

# Comparing Space Agency Intervention in Taiwan and South Korea

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To develop their space sectors, Taiwan's and South Korea's space agencies intervene differently. This is despite the developmental state literature indicating that the agencies' ideologies, mechanisms, and preferences will be similar. This article recounts the literature's expectations about the two agencies. It then reviews what the two agencies are actually doing to develop their space sectors. This article ends by discussing the implications of the two agencies' differences for stakeholders in Taiwan's and South Korea's space sectors and identifying questions to guide future research that builds off this article's findings.

## Introduction

An increasing number of countries are establishing their own space agencies. These agencies intervene to influence the development of their space sectors. For practical and academic reasons, it is worth studying the following question: How do different space agencies vary in terms of intervening to influence the development of their space sectors? Knowing how space agencies' approaches to intervention differ gives insight into how different space sectors will develop over time. Such insight is useful for a variety of stakeholders, including firms working in the space sector, market analysts assessing trends in the space sector, and policy makers directing space agencies' actions.

To learn more about space agencies' approaches to intervention, this article compares two different space agencies, those of Taiwan and South Korea. The reason for choosing Taiwan and South Korea is that this article builds on developmental state literature that explains how "developmental states," which Taiwan and South Korea both are, intervene to guide economic development. This article assesses whether empirical reality reflects the literature's expectations about how the Taiwanese and South Korean space agencies intervene to develop their space sectors.

## Literature Review

The origin of the developmental state literature focused on explaining Japan's economic success in the years following World War II. The founding piece of scholarship in the literature is *MITI and the Japanese Miracle* by Chalmers Johnson, written in 1982.<sup>1</sup> In it, Johnson provided a detailed account of how Japan was able to achieve economic success. Several factors were at play, according to John-

son, but chief among them was Japan's "plan rationalism," as opposed to the United States' "market rationalism;" in Japan, government's legitimate role was to steer business activity toward developmental goals, whereas in the United States, government's legitimate role was to remove barriers to firms' doing business.<sup>2</sup> Several other scholars subsequently identified plan rational characteristics in governments elsewhere—most notably in Taiwan, South Korea, and Singapore.<sup>3</sup> Today, these developmental states—Japan, Taiwan, South Korea, and Singapore—all continue to display plan rational tendencies in their approaches to intervention.<sup>4</sup> This is despite the homogenizing effects that globalization has had on countries' economic policies, which has arguably undermined governments' ability to control business activity.<sup>5</sup>

The developmental state literature is unlike some other comparative political economy literatures in that its scholars have been reluctant to theorize; there is little consensus about a developmental state "model," which abstracts beyond any particular set of empirical circumstances. This reluctance ties back to Johnson's 1982 book, which was primarily an empirically driven account of Japan's economic interventionism. Subsequent developmental state scholars have also tended to place great emphasis on providing lengthy empirical accounts of how governments go about intervening in economies.<sup>6</sup> Such empirical specificity means many developmental state researchers are region- or country-specific scholars. This is noticeably different than the Varieties of Capitalism literature, another literature in the comparative political economy discipline, which focuses on developing theoretical frameworks to explain how and why different countries organize economic activity differently.<sup>7</sup>

Despite theory rarely being explicitly stated in the developmental state literature, it is implicitly present. Implicit theoretical propositions about how developmental states intervene become clearest considering some of the newer developmental state scholarship, which examines "regulatory states," the market rational counterparts like the United States against which scholars often contrast plan rational developmental states.<sup>8</sup> It should be noted that the term "regulatory state" is in quotes because, in fact, there is no consensus about the appropriate term for the developmental state's market rational counterpart. Scholars focusing on regulatory states describe a process of intervention that parallels, yet differs from, the intervention in developmental states. It is through comparing these parallel approaches to intervention that the implicit theoretical propositions about intervention in developmental states become clear.

