with managers of local private firms. This does not mean that the Chinese state does not guide private firms as well – it certainly does (The Economist, 2012). However, doing so is more costly compared with controlling Chinese SOE managers, who are already 'semi-officials' (Li & Zhou, 2005). The Chinese government directly appoints top executives in SOEs (Walder, 2010), sets performance evaluation requirements for SOE executives tied to meeting government policy goals (e.g., Jia, Huang, & Zhang, 2019), and maintains softer *guanxi*-based influence over managers at all levels in SOEs (Li, Yao, Sue-Chan, & Xi, 2015). The central-level government plays an important principal role here by allowing local control of SOEs by provincial government agents rather than nationalizing all SOEs or forcing privatization of all local SOEs. This is a meaningful allowance in China, as the central-level government has, at various times, launched SOE consolidation and privatization initiatives across the country (Naughton & Tsai, 2015).

In terms of smart industrial specialization policymaking in particular, provincial governments will not only have basic organizational efficacy via access to local SOEs, but will also have access to SOEs that more or less significantly contribute to comparative advantages in local industries. Among these, the officials with better-resourced SOEs in focal industries may, knowing they have control of greater resources for specialization and thus can better secure returns on their effort, more carefully design their industrial specialization policies.

To be sure, our assumptions here appear reasonable. Over the years, some of the least capable subnational SOEs have been shuttered by the central-level government (Naughton & Tsai, 2015). Further, there is evidence that various subnational Chinese SOEs have eventually, often due to state guidance,

channeled their preferential access to state resources into substantive R&D efforts (Jia et al., 2019; Zhou, Gao, & Zhao, 2016). Moreover, a growing body of scholarship has explicitly shown that, in the last decade or so, various subnational Chinese SOEs in knowledge-intensive industries have accumulated strong technological capabilities, making them sometimes even more innovative than peer private firms (e.g., Gao, 2017; Genin, Tan, & Song, 2021; Huang, 2021; Kroll & Kou, 2018; Lazzarini, Mesquita, Monterio, & Musacchio, 2021; Liu, Wang, & Hu, 2021; Prud'homme & von Zedtwitz, 2018; Zhou et al., 2016).

Based on these concepts, we predict that the presence of more local SOEs with greater resources in SEIs will positively moderate the relationship between local comparative advantages in SEIs and how significantly provincial governments promote those SEIs. Simply put:

Hypothesis 2 (H2): Provincial governments with access to better-resourced local SOEs in SEIs will make smarter specialization choices in those industries.

Moderating effects of government officials' job promotions

The most well-documented public governance tool in China meant to reduce insufficiently guided agency problems among provincial governments is *job promotions of their officials to the central government* (Bo, 1996, 2002; Jia, Kudamatsu, & Seim, 2015; Li & Zhou, 2005; Zhao, 2009; Zhu, 2011). It is likely that this central government tool will significantly, albeit unintentionally, impact the smartness of Chinese provincial governments' SEI specialization policymaking.

China's central government policy guidance for SEI specialization is, as mentioned, quite broad: it simply designates seven industries for provincial governments to consider promoting themselves. Even though the central government simultaneously expects that provincial governments will make local SEI specialization policy choices that will expeditiously lead to technological and ultimately economic development (Knight, 2014, 2016; Wen, 2009), the central government does not appear to set explicit performance targets to ensure this occurs. At first blush, this seems sensible as it takes significant time for SEI specialization policy choices to yield effects and it is not necessarily a straightforward exercise to attribute meaningful outcomes back to such policy choices anyway. Instead, provincial government officials are usually promoted if they meet much higher-level performance goals in terms of annual provincial GDP growth targets and maintenance of social order (Bo, 1996, 2002; Jia et al., 2015; Knight, 2014: 1344; Li & Zhou, 2005; Marquis & Qiao, 2022; Zhao, 2009; Zhu, 2011).

Amidst this gap between theoretical smart specialization policymaking, central-level guidance provided for such policymaking, and what provincial government officials are actually rewarded for, provincial governments in China striving to closely adhere to the central level's SEI guidance may simply promote all the SEIs recommended by the central level. They may even do this even if they do not have advantages in those industries. Due to their organizational culture legacies, provincial governments with a history of seeing their former officials promoted to the central government seem most likely to adopt this 'promote all the industries' approach. This is because past job promotions with high organizational proximity, meaning those that are visible and memorable to others (Monge, Rothman, Eisenberg, Miller, & Kirste, 1985), can create a long-lasting organizational culture that is hyperattentive to replicating choices that previously resulted in job promotions (Obloj & Zenger, 2017; Simon, 1991). In turn, this hyperattentiveness can lead agents to prioritize sending the most unambiguous signals as possible about their compliance with the principal's advice (Obloj & Zenger, 2017). In the provincial specialization policymaking in China context, the central government's job promotions of provincial officials would therefore commit, as Kerr (1975) and Strong and George (1997) put it, the 'folly of rewarding A, while hoping for B'. Provincial government officials' past job promotions may inadvertently restrict the healthy agency exercised by their successors, leading to new organizational agency problems such as increased risk aversion when making specialization policies.

Considering this, provincial governments with a history of seeing their former officials promoted to the central government may overly look up to the center instead of down and locally during their industrial specialization policymaking. As such, we predict that greater past promotion of provincial

governments' officials to the central government will negatively moderate the relationship between local comparative advantages in SEIs and how significantly the provincial governments promote those SEIs. In short:

Hypothesis 3 (H3): Provincial governments accustomed to having their officials promoted to the central government will make less smart specialization choices in SEIs.

Methods

Data and Variables

Dependent variable

Our dependent variable is a novel 'Industrial Specialization Promotion' Index (ISP Index) calculated *for each* of the seven strategic emerging industries/SEIs *for each* of China's 31 provinces for the years 2012, 2013, and 2014. The index is based on an in-depth review of 355 official SEI specialization policy documents promulgated by each of China's 31 provincial governments. Following Prud'homme (2016b), these documents were manually collected by using the Chinese keywords for 'strategic emerging industry', 'development plan', and several other terms to search for official government plans on each provincial government's official websites. On average, 11 specialization policy documents per province (standard deviation/SD of 3.79) and 1.5 documents per each SEI that each province selects for specialization (SD of 0.55) were identified.