When compared to the regulatory states, three implicit theorized propositions about how developmental states intervene come to light. These propositions relate to ideology, mechanisms, and preferences. The first proposition regards ideology:

developmental states are indeed plan rational, rather than market rational, in that they see their legitimate purpose as guiding business behavior toward national development goals.<sup>9</sup> The second proposition regards mechanisms: developmental states prefer intervening via financial incentives such as grants, contracts, and loans, whereas regulatory states prefer intervening via customized support such as innovation or networking services.<sup>10</sup> The third proposition regards preferences: developmental states prefer intervening to support domestic firms that are already active in planned business areas, unlike regulatory states that prefer supporting firms that are competitive.<sup>11</sup>

This is, of course, a simplified summary of the salient characteristics of developmental states. There is no consensus in the literature that these three characteristics—ideology, mechanisms, and preferences—are what define developmental states' approach to intervention. There is, for instance, significant emphasis in the literature on how government bureaucrats in developmental states have “embedded autonomy;” on the one hand, they are business-savvy enough to understand how to best devise intervention efforts, and on the other hand, they are professional enough to put state interests before their personal interests.<sup>12</sup> However, in comparison to regulatory states, such a combination of mission drive and business-savviness does not appear to be a core differentiator; bureaucrats in regulatory states also have embedded autonomy.<sup>13</sup>

This article takes these three characteristics regarding ideology, mechanisms, and preferences as those that define developmental state intervention, but it should be noted explicitly here before proceeding that what developmental states' core characteristics are is still subject to debate. Hopefully, future research that contrasts developmental and regulatory states will, over time, advance consensus about core characteristics of both developmental and regulatory states.

The rest of this article is devoted to reviewing evidence for these three core characteristics in Taiwan's and South Korea's space agencies, to assessing the implications of the space agencies' characteristics for various stakeholders in the two space sectors, and to discussing opportunities for further research. Taiwan and South Korea are suitable countries of focus for this article because they are widely regarded as developmental states.<sup>14</sup> They are furthermore similar regarding their space sectors' status; they are both actively developing their reputations as space powers. This is unlike the two other countries widely regarded as developmental states, Japan and Singapore. Japan, on the one hand, is a well-established space power; the Japan Aerospace Exploration (JAXA) is an accomplished space agency. Singapore, on the other hand, is a nonexistent space power; it does not have a space agency, nor is space sector development a priority for the government.

## **Empirical Evidence for Space Agency Intervention in Taiwan**

### ***Empirical Evidence for Ideology***

Regarding Taiwan, there is significant evidence to support the theorized proposition about its ideology. Taiwan's space agency, the National Space Organization (NSPO), clearly sees its role as guiding business activity in the space sector in ways that align with national economic development plans. NSPO is a member organization of the National Applied Research Laboratories (NARLabs), which is in turn overseen by the Ministry of Science and Technology.<sup>15</sup> NARLabs' mission is fourfold: (1) to support research and development; (2) to cultivate academic research; (3) to promote "frontier" science and technology; and (4) to develop high-tech human capital.<sup>16</sup> NSPO specifically focuses on conducting this mission in the space sector. Its primary goal is developing indigenous technology capabilities, principally in the areas of satellite construction and operation.

Over the past several years, NSPO has organized the construction and operation of a series of Earth observation satellites: the FORMOSAT-3 satellites in 2006, the FORMOSAT-5 satellites in 2017, and the FORMOSAT-7 satellites in 2019.<sup>17</sup> Over time, the agency has gradually been indigenizing hardware and human capital. A stated goal of the FORMOSAT-5 program, for instance, was to "build up Taiwan's self-reliant space technology."<sup>18</sup> An external private contractor in the United Kingdom built the satellite bus for the FORMOSAT-7 batch of satellites, but the bus for the next iteration will be "NSPO-built" (though still using some of the contractor's hardware).<sup>19</sup> It is worth noting that NSPO documents rarely emphasize foreign firms' participation in the satellite program. Taiwanese firms' participation in the satellite program, on the other hand, is often highlighted (particularly with regards to scientific payloads).<sup>20</sup>

NSPO's satellite program is concerned not only with the construction of satellites but also with their operation. Taiwan's ground stations, for instance, are the "primary commanding" sites for FORMOSAT-7 satellite operations; two sites in Taiwan, located in Chungli and Tainan, belong to a network of ground stations in several countries to ensure regular contact with the satellites.<sup>21</sup> Thus, through its satellite program, NSPO helps Taiwan accrue space-sector expertise not just in terms of constructing satellites but also in terms of operating them after they reach orbit.

NSPO's ideological orientation clearly aligns with what one would expect of a government agency in a developmental state. It sees its legitimate purpose as building up a particular part of Taiwan's economy in line with government's larger economic development policy; NARLabs' goal is to develop indigenous technology capabilities, and NSPO is doing this in the realm of space technology. Through

its satellite program, NSPO develops local expertise on how to build and operate satellites. This is a form of intervention that matches the “husbandry” or “mid-wifery” that scholars expect to see coming from a developmental state government agency like NSPO.<sup>22</sup>

### ***Empirical Evidence for Mechanisms***

Turning now to the second theorized characteristic for NSPO, which regards the mechanisms it uses to intervene in the space sector, the literature indicates NSPO intervenes via financial incentives. A review of available information certainly indicates that this is what is happening with regards to NSPO’s interactions with Taiwanese firms; NSPO contracts them to provide specific components that are incorporated into the satellites. Such firms include: CAMELS Vision Technologies; CMOS Sensor, Inc.; the SYSCOM Group; Advanced Control & Systems, Inc.; and Victory Microwave Corporation.<sup>23</sup> At least some of these firms have well-established histories of fulfilling government contracts; one firm, for instance, has had many other government clients besides NSPO.<sup>24</sup>

It is interesting to note that NSPO also contracts several foreign firms. These firms, which provide NSPO with components for its satellite program, include the German firm SpaceTech GmbH Immenstaad; the British firm Surrey Satellite Technology (SST); the Canadian firm COM DEV; the American firm Red-Eye; and the British firm Ball Aerospace.<sup>25</sup> The reason for NSPO contracting these firms appears to be facilitating knowledge transfer. SST, for instance, built the bus for the FORMOSAT-7 satellites, but now NSPO is developing the next-generation bus on its own, albeit with some of SST’s technology.<sup>26</sup> Contracting foreign firms thus helps NSPO develop local expertise.

Many of the entities NSPO involves in its satellite program are other government entities, not just firms. These other government entities’ participation in the program appears to be a consequence of policy-making coordination, not NSPO contracts. The National Chip Implementation Center (CIC), for instance, which is involved in the satellite program, shares lines of reporting with NSPO (it is affiliated with NARLabs, which is NSPO’s parent organization); it is thus likely that policy makers coordinate the budgets and goals of both entities.<sup>27</sup> Similarly, the Instrument Technology Research Center (ITRC) is a member of NARLabs like NSPO.<sup>28</sup> Besides the CIC and ITRC, other government entities involved in the satellite program include the Chung-Shan Institute of Science and Technology, a state-owned corporation; the Institute of Space Science at National Central University, a public school; and the Aerospace Industrial Development Corporation, a government entity privatized in 2014 but whose largest shareholder remains the Ministry of Economic Affairs.<sup>29</sup>

Several US government entities are also involved in NSPO's satellite program. In fact, observers sometimes describe the entire FORMOSAT program as a "joint constellation meteorological satellite mission" by the Taiwanese and US governments.<sup>30</sup> US government entities tend to call the program COSMIC, whereas Taiwanese government entities tend to call the program FORMOSAT.<sup>31</sup> US government entities involved in the program include the National Oceanic and Atmospheric Administration (NOAA), which is NSPO's primary partner; the US Air Force (specifically its Space and Missile Systems Center and its Air Force Research Laboratory); and NASA's Jet Propulsion Laboratory.<sup>32</sup> Utah State University's Space Dynamics Laboratory and the University Corporation for Atmospheric Research have also been involved in the satellites' development.<sup>33</sup> Furthermore, facilities located not just in Taiwan but also in the United States process data collected by the NSPO satellites.

In summary, NSPO's mechanisms of intervention are more varied than the literature expects. NSPO does use contracts, which are a type of financial incentive, but the organization furthermore involves other government entities by policy-making coordination. It is, of course, notable, that NSPO uses both mechanisms—contracts and policy-making coordination—with not just domestic firms and government entities but also with foreign ones.