We then constructed an ISP Index based on these policy documents following the method outlined in Table 1 and explained in further detail in the Appendix. The logic behind our ISP Index is that more detailed and meaningful provisions in provincial policy documents aimed at promoting focal industries represent greater specialization efforts in those industries. The ISP Index is formulated according to a four-point scale (i.e., 0, 1, 2, 3) following the Guttman ordering principle that lower scores are always of lower value. Both the lower-bound index (ISP Index.LB) and the upper-bound index (ISP Index.UB), which was more liberally scored, were produced. After conducting robustness checks (see the Results section), the results presented in this paper are based on the upper-bound index.

To avoid selection bias, we only included ISP Index scores for the years in which each province fully promoted each SEI. If a province introduced new policies to more strongly promote industry at the latter end of our dataset, their promotion scores in prior years would be comparatively lower and therefore downwardly skewed. In other words, including these early-year scores on the ISP Index would inaccurately represent the total promotion efforts of that province. Instead, it would just represent that the provincial government did not yet publish all their policies promoting that industry. To address this issue, we deleted the observations falling into this category (scores of 0, 1, or 2), only keeping the highest SEI-year ISP Index scores for the provinces (scores of 1, 2, or 3). This method yields 578 observations. The final sample size throughout all the regression models becomes 554 because our moderating and instrumental variables have some missing values.

Independent and moderator variables

Our independent variable for testing H1 is a *revealed technological advantage* (*RTA*) *Index* formulated for all seven SEIs in each of China's 31 provinces. The index provides distinct RTA scores for each of the seven industries in each province, per year. The RTA calculations are based on the method for gauging knowledge-intensive industrial specialization in any economy developed by Soete and Wyatt (1983), Soete (1987), and Soete (1988). Namely,

$$\mathrm{RTA}_{ij} = \frac{n_{ij} / \sum_i n_{ij}}{\sum_j n_{ij} / \sum_i \sum_j n_{ij}}$$

whereby n_{ij} is the number of granted invention patents of province i in technological class j registered with China's State Intellectual Property Office (SIPO) (which recently changed its name to China National Intellectual Property Administration/CNIPA). The RTA figures are calculated based on a

Table 1. Industrial specialization promotion (ISP) Index scoring method

Score	Indicators (upper bound)†	Indicators (lower bound)†
0	0) SEI not designated for development in government industrial development plans	Same as the upper-bound scoring method.
1	1(a) SEI explicitly designated by name in overarching SEI plans identifying several SEIs by name or 1(b) SEI promotion indicated because plans promote a broader industry that includes the SEI, although they are not titled as exclusively promoting that SEI‡	Same as the upper-bound scoring method except also includes promotion efforts satisfying indicator 2(b).
2	2(a) (i) SEI designated in plans explicitly titled as developing that SEI and (ii) the plans include industrial promotion targets (usually output figures) specific to developing the SEI§ or 2(b) (i) SEI promotion indicated because plans promulgated that promote a broader industry that includes the SEI and (ii) the plans, although not titled as exclusively promoting that SEI, include industrial targets (usually output figures) specific to developing the exact SEI†† or 2(c) (i) SEI designated in overarching SEI plans and (ii) at least one subindustry plan specific to that SEI promulgated and/or specific amounts of government funding (distinct from industrial targets) for developing the SEI are publicized in the plans	Same as the upper-bound scoring method except in two circumstances. First (as mentioned above), promotion efforts satisfying the conditions in indicator 2(b) are scored as a '1' instead. Second, promotion efforts satisfying the conditions in indicator 3(b), are scored as a '2'.
3	3(a) (i) SEI designated in plans explicitly titled as developing that SEI; (ii) the plans also include industrial promotion targets (usually output figures) specific to developing the SEI; and (iii) at least one subindustry plan specific to that SEI promulgated and/or specific amounts of government funding (distinct from industrial targets) for developing the SEI are publicized in the plans or 3(b) (i) SEI promotion indicated because plans promulgated that promote a broader industry that includes the SEI; (ii) the plans, although not titled as exclusively promoting that SEI, include industrial targets (usually output figures) specific to developing the exact SEI§; and (iii) at least one subindustry plan specific to that SEI promulgated and/or specific amounts of government funding (distinct from industrial promotion targets) for developing the SEI are publicized in the plans	Same as the upper-bound scoring method except for (as mentioned above) promotion efforts satisfying the conditions in indicator 3(b) are scored as a '2' instead.

Notes: †The upper-bound index is more liberally scored than the lower-bound index. ‡Such situations would arise when, for example, a province promulgated a plan titled as promoting the 'information/ICT' industry rather than the 'NGIT' industry or the 'equipment manufacturing industry' rather than the 'HEEM' industry. §Such situations would arise when, for example, a province promulgated a plan titled as promoting the 'information/ICT' industry rather than the 'NGIT' industry but included specific targets for developing the 'NGIT' industry. Another example is when a plan promoted the 'equipment manufacturing industry' rather than the 'HEEM' industry but included specific targets for developing the 'HEEM'/advanced equipment manufacturing industry.

concordance obtained by the authors of international patent classification (IPC) codes matched by researchers at SIPO/CNIPA to the aforementioned seven SEIs, as well as official invention patent data from SIPO/CNIPA collected per each industry per each Chinese province.

The RTA Index was always lagged by 1 year vis-à-vis the dependent variables to avoid simultaneity. In line with prior scholarship, provincial RTAs are calculated on an intra-China basis rather than vis-à-vis other economies (Huang, 2013). We followed this approach because, while international trade certainly affects specialization in some Chinese provinces, Chinese provinces vary in their level of exposure to the international economy, and often first and foremost trade in goods and services with each other and compete with one another (Huang, 2013).

Our H2 independent variable is the interaction effect between organizational efficacy, measured by *SOE ratio*, and the *RTAs* per each of the seven SEIs per each province (*RTAs* × *SOE ratio)*. *SOE ratio* is the number of local SOEs in each SEI in each province divided by the number of all types of firms in the same SEI in the same province. We calculate this variable based on the Annual Surveyed Industrial Enterprise (ASIE) dataset from China's National Bureau of Statistics. The variable was lagged by 1 year to avoid simultaneity.

As an alternative measure of organizational efficacy via SOEs, we leverage He, Tong, Zhang, and He's (2018) work. Using their dataset, which matches the ASIE dataset to patent data provided by

China's SIPO, we calculate the ratio of SOEs' patents to the patents of all types of firms in each SEI in each province (*SOEs' patent ratio*). We calculate this variable based on invention patents and utility model patents, excluding design patents because they reflect aesthetic innovation rather than technological capabilities (Prud'homme, Tong, & Han, 2021). We then create an interaction term *RTAs* × *SOEs' patent ratio*. The results of this alternative measure are reported as a robustness test.