### ***Empirical Evidence for Preferences***

In terms of which sorts of market actors NSPO prefers engaging, its preferences do not align with expectations from the literature. The implicit theorized proposition about the preferences of government agencies in developmental states, like NSPO, is that they prefer engaging domestic firms that are already active in the business areas the government agencies are trying to develop. For the purposes of assessing whether NSPO conforms to this theorized proposition, it is useful to think of this proposition as having two elements: (1) a preference for domestic firms, and (2) a preference for market actors that are already active in planned business areas.

Regarding the first element, NSPO clearly does not conform to expectations in that it engages a wider set of market actors than just domestic firms. While it is true that in some cases NSPO prefers engaging domestic firms, in other cases NSPO also prefers engaging other sorts of entities. As discussed in the previous section, beyond just engaging domestic firms, NSPO also engages foreign firms, domestic government agencies, and foreign government agencies.

Regarding the second element, NSPO does conform to expectations. The market actors NSPO engages—be they firms or government entities, domestic or foreign—already work in the business areas NSPO is trying to develop. SST, for

instance, is a well-established satellite bus maker in the United Kingdom. Similarly, CAMELS Vision Technologies in Taiwan develops imagery devices, which has obvious relevance to Earth observation. The CIC in Taiwan and NOAA in the United States, on the other hand, already work in business areas NSPO is trying to develop.

Thus, one can conclude that NSPO's preferences somewhat match expectations. On the one hand, NSPO engages many types of market actors, not just domestic firms, which is not as the literature expects. On the other hand, NSPO holds true to the expectation about it preferring to work with entities that already have experience in the business areas it is trying to develop.

## **Empirical Evidence for Space Agency Intervention in South Korea**

### ***Empirical Evidence for Ideology***

South Korea's space agency is the Korea Aerospace Research Institute (KARI). Like NSPO in Taiwan, KARI has an ideological orientation that aligns with what one would expect of a government agency in a developmental state. KARI describes itself as "a specialized institution founded for national development through the research and development of aerospace scientific technologies."<sup>34</sup> KARI is explicit about how it sees its role in terms of intervening in markets: "secur[ing] core technologies to enhance . . . national competitiveness and [to act as a] future growth engine in the era of the Fourth Industrial Revolution."<sup>35</sup> In other words, KARI sees its role as ensuring particular types of business activities happen. KARI is not content to let business activity occur as it would without government intervention; the agency rather sees its role as necessarily guiding business activity toward economic development objectives. This is the *husbandry* or *midwifery* the literature expects to see of a government agency like KARI.<sup>36</sup>

KARI is involved in many areas of the aerospace industry, but there are two that are particularly high priorities: the development of a launch vehicle, and the continued development of Earth observation satellites. Regarding launch vehicles, KARI is developing an indigenous one called KSLV-II, or Nuri, which it plans to launch in 2021.<sup>37</sup> Regarding the satellite program, called KOMPSAT, KARI has launched many satellites to orbit over the past decade.<sup>38</sup> The most recent satellite launched in February 2020.<sup>39</sup> So far, KOMPSAT satellites have launched from other countries on non-South Korean vehicles. Thus, there is an obvious confluence of interest between the two business areas for KARI, with the intent for South Korea to be able to build, launch, and operate its own satellites.

Like NSPO in Taiwan, there is an indigenization aspect to KARI's mission. Particularly with regards to the satellite program, KARI regularly awards con-

tracts to foreign firms to provide components.<sup>40</sup> Such contracts appear designed to, over several generations of satellites, facilitate knowledge transfer so that South Korea can build its own satellites with less reliance on foreign firms. To this end, KARI highlights increasing rates of self-sufficiency in terms of satellite design and fabrication.<sup>41</sup> This indigenization is also occurring with regards to the launch vehicle; the previous generation of the launch vehicle, KSLV-I, relied on Russian technology. Now, for KSLV-II, KARI has awarded contracts to a South Korean conglomerate to build more domestic components.<sup>42</sup> There is little indication of foreign firms playing central roles in KSLV-II's design and fabrication.

### ***Empirical Evidence for Mechanisms***

KARI does not totally conform to expectations in terms of the mechanisms it uses to intervene in the space sector. On the one hand, it certainly does use financial incentives, mostly in the form of contracts. For KSLV-II, for instance, KARI is contracting Hanwha Techwin to develop the launch vehicle's rockets and other components.<sup>43</sup> KARI awarded the firm approximately 12 million USD in January 2016 to develop KSLV-II's 75-ton and 7-ton liquid rocket engines, and it previously awarded Hanwha Techwin contracts to develop other KSLV-II components and infrastructure.<sup>44</sup> Similarly, for the satellite program, KARI contracted Qnion, a South Korean company, to provide some of the instrumentation for the KOMPSAT satellites.<sup>45</sup>

KARI also awards contracts to foreign firms, especially for its satellite program. KARI has contracted the global conglomerates Northrop Grumman and Airbus to provide satellite subsystems, for instance.<sup>46</sup> The agency has also contracted the British firms Ball Aerospace and Dartcom to provide, respectively, a spectrometer and a communications system.<sup>47</sup> KARI has contracted American firms like Harris Corporation and ITT Exelis to provide satellite components.<sup>48</sup> The European firm Thales Alenia Space has furthermore collaborated with the Korean firm Qnion to provide instrumentation.<sup>49</sup>

There is more evidence of foreign firm involvement in the satellite program than in the launch vehicle program, which may be because indigenization is further progressed in the latter. As mentioned before, Russian technology played a role in KSLV-I's development, but now Hanwha Techwin is manufacturing many parts of KSLV-II. It may be that due to knowledge transfer that happened during the development of KSLV-I, KARI can now rely on local businesses like Hanwha Techwin to build most components of the launch vehicle without needing to include foreign firms. Given time, if KARI's satellite program goes according to plan, then indigenization will also progress in that business area; there will be less satellite-related contracts for foreign firms and more for domestic firms.



Like NSPO in Taiwan, KARI also involves other government entities in its programs. Like in Taiwan, this does not appear to be because KARI is awarding those government entities contracts but rather due to policy-making coordination. Unlike in Taiwan, no foreign government entities play significant roles in KARI's launch vehicle or satellite programs. Other South Korean government entities involved in KARI's programs include the Korea Institute of Ocean Science and Technology, which provided components to the KOMPSAT program (in conjunction with Airbus); the Korea Institute for Advancement of Technology, which partially funded the development of satellite instrumentation; and Kyunghee University, which provided space monitoring equipment.<sup>50</sup> Furthermore, the Korea Meteorological Association manages data from the satellite program.<sup>51</sup>

### *Empirical Evidence for Preferences*

As is the case for NSPO in Taiwan, KARI's preferences do not totally align with expectations from the literature. Recall that the theorized proposition about KARI's preferences is that it prefers to engage domestic firms that are already active in the business areas it is trying to develop. Like for NSPO, it is useful to assess if KARI is conforming to expectations by splitting the theorized proposition into two elements: (1) a preference for engaging domestic firms, and (2) a preference for engaging market actors that are already working in the planned business areas. For both elements, KARI does not hold true to expectations.

On the one hand, KARI works with more than just domestic firms. It contracts many foreign firms, and it also works with many other government entities to support the development of satellites and the Nuri launch vehicle. It is worth noting that, in comparison to NSPO, KARI does not involve foreign government entities in its programs to any significant extent. The one identified instance of a foreign government entity being involved in KARI's program relates to satellite instrumentation jointly developed by Qnion and Thales Alenia Space; Spain's quasi-government institute, the Center for Industrial Technology Development, partially funded the instrumentation's development.<sup>52</sup>

It is also not clear that KARI prefers the market actors it engages—be they firms or government entities—to have experience in the business areas it is trying to develop. Generally, this seems to be true, but there are notable exceptions. On the one hand, foreign firms like Northrop Grumman and South Korean government entities like the Korea Meteorological Association have obvious relevant experience. However, in the case of domestic firms, it is more debatable to assert that they have relevant experience. Particularly, with Hanwha Techwin appearing to be responsible for developing most of KSLV-II's components, it is difficult to ignore the fact that the conglomerate has never built such large rocket engines before. It is

true that Hanwha Techwin previously built KSLV-I’s “upper propulsion unit,” which provides last-minute trajectory changes to reach orbit; however, the larger first-stage rocket was provided by Russia’s Khrunichev State Space Science and Production Center.<sup>53</sup> Hanwha Techwin describes its provision of KSLV-II’s main engine as a “revving up” of its capabilities.<sup>54</sup> Whereas the firms NSPO engages are quite clearly working in business areas in which they have experience, KARI’s contracting Hanwha Techwin raises questions about how much KARI prefers engaging firms that are already working in business areas it wants to develop.