Our H3 independent variable is the interaction effect between *Job promotion of provincial officials to the central government* (*Off. Prom.*) per each province and the *RTAs* per each SEI per each province (*RTAs* × *Off. Prom.*). *Off. Prom* is measured by the total number of career promotions of the most senior provincial Communist Party secretaries and the governors of each province for a decade prior to the SEI initiative. The calculations for this aggregated variable were based on official Chinese government cadre decisions found in the database developed by Landry, Lu, and Duan (2017), a review of provincial People's Government websites, and the 'China Vitae' database maintained by the Carnegie Endowment for International Peace. The promotion variable was lagged by 1 year vis-à-vis the dependent variable to avoid simultaneity.

Control variables

We included several controls proxying agency problems and other sources of variance. Information asymmetry agency problems in decentralized polities can be proxied by a lack of transparency in subnational governance (Lin, Tian, & Lv, 2018). A *Provincial Government Transparency* (*Transp. Index*) was therefore included based on Deng, Peng, and Wang's (2013) China Provincial Fiscal Transparency Index. Their index is based on a 113-question survey of provincial government departments measuring the level of comprehensiveness and detail of fiscal information that provincial governments make available to higher-level authorities; higher scores on the index indicate worse performance. Further, we used the fifth component of the NERI Index developed by China's National Economic Research Institute, which measures the *Quality of Provincial Rule of Law* (*NERI5 Index*) in China (Qu, Qu, & Wu, 2017; Weng, Li, Yang, & Ren, 2021). This indicator is primarily derived from large-scale enterprise surveys about each Chinese province's defense of rule of law. The index, on which higher scores indicate worse performance, has been used by prior scholarship to proxy subnational governmental capabilities and subnational agency problems in China (Jia et al., 2019: 229). We also controlled for GDP per capita (*GDP_cap.*) and provincial population (*Pop.*), based on NBS data. Provincial science & technology expenditures (*S&T exp.*), based on NBS data, were also included. All these variables were lagged by 1 year to avoid simultaneity. For H3, which involves job promotions of high-level provincial government officials, cross-sectional controls were included for the average age (*Off. Age*) and duration in office (*Off. Tenure*) of all those officials when they were promoted.[2] We also included fixed effects (FE), namely dummies for each year and province.

Table 2 provides descriptive statistics and correlations for our variables.[3] When missing, data for RHS variables were forward imputed using the Multiple Imputation by Chained Equation method (Su, Gelman, Hill, & Yajima, 2011).

Estimation Methods

Considering the hypothesized relationships and the panel data distribution, we opt for linear multivariate regressions. Pooled OLS, FE, and random effects regressions were run. Hausman tests confirmed the FE models are most appropriate. VIF checks were conducted to identify potential multicollinearity.

Results

Effect of Baseline Organizational Efficacy on Industrial Specialization Choices

The results in Table 3 test our H1. The RTAs for each of the seven SEIs per each province are significantly positively correlated with the ISP Index (0.142, $p < 0.01$). In terms of effect size, given the coefficient for *RTAs* in Model 2 in Table 3, the ISP Index is expected to rise by 0.107 as *RTAs* increase by one SD (0.142 * 0.75 = 0.107). This is not a small change considering that the ISP Index ranges from 0 to 3, with a mean value of 1.90. In sum, the result supports H1 that, on average, provincial

Table 2. Summary statistics and correlation matrix[†]

		Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10
1	ISP Index	1.90	0.89	0.00	3.00										
2	RTAs	0.94	0.75	0.00	6.00	0.168									
3	SOE ratio	3.99	6.01	0.06	58.82	−0.149	−0.275								
4	Off. Prom	1.88	1.16	0.00	4.00	0.225	0.108	−0.263							
5	Pop.[‡]	5.85	0.79	3.41	6.97	0.220	0.279	−0.473	0.220						
6	Transp. Index	22.72	5.95	15.40	50.40	0.118	−0.006	−0.174	0.074	0.235					
7	NERI5 Index	15.58	8.75	1.00	31.00	−0.232	−0.339	0.410	−0.415	−0.385	−0.043				
8	S&T exp.[‡]	14.34	1.41	9.35	16.52	0.324	0.354	−0.603	0.441	0.744	0.209	−0.769			
9	GDP cap.[‡]	10.60	0.42	9.71	11.51	0.171	0.191	−0.424	0.360	0.039	0.209	−0.675	0.643		
10	Off. Age	57.84	1.99	49.59	60.64	−0.076	0.171	−0.094	−0.037	0.342	−0.047	−0.243	0.345	0.131	
11	Off. Tenure	5.02	1.42	3.32	9.91	−0.017	−0.129	0.030	−0.298	−0.181	0.047	0.094	−0.075	0.127	0.114

Notes: [†]Number of obs. is 554. [‡]Logged values. [§]Correlations with absolute value larger than 0.04 are significant at the $p < 0.05$ level.

Table 3. Comparative advantages and provincial industrial specialization policy choices

Variables	Model 1 ISP Index	Model 2 ISP Index
RTAs	0.142***	0.142***
	(0.045)	(0.045)
Pop.	–	4.456
		(4.787)
Transp. Index	–	0.003
		(0.008)
NERI5 Index	–	0.006
		(0.015)
S&T exp.	–	−0.482
		(0.869)
GDP cap.	–	1.685
		(1.579)
Constant	1.338***	−35.923
	(0.210)	(35.668)
Observations	554	554
R^2	0.430	0.432
Prov FE	Yes	Yes
Year FE	Yes	Yes

Notes: Standard errors are in parentheses. ***Significant at 1%, **Significant at 5%, and *Significant at 10% (two-tailed test).

governments in China will more (less) significantly promote SEIs that have greater (lesser) local technological comparative advantages.

Effect of Organizational Efficacy via SOEs on Industrial Specialization Choices

The results in Table 4 test our H2. The interaction term between the RTAs for each of the seven SEIs per each province and the proportions of SOEs relative to all types of firms per each SEI per each province (*RTAs* × *SOE ratio*) is significantly positively correlated with the ISP Index (0.028, $p < 0.05$). In other words, when provincial governments in China have access to more local SOEs in SEIs and higher comparative advantages therein, they tend to more strongly promote those SEIs. This result offers preliminary support for our H2.

To visualize the marginal effect of *RTAs* on the dependent variable (the *ISP Index*) as the moderating variable *SOE ratio* ranges from its minimum to maximum in our sample, we follow Brambor, Clark, and Golder (2006) and plot the marginal effect of *RTAs*. Figure 2 shows the marginal effects and the confidence intervals of *RTAs* on *ISP Index* at the different values of the moderating variable *SOE ratio*. The positive effects of *RTAs* on *ISP Index* increase with the ratio of SOEs in each SEI in each province. This result lends further support to our H2 that provincial governments with access to better-resourced SOEs in SEIs seem to make smarter specialization choices in those industries.

Effects of Past Job Promotions on Industrial Specialization Choices

The results in Table 5 test our H3. The interaction effect between the number of past job promotions of provincial government officials in each province to the central government and the RTAs for each of

Table 4. Moderating effect of provincial organizational efficacy

Variables	Model 1 ISP Index	Model 2 ISP Index	Model 3 ISP Index
RTAs	0.142***	0.149***	0.051
	(0.045)	(0.045)	(0.066)
SOE ratio	–	0.013	0.010
		(0.009)	(0.009)
RTAs * SOE ratio	–	–	0.028**
			(0.014)
Pop.	4.456	4.892	4.988
	(4.787)	(4.793)	(4.778)
Transp. Index	0.003	0.003	0.003
	(0.008)	(0.008)	(0.008)
NERI5 Index	0.006	0.006	0.005
	(0.015)	(0.015)	(0.015)
S&T exp.	−0.482	−0.254	−0.307
	(0.869)	(0.884)	(0.881)
GDP cap.	1.685	2.336	2.438
	(1.579)	(1.645)	(1.641)
Constant	−35.923	−48.553	−49.489
	(35.668)	(36.769)	(36.660)
Observations	554	554	554
R^2	0.432	0.434	0.438
Prov FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: Standard errors are in parentheses. ***Significant at 1%, **Significant at 5%, *Significant at 10%. (two-tailed test).

the seven SEIs per each province (*RTAs* × *Off. Prom*) is significantly negatively correlated with the *ISP Index* (–0.144, $p < 0.01$). This indicates that the importance of comparative advantages (*RTAs*) to provincial governments' industrial specialization policy choices (*ISP Index*) is reduced when they historically have more of their officials promoted to the central government. Provinces facing these conditions tend to heavily promote SEIs even if lacking comparative advantages in them. This result offers preliminary support to our H3.

Mirroring our test for H2, we illustrate the marginal effect of *RTAs* on the dependent variable (*ISP Index*) as the moderating variable *Off. Prom* ranges from its minimum to maximum in our sample. Figure 3 shows that the positive effects of *RTAs* on *ISP Index* decrease and become statistically insignificant as past job promotions of government officials in each province increase. This result lends further support to our H3.

Robustness Checks

Several checks help confirm the robustness of our work. First, we tested the robustness of the ISP Index. To do this, in line with guidance from OECD (2008), the ISP Index indicators and scoring method (see Table 1 and the Appendix) were discussed and confirmed with two peers familiar with Chinese industrial policy and index methodologies. Also, an upper-bound ISP Index and then a lower-bound ISP Index, which was more conservatively scored, were produced (see Table 1). The Spearman

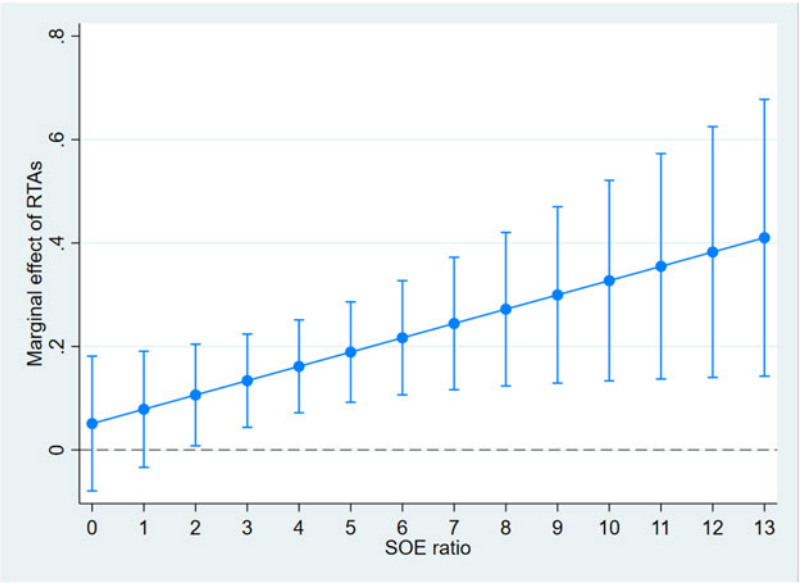

Figure 2. Marginal effect of RTAs on ISP Index as organizational efficacy varies

rank correlation coefficient (*rs*) for each index was then calculated. A high correlation between the indexes indicates the rankings of promotion efforts do not differ significantly regardless of which scoring options are used. The results of the *rs* tests showed a correlation of ≥0.98 between the indexes, which is extremely high (Williams, 1979), indicating that there was no bias prohibiting us from relying on our original scoring, the upper-bound index. Further, just to be sure, we incorporated the lower-bound index in a separate set of regressions, not presented here to conserve space, and found it produced the same overall results as the upper-bound index.[4]

Second, as mentioned earlier in our methods section, we use *SOEs' patent ratio* as an alternative measure of organizational efficacy and examine its moderating effect on the relationship between *RTAs* and provincial governments' promotion of industrial specialization in SEIs (*ISP Index*). The results, which are not presented here due to space limitations but are available upon request, are highly consistent with those in Table 4, thus providing additional support to our theoretical prediction in H2.

Third, since the dependent variable *ISP Index* is an ordered categorical variable ranging from 0 to 3, we use ordered logistic regressions as a robustness test (the 'ologit' command in Stata), which assumes the error terms to be independent and follows a logistic distribution function. We then re-ran the regressions for all three of our hypotheses. The results, reported in Table 6, are qualitatively consistent with those in the main analyses with OLS regressions (in Tables 3–5), thus further supporting our predictions.