### Comparing Taiwan and South Korea

The literature indicates NSPO and KARI will intervene in their space sectors similarly. According to the literature, NSPO and KARI’s ideologies, mechanisms, and preferences will be as follows:

**Table 1. Expected ideologies, mechanisms, and preferences**

Ideology	Guiding business behavior toward national development goals
Mechanisms	Intervening via financial incentives
Preferences	Engaging domestic firms already active in planned business areas

The empirical situation aligns with these expectations in some ways, but as indicated in the previous sections, NSPO and KARI also intervene in their space sectors in ways that do not align with expectations. Their ideologies, mechanisms, and preferences are summarized in the chart below:

**Table 2. Actual ideologies, mechanisms, and preferences**

	NSPO	KARI
Ideology	Expected—guiding business behavior toward national development goals	Expected—guiding business behavior toward national development goals
Mechanisms	Unexpected—intervening via financial incentives (for firms), but also via coordination (for government entities)	Unexpected—intervening via financial incentives (for firms), but also via coordination (for government entities)
Preferences	Unexpected—engaging firms (domestic and foreign) and government entities (domestic and US); already active in planned business areas	Unexpected—engaging firms (domestic and foreign) and government entities (domestic); debatable whether already active in planned business areas

Both agencies align with expectations about ideology; they are indeed developmental in that they see their missions as guiding business behavior to align with national development goals. Both space agencies also use financial incentives to engage firms, as expected, but they also notably diverge from expectations by co-

ordinating with other government agencies to involve them in intervention programs. In terms of preferences, there is again divergence, both in terms of not matching the expectations from literature and in terms of differing from each other. NSPO does not simply engage domestic firms but also foreign firms and government entities from Taiwan and the United States. Thus, the types of market actors that NSPO prefers engaging are much wider ranging than expected. NSPO appears to align with expectations in terms of preferring to engage market actors that are already active in planned business areas.

For KARI's preferences, beyond engaging just domestic firms as expected, it also engages foreign firms and other domestic government entities (though not foreign government entities like NSPO). It is worth noting that KARI furthermore does not appear to require the market actors it engages to have significant experience in the business areas it is planning. Hanwha Techwin, for instance, does not have experience building large rocket engines, but that is precisely what KARI has contracted the firm to do.

### **Implications for Stakeholders**

It is worth considering what the implications of these findings about NSPO and KARI are for stakeholders in Taiwan's and South Korea's space sectors. The term *stakeholders* can mean many things. For the purposes of this article, three groups of stakeholders will be considered: firms, market analysts, and policy makers. The discussions below are not comprehensive—they are simply illustrations of some implications, the full array of which is too broad to be addressed in this article. It is also worth noting that just because this article does not mention other groups of stakeholders, this does not mean that there are no relevant implications for them. Similar discussions can focus on other stakeholder groups to consider implications of NSPO and KARI's ideologies, mechanisms, and preferences.

#### ***Implications of Ideology***

Turning to ideology first, the two space agencies are similar in that they see their missions as guiding business activity. For firms, this has obvious implications, since the space agencies' ideologies are likely to impact business opportunities. Something a firm should consider is whether its business plans align with the space agencies' ideology-derived goals. It seems likely, for example, that both NSPO and KARI will continue to push for indigenization of space technologies. Firms should be aware of these indigenization plans and decide how they will respond. In some cases, an appropriate response for firms could be to promote their businesses as facilitating knowledge transfer to build up domestic space-

sector expertise. In the case of some foreign firms, on the other hand, they could decide to work in business areas that the space agencies are not trying to indigenize, thus avoiding appearing to conflict with the agencies' agendas. There is no single appropriate response for how firms should respond to NSPO and KARI's ideologies; the point is rather that firms should be aware of the space agencies' ideologies and respond intelligently.