Fourth, we adopt an instrumental variable (IV) technique to evaluate endogeneity. We extensively search for an appropriate variable and settle on *Employment ratio*, which both conceptually and empirically satisfies the requirements for a valid instrumental variable. The IV is measured as the ratio of the number of employees (in all organizations) in a given SEI to the total number of employees (in all organizations) in all industries in a certain province in year *t*–1. We calculate this variable by using the ASIE dataset mentioned in our methods section. We use the values in year *t*–1, which allows us to keep the instrumental variable consistent with our independent variable (*RTAs*) and lag it by 1 year vis-à-vis our dependent variable (*ISP Index*) to avoid simultaneity. Conceptually speaking, on the one hand, more employees in a given SEI in a given province indicate a stronger workforce therein, and therefore might be positively associated with greater RTAs in that SEI. On the other hand, the ratio of employment in any single SEI in a province relative to all other industries in that province seems, on its own, unlikely to have a significant influence on that provincial government's decision to promote

Table 5. Moderating effect of promoting provincial government officials

Variables	Model 1 ISP Index	Model 2 ISP Index	Model 3 ISP Index
RTAs	0.142***	0.141***	0.404***
	(0.045)	(0.045)	(0.104)
Off. Prom	–	−0.076	0.037
		(0.327)	(0.327)
RTA* Off. Prom	–	–	−0.144***
			(0.051)
Pop.	4.456	4.453	4.334
	(4.787)	(4.791)	(4.760)
Transp. Index	0.003	0.003	0.003
	(0.008)	(0.008)	(0.008)
NERI5 Index	0.006	0.005	0.006
	(0.015)	(0.015)	(0.015)
S&T exp.	−0.482	−0.477	−0.426
	(0.869)	(0.870)	(0.865)
GDP cap.	1.685	1.673	1.714
	(1.579)	(1.582)	(1.571)
Off. Age	–	−0.779	−0.754
		(0.792)	(0.787)
Off. Tenure	–	−0.588	−0.612
		(1.016)	(1.010)
Constant	−35.923	13.729	11.671
	(35.668)	(25.205)	(25.049)
Observations	554	554	554
R^2	0.432	0.432	0.440
Prov FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: When estimating the moderating effect of *Officials' promotion* from the provincial government to the central government, we add two additional control variables in this table that were not included in Tables 3 and 4, namely *Official's Age* and *Official's Tenure*. Standard errors are in parentheses. ***Significant at 1%, **Significant at 5%, and *Significant at 10% (two-tailed test).

that specific SEI. This is because the total percentage of employment in any single SEI in a province should always be relatively low compared with employment in all other industries there (to be sure, this is the case in our data, where the mean of the *Employment ratio* in all SEIs is only 0.067, with a SD of 0.059). As such, preserving or disrupting employment in any single SEI is less of a political concern for provincial governments.

Empirically, we perform two-stage least squares (2SLS) regressions and report the results in Table 7. Model 1 reports the result of the first stage. The estimated coefficient of the instrumental variable *Employment ratio* is positive and statistically significant, indicating that a given SEI in a given province is more likely to have technological advantages when it has a greater proportion of employees. To rule out concerns about the weakness of our IV, we conduct the Stock–Yogo Weak IV test (Stock & Staiger, 1997). As the statistic shows, the Cragg–Donald Wald *F*-statistic is 17.885, which is above the threshold for a weak IV (16.38), thus validating our instrumental variable. Model 2 presents the result of the

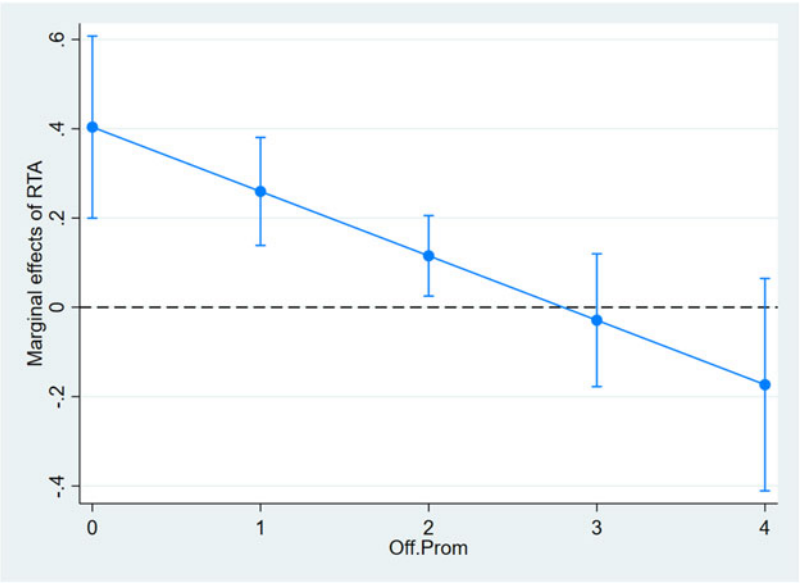

Figure 3. Marginal effect of RTAs on ISP Index as government officials' promotion varies

second-stage estimation. The IV specification confirms our previous finding that prior technological advantages in a given SEI in a given Chinese province tend to facilitate the local provincial government's subsequent decision to promote specialization in that industry. While we recognize that our instrumental variable might not be fully exogeneous, it does provide evidence of interesting associations that are robust to the IV estimation.

Fifth, in addition to the instrumental variable technique, we adopt the Impact Threshold of a Confounding Variable (ITCV) approach to assess possible endogeneity (Busenbark, Yoon, Gamache, & Withers, 2022; Frank, 2000). This approach helps evaluate how strong a correlated omitted variable would have to be to overturn our results. The results show that an omitted variable would have to be correlated at 0.264 with the DV *ISP Index* and at 0.264 with the independent variable *RTAs* to overturn our findings. Similarly, the impact of an omitted variable, as defined by Frank (2000), would need to be $0.264 * 0.264 = 0.0698$ to invalidate our findings. Considering this, we use the Stata command *konfound* to calculate the partial correlations of our control variables with the independent variable *RTAs* and with the dependent variable *ISP Index*. The result shows that *GDP capita* has the highest partial correlation with both *RTAs* and *ISP Index*. Nevertheless, its partial correlation with *RTAs* is 0.0417, which is far below the threshold (i.e., 0.264) needed to invalidate our findings. To put this in perspective, it would take a correlated omitted variable with an impact much larger than even the strongest variable in this model to overturn our results (Hubbard, Christensen, & Graffin, 2017). Assuming we have a reasonable set of control variables, this suggests that our results are unlikely to be driven by a correlated omitted variable. Further, the results of the ITCV analysis also show that, to invalidate our findings, 47.20% of cases (i.e., 261 out of 554 observations) would have to be replaced with cases for which there is an effect of 0 for *RTAs* on *ISP Index*. This is also unlikely to happen. Considering this alongside the decision tree for the ITCV approach (Busenbark et al., 2022: 27), we conclude that our inference is not biased by omitted/confounding variables, thus further relieving concerns about endogeneity.

All these checks help verify the robustness of our results. Our results also held consistent when we included additional control variables – such as provincial corruption levels, central-provincial government directorate interlocks, punishment of provincial government officials, and authority levels of the government bodies promulgating the provincial specialization policies in the *ISP Index*.[5] However, the correlations we have identified should still not be interpreted as necessarily representing causality, as

Table 6. Robustness test with the ordered logistic regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Variables	ISP Index	ISP Index	ISP Index	ISP Index	ISP Index	ISP Index	ISP Index
RTAs	0.322**	0.322**	0.338***	0.029	0.321**	1.048***	0.715**
	(0.128)	(0.128)	(0.129)	(0.182)	(0.128)	(0.295)	(0.343)
SOE ratio	–	–	0.030	0.023	–	–	0.023
			(0.025)	(0.025)			(0.025)
RTAs * SOE ratio	–	–	–	0.096**	–	–	0.078*
				(0.041)			(0.041)
Off. Prom	–	–	–	–	−0.253	0.045	0.052
					(0.869)	(0.877)	(0.881)
RTA* Off. Prom	–	–	–	–	–	−0.397***	−0.347**
						(0.144)	(0.147)
Pop.	–	14.595	16.119	16.714	14.594	14.137	16.166
		(14.172)	(14.255)	(14.320)	(14.174)	(14.296)	(14.406)
Transp. Index	–	0.008	0.010	0.010	0.008	0.009	0.010
		(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
NERI5 Index	–	0.019	0.018	0.019	0.017	0.017	0.017
		(0.042)	(0.042)	(0.043)	(0.043)	(0.043)	(0.044)
S&T exp.	–	−1.592	−0.994	−1.302	−1.572	−1.442	−1.122
		(2.333)	(2.388)	(2.397)	(2.334)	(2.339)	(2.400)
GDP cap.	–	4.745	6.378	6.920	4.696	4.698	6.710
		(4.461)	(4.664)	(4.677)	(4.465)	(4.448)	(4.680)
Off. Age	–	–	–	–	−2.516	−2.429	−2.861
					(2.333)	(2.354)	(2.384)
Off. Tenure	–	–	–	–	−1.952	−1.988	−2.652
					(2.935)	(2.959)	(3.018)
Observations	554	554	554	554	554	554	554
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table replaces the OLS regressions with the ordered logit regressions to test all the hypotheses. Standard errors are in parentheses. ***Significant at 1%, **Significant at 5%, and *Significant at 10% (two-tailed test).

we cannot entirely rule out the existence of some endogeneity in our results. Considering this limitation, we cautiously discuss the significance of our findings.

Discussion

Leveraging the Chinese context, we show that provincial governments tend to smartly specialize in strategic emerging industries/SEIs. Moreover, two sets of central government tools governing subnational agency problems – enabling provincial governments' organizational efficacy through control of local SOEs, and job promotions of provincial government officials to the central level – moderate these choices. Specifically, provincial governments with access to better-resourced local SOEs in

Table 7. Robustness test with the 2SLS regressions

Variables	Model 1 RTAs	Model 2 ISP Index
IV: Employment ratio	2.255***	–
	(0.533)	
Predicted value of RTAs	–	1.208***
		(0.243)
Pop.	−0.094	6.141
	(4.657)	(4.779)
Transp. Index	−0.000	0.004
	(0.008)	(0.008)
NERI5 Index	−0.008	0.015
	(0.016)	(0.016)
S&T exp.	0.040	−0.524
	(0.838)	(0.860)
GDP cap.	0.968	1.294
	(1.542)	(1.580)
Constant	−8.652	−42.734
	(34.588)	(35.317)
Weak identification test (Cragg–Donald Wald *F*-statistic)	17.885	–
Stock–Yogo weak ID test critical values (10% maximal IV size)	16.38	–
Observations	548	548
R^2	0.275	0.446
Prov FE	Yes	Yes
Year FE	Yes	Yes

Notes: Model 1 reports the first-stage result, which regresses the *RTAs* on the instrumental variable and the control variables. The Cragg–Donald Wald *F*-statistic (17.885) is above the critical value of Stock–Yogo weak ID test (16.38), which implies that our instrumental variable is valid. Model 2 reports the second-stage result, which is highly consistent with our previous finding. Standard errors are in parentheses. The sample size in this table is smaller than that in Table 3 due to missing values for *Employment ratio* in Shaanxi Province. ***Significant at 1%, **Significant at 5%, and *Significant at 10% (two-tailed test).

SEIs seem to make smarter specialization choices in those industries, while provincial governments accustomed to having their officials promoted to the central government seem to make less smart specialization choices in SEIs.

Theoretical Contributions

Our research makes several contributions. Most importantly, we *extend smart specialization theory* (e.g., Capello & Kroll, 2016; Foray, 2014; Krammer, 2017; Lee, 2013, 2016, 2017; Lin, 2012, 2017; Mathews, 2002, 2005, 2007, 2017; Radosevic, 2017). Our agency theory lens into smart specialization helps explain how the two central government tools in China that we study, which are meant to mitigate subnational agency problems, can produce knock-on effects making subnational governments' industrial specialization choices smart or unsmart.

The first governance tool (allowing organizational efficacy via control of local SOEs) likely facilitates smarter specialization by enhancing returns to policymaking efforts. Specifically, the tool likely incentivizes provincial government officials with access to better-resourced SOEs in focal industries to – knowing they have control of greater resources for specialization and thus can better secure returns

on their efforts – more carefully design their industrial policies. In this sense, by leveraging this general agency governance tool, the central government can also mitigate subnational agency problems, such as shirking, specifically inhibiting smart specialization. This realization offers a perspective about the role of SOEs in industrial development in China that sharply contrasts with longstanding criticisms of Chinese SOEs (The Economist, 2012). Instead, we build on recent scholarship arguing that various Chinese SOEs have, in fact, at least in the last decade or so, accumulated technological capabilities and helped advance Chinese government goals to develop knowledge-intensive industries (e.g., Gao, 2017; Genin et al., 2021; Huang, 2021; Jia et al., 2019; Kroll & Kou, 2018; Lazzarini et al., 2021; Liu et al., 2021; Prud'homme & von Zedtwitz, 2018; Zhou et al., 2016).