From the perspective of market analysts, any assessment of market trends should address the space agencies' ideologies, since those ideologies have clear implications for market trends. If a market analyst attempts to forecast the development of Taiwan's space sector, for instance, the analyst should assume that NSPO will likely continue intervening to cultivate certain business areas. The analyst should assess what the consequences of those intervention efforts will be. Will Taiwan's reputation as a state-guided economy affect its ability to attract foreign investment? Will changes in political leadership affect the space agency's prioritization of certain business areas? There are a host of such questions to consider, and rarely will they have clear answers. That being said, market analysts should address them to provide assessments that can help their audiences better understand market trends.

For policy makers, too, there are implications stemming from NSPO and KARI's ideologies. The pertinent issues for policy makers have to do with assessing the effectiveness of the space agencies' ideologies. Are the ideologies effective? Should they be changed? Can they be changed? Answering these questions requires considering the costs and benefits of the ideologies and comparing them to the costs and benefits of alternative ideologies. It may be, for instance, that policy makers conclude that the space agencies' ideologies cause them to behave in ways that have benefits but that an alternative ideology (e.g., a market rational one) would result in more net benefits according to a key performance indicator. Like for firms and market analysts, there is no one way policy makers should react to awareness about the space agencies' ideologies; the point is rather that they should consider the space agencies' ideologies when making policies.

### ***Implications of Mechanisms***

In terms of mechanisms, NSPO and KARI are similar in that they intervene via contracts and policy-making coordination. Like ideology, these mechanisms have implications for space-sector stakeholders. For firms, it is important to be aware that the main way the space agencies engage firms is via contracts. This means if firms are seeking government assistance, they should seek it in the form of contracts instead of in some other form (e.g., consulting or innovation support). Firms should also be aware that since the space agencies coordinate with

other government entities, this may have consequences that affect their business. These consequences depend on how the other government entities are involved; if, for instance, the other government entities provide funding opportunities, then this would be useful to know for firms because they could apply for funding from more sources.

The mechanisms NSPO and KARI use also have implications for market analysts. Regarding the space agencies' use of contracts to engage firms, market analysts should consider the potential consequences of such contracts in terms of market trends. Financial incentives are known, for instance, to potentially warp market demand, influencing firms to modify their business plans to depend on continued government financial support. If the space agencies suddenly remove or reduce such contracts, then this could lead to economic shocks. If, however, the space agencies use contracts intelligently, they can in the long term end up fomenting the emergence of new self-sustaining business areas. Whatever market analysts' assessment of the contracts' consequences, no assessment of Taiwan's or South Korea's space sectors would be complete without addressing them.

The space agencies' coordination of other government entities also has implications for market analysts. Market analysts should, for instance, expect that other government entities will assist the space agencies in their intervention efforts. Market analysts should anticipate which other government entities will likely assist. They should assess how those entities will become involved. They should then forecast what the consequences will be of those entities' involvement. If, for instance, the other government entities also provide contracts or other sorts of financial incentives to the private sector to become more involved in planned business areas, this could have a similar distorting effect as the space agencies' contracts. Market analysts, regardless of their assessment of the consequences of the other government entities' involvement, should address their involvement in their market assessments.

For policy makers, too, NSPO's and KARI's intervention mechanisms have implications. When deciding how effective the space agencies are and considering whether they ought to change, for instance, it is worth policy makers taking the time to consider the mechanisms. It is worth considering, for instance, whether it would make more sense for the space agencies to use other mechanisms (such as state-provided consulting services, innovation assistance, or networking support). To make such a determination, policy makers should calculate the costs and benefits of different combinations of mechanisms and then adjust policy to modify the space agencies' behavior accordingly. Policy makers should also contextualize decisions about the appropriate amount and mix of mechanisms within a larger awareness of other issues. Policy makers may, for instance, be aware of an impend-

ing need to reduce government spending, which potentially necessitates switching the space agencies over from awarding contracts to using different mechanisms that spend fewer fiscal resources.

With regards to the space agencies' coordination with other government entities, this too has implications for policy makers. Policymakers may, for instance, when taking stock of which other government entities the space agencies are working, realize the space agencies should work with different government entities. It may be, for instance, that KARI works with another government entity because KARI personnel are familiar with that government entity, but policy makers may be aware that another government entity would be better suited to assisting KARI. In general, policy makers should be aware of the space agencies' tendency to coordinate with other government entities, and they should be prepared to change such coordination if doing so makes sense from a policy-making perspective.