At the same time, a word of caution is warranted. Industrial policy reliant on SOEs may be a double-edged sword: sometimes promoting smart specialization, but not necessarily doing so efficiently. For example, despite our results, it is certainly still possible that provincial governments in China may allocate capital to inefficient local SOEs (Howell, 2018). Considering this risk, while provincial governments should be allowed to make somewhat risky investments in industries dominated by local SOEs, it is necessary to ensure that this occurs within reasonable bounds. Also, to warrant further government investment, the local SOEs that provincial governments rely upon to specialize should have competitive advantages. Perhaps China's National Audit Office, think-tanks, or other organizations in China could propose governance tools meant to ensure that these fundamental smart specialization parameters are honored. Further, governmental organizational efficacy that fosters smart industrial specialization may be effectively enabled via public private partnerships (PPPs) (e.g., Iossa & Martimort, 2015).

Our findings for the second governance tool (job promotions of provincial officials to the central level) also yield interesting implications for the management and organization of industrial specialization. This tool likely facilitates unsmart specialization by making provincial government officials hyperattentive to replicating choices that previously resulted in job promotions. Rather than more smartly promoting some industries over others, these provincial governments may equally promote all industries allowed for specialization by the central government to send unambiguous signals about their compliance with the central government's advice. In this sense, promoting provincial government officials to the central government can create the unintended consequence of excessive risk aversion when making specialization policies. These problems might be mitigated if, for example, the central government establishes more granular and measurable goals related to industrial specialization, and clearer rules that subnational government officials will not be promoted if failing to meet these indicators.

More generally, our work offers a promising line of inquiry into the debate about the downsides and upsides of China's *quasi-decentralized political system* as a facilitator of industrial development. On the one hand, past research about industrial policymaking in China's quasi-decentralized political economy has shown that provincial governments have sometimes unwisely attempted to build industries where they lacked comparative advantages (e.g., Fuller, 2019; Thun, 2006). On the other hand, some research has shown that provincial governments in China have sometimes made smart industrial policy choices (e.g., Huang, 2021; Lan & Galaskiewicz, 2015). We contribute to this conversation by suggesting that the nuances of industrial policy choices in China can be further understood by more granularly examining the public governance tools that shape the principal-agent relationship between the central government and provincial governments in the country.

Lastly, our empirical work has *several implications for practitioners* wanting to better understand the significance of central government tools governing agency problems and government industrial specialization choices in China. Our work joins Prud'homme (2016a) in helping foreign firms seeking suppliers as well as other firms investing in China to better appreciate that, despite mishaps in industrial policymaking in the country in the past, the country's recent approach to specializing in SEIs may offer them some opportunities. Also, the presence of local SOEs in SEIs may facilitate smart specialization in a province, and so should be seriously considered as a source of not just risks but also opportunities. Further, past job promotions of provincial government officials may not always indicate categorically good future governance in a province, and thus should be cautiously considered when making investments.

Limitations and Future Research

There are several limitations of our research. First, some of our findings from the Chinese context might not be generalizable to decision-making in other quasi-decentralized polities. Second, as mentioned, our research only presents correlations rather than establishing causality and therefore our findings and conclusions need to be cautiously considered. Third, we could benefit from a more complete understanding of how exactly the policies gauged in our ISP Index were implemented in practice. Fourth, due to data limitations, we do not consider how technological relatedness among subnational economies might affect governmental industrial specialization choices; but recent scholarship suggests this might matter to firm-level specialization (Howell, 2019; Wang, Li, & Shi, 2020).

Future research could address these issues and expand upon our work in several ways. For example, first, the central-provincial political structure in China provides an interesting context to study many other management and organization questions. Second, scholars could attempt to collect data on subsidies received by firms in SEIs to more precisely gauge the actual implementation of provincial governments' SEI promotion efforts. Third, scholars could explore how alternative governance tools beyond those discussed hereto, such as PPPs, influence smart industrial specialization in quasi-decentralized polities. Fourth, the casual impact of specialization policy choices on concrete economic outcomes (e.g., productivity and innovation) deserves to be investigated. Fifth, more research is warranted as to why some provincial governments' industrial specialization choices deviate more or less from the central-level government's suggested list in China. Some provincial government officials may, given their recognized past performance, highly influence the central government's list in the first place (Ling & Naughton, 2016) and therefore feel more obliged to promote those same industries. Sixth, future research could explore how complementarities between specific provincial and lower-level government policies and institutions (e.g., Helveston, Wang, Karplus, & Fuchs, 2019), or lack thereof, might interact with the governance tools explored in this paper to influence the smartness of subnational industrial specialization choices.

Data availability statement. The authors confirm that the data supporting the findings of this study are available at the Open Science Framework (https://osf.io/) under identifier DOI:10.17605/OSF.IO/FRZ5 T

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Notes

1. A valuable branch of literature illustrates how administrative decentralization can enable industrial 'protectionism' by subnational governments that leads firms to choose less geographic concentration rather than agglomeration of industrial production (e.g., Bai, Du, Tao, & Tong, 2004; Batisse & Poncet, 2004; He, Wei, & Xie, 2008; Young, 2000). However, these studies do not analyze the smartness of the subnational governments' actual specialization policy choices.
2. Although we considered incorporating controls for workplace and birthplace-related connections between officials at different levels of government, we ultimately avoided this due to data limitations and because, as mentioned in Keller (2016), such connections generate a significant number of false positives upwardly biasing estimates of the impacts of political connections.
3. Citation for our dataset: Prud'homme, D. & He, W.L. 'Industrial specialization in China: Effects of central tools governing subnational agency'. doi:10.17605/OSF.IO/FRZ5T, June 2024.
4. Additionally, a Spearman rank analysis between funding figures, which is the subcomponent of the ISP Index that most clearly represents policy implementation, and the aggregated final ISP Index score, which also includes more aspirational goals, confirmed a basic relationship between the two.
5. Authority of government bodies making specialization choices is measured by provinces who had all their SEI specialization plans promulgated by their people's provincial government vs. those with at least one plan promulgated at a lower level of government (from a provincial agency).

6. A plan that specifically targets more than one SEI but less than three SEIs still receives the full score possible on Indicator 2(a). The ceiling of three SEIs is used because a few plans cover two closely related SEIs (e.g., new materials and new energy), but if a plan covers more SEIs it was always found to be an overarching SEI plan (see Indicator 1(a)).

Appendix

This section provides additional details of the ISP Index indicators and scoring presented in Table 1. As mentioned, the ISP Index is formulated according to a four-point scale (i.e., 0, 1, 2, 3) following the Guttman ordering principle that lower scores are always of lower value and higher scores are always of higher value. The rationale of our scoring is as follows:

Score of 0

If an industry is *not at all designated as an 'SEI'* in any provincial policy documents, it scores a 0 on our index. This intuitively indicates that a province is not interested in promoting the SEI at all.

Score of 1

Indicator 1(a) measures the designation of an SEI for development in an *overarching provincial SEI plan(s)* (e.g., provincial 12th Five Year Plan on SEIs Development). This is the most fundamental indicator that a province is indeed interested in promoting a specific SEI. However, it tells us little about how much, exactly, that SEI will be promoted. As such, considering Guttman ordering principles, the presence of an overarching provincial SEI plan only deserves a 1 on our index, as it is the lowest score possible above 0.

Indicator 1(b) measures the presence of a *plan that promotes a broader industry that includes the SEI, although the plan is not titled as exclusively promoting that SEI*. Such situations would arise when, for example, a province promulgated a plan titled as promoting the 'information/ICT' industry rather than, explicitly, the 'NGIT' SEI; or the 'equipment manufacturing industry' rather than, explicitly, the 'HEEM' SEI. This type of plan clearly indicates that a provincial government is interested in developing the industry as an SEI. However, like Indicator 1(b), it tells us little about exactly how much that SEI will be promoted. As such, we score this type of plan the same as those measured by Indicator 1(a).

Score of 2

The first criterion of Indicator 2(a) measures the presence of a plan that is *entirely devoted to a specific SEI* (e.g., provincial 12th Five Year Plan on developing the ECEP industry). Such plans provide important blueprints for industry-specific government promotion efforts. This level of specificity generally indicates greater effort in industrial policymaking and therefore greater seriousness to develop the focal SEI compared with those gauged by Indicators 1(a) and 1(b).[6]

The first criterion for Indicator 2(b) refers to a *plan covering an industry that includes an SEI but is broader in its industrial focus* than the SEI-specific plan captured in Indicator 2(a) (e.g., a provincial 12th Five Year Development Plan for the Energy Industry) *and that explicitly refers to an industry targeted for development as an 'SEI'* (for example, the 'new energy SEI'). As with the plans captured in indicator 2(a), these types of plans can provide important blueprints for SEI-related government promotion efforts that are more specific than those gauged by Indicators 1(a) and 1(b). They also are not necessarily any less serious about developing the focal industry than those plans measured by Indicator 2(b). Rather, they reflect policymakers' cognizance of the relatedness among industrial segments while also being explicit that the focal industry is indeed an 'SEI' that the government intends to develop.

Considering Guttman ordering principles, industries with one or both of the aforementioned plans seem, prima facie, well suited to score at a higher level compared to if they only had the broader plans mentioned in Indicator 1(a) or 1(b). However, to be sure that the plans devoted to a specific SEI were indeed written in a way that substantively seeks to develop that industry beyond the plans measured by Indicators 1(a) and 1(b), we add a second criterion for the plans in Indicators 2(a) and 2(b). This requirement is that the plans must contain *SEI-specific quantitative planning targets*. Quantitative industrial planning targets lend specificity to industrial policy in China, and their existence serves as an indicator of the effort and seriousness of policymakers to promote corresponding industries (Heilmann, 2011). Quantitative SEI development targets in an SEI plan – which usually take the form of figures on value-added growth or sales revenue/income generated, but can include specific numbers of enterprises that should lead the SEI –therefore indicate a higher level of knowledge about as well as seriousness to develop that SEI. Moreover, since such targets can be tied to performance evaluations of provincial government officials in China, there is an incentive to ensure that efforts are undertaken to meet these targets. To satisfy this criterion, the targets must be SEI-specific and could be from any of the plans mentioned in the above description for Indicators 1(a) and 1(b). Considering Guttman ordering principles, plans that collectively meet these criteria have a score of 2.

The alternative way to receive a score of 2 on the ISP Index is spelled out in Indicator 2(c). The first criterion here measures if an SEI is *designated in an overarching SEI plan*, as also measured in Indicator 1(a). The second criterion is that at *least one subindustry plan specific to that SEI is promulgated*. Any 'SEI subindustry' must be explicitly labeled as such in the available overarching SEI plans. An alternative second criterion is that the overarching plans must pledge *specific amounts of government funding* (which, to be sure, is distinct from the aforementioned quantitative planning targets) *for developing the focal SEI*.

These Indicator 2(c) criteria are mindful of situations where available plans do not meet the criteria discussed for Indicators 2(a) and 2(b), yet the broader plans that are available still reflect greater specificity, effort, and therefore seriousness on the part of the promulgating governments to promote the focal SEI compared with the lower-level efforts only captured by Indicators 1(a) and 1(b). Here, formulating an entire plan for specific SEI subindustry indicates a seriousness to promulgate that industry, even if

just a subindustry, on par with the industrial promotion efforts captured by Indicators 2(a) and 2(b). And, to be sure, this component clearly indicates greater government policymaking efforts than those captured by Indicators 1(a) and 1(b). Meanwhile, a provincial governments' funding of an SEI indicates significant commitment to its development because provincial governments have limited budgets and because allocating funding requires notable efforts by government officials to agree upon budgets in the first place.

Score of 3

Scores of 3 are provided for plans that satisfy *three core criteria collectively listed in Indicators 2(a), 2(b), and 2(c)*. Specifically, Indicator 3(a) is built on both criteria from Indicator 2(a) plus the second criterion from Indicator 2(c). And Indicator 3(b) is built on both criteria from Indicator 2(b) plus the second criterion from Indicator 2(c). In line with Guttman ordering logic, Indicators 3(a) and 3(b) require satisfying more criteria representing effort and seriousness of industrial specialization policymaking than required by the other aforementioned indicators.

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