### ***Implications of Preferences***

NSPO's and KARI's preferences are similar, but different. On the one hand, the two space agencies are similar because they prefer engaging both domestic and foreign firms, as well as domestic government entities. NSPO differs from KARI, though, in that it also prefers engaging foreign government entities, specifically US government entities. Another difference regards what NSPO and KARI require of market actors they engage—be they firms or government entities, domestic or foreign—in terms of the extent to which they have experience in planned business areas. NSPO prefers the market actors already be active in planned business areas, whereas KARI does not necessarily require actors to already be active in planned business areas. Below is a brief discussion of some potential implications of NSPO's and KARI's preferences for firms, market analysts, and policy makers.

For firms in Taiwan, one implication of NSPO's preferences is that, since NSPO prefers to engage both domestic and foreign firms, there may be opportunities for firms to access contracts regardless of whether they are domestic or foreign. Another implication for firms relates to NSPO's preference that firms be experienced in relevant business areas; firms should be aware that having relevant experience may help them access NSPO contracts. If they have minimal experience, on the other hand, it may be best for firms to decide to not pursue any contracts. NSPO prefers to coordinate with other government entities from both Taiwan and the United States, which also has implications for firms. An American firm, for instance, may be able to gain knowledge about potential NSPO contract opportunities by leveraging its contacts within relevant US government entities to learn about NSPO's intervention programs.

In South Korea, KARI's preferences are different, presenting a separate set of implications for firms. On the one hand, KARI, like NSPO, prefers contracting both domestic and foreign firms. This implies that firms, regardless of where they are from, may be able to access KARI contracts. Unlike NSPO, though, KARI appears to not require that firms have significant experience in the business areas related to the contracts, at least in the case of domestic firms (as is the case for Hanwha Techwin's contracts to build KSLV-II's rocket engines). This implies that domestic firms may be able to win KARI contracts even if they do not have significant direct experience; this seems more likely to be the case if the domestic firms are applying for contracts in business areas where KARI is particularly intent on building up domestic expertise and is thus more willing to prioritize domestic firms regardless of their experience. Another KARI preference is for working with other South Korean government entities, but not US government entities like NSPO does. One implication of this for firms is that there is no other set of government entities outside South Korea they can access to learn about contract opportunities related to KARI.

The preferences also have implications for market analysts. For market analysts studying Taiwan, they should expect that domestic and foreign firms will be involved in NSPO's programs; the space agency prefers providing contracts to both. Any analysis of Taiwan's space sector that examines just contracts for domestic firms and not for foreign firms, therefore, is incomplete. Market analysts should also be aware that NSPO prefers to contract firms that already have relevant experience. This implies that NSPO will contract only certain types of firms, and analysts should take this into account; they should not, for instance, overemphasize the possible range of firms that may be involved in NSPO's programs. A final implication of NSPO preferences for market analysts is that they should expect there to be a combination of Taiwanese and US government entities supporting NSPO's efforts. This has myriad implications for market analysis, perhaps most notably that the presence of US government entities lowers the likelihood of other types of market actors being present in Taiwan's space sector; it is unlikely, for instance, that NSPO will collaborate with firms that are tied to governments with which the United States has a hostile relationship.

KARI's preferences have a distinct set of implications for market analysts. On the one hand, analysts should be aware that, like in Taiwan, the space agency awards contracts to both domestic and foreign firms. Any analysis that focuses purely on domestic or foreign recipients of KARI's contracts will thus be incomplete. Market analysts should also be aware that KARI does not necessarily prefer firms it contracts to have significant experience in the business areas it is developing; analysts should be aware that South Korean conglomerates like Hanwha Techwin may re-

ceive large contracts, particularly in business areas where KARI is intent on indigenizing expertise. The fact that KARI appears to prefer working with only other government entities from South Korea is also relevant for market analysts. This implies that they should not generally expect foreign government entities to play an influential role in space-sector development in South Korea. This leads to many potential analytical takeaways, one being that South Korea's space-sector development efforts may be unlikely to be influenced by foreign governments.

The final group of stakeholders to address is policy makers, for whom the findings about NSPO's and KARI's preferences also have implications. Starting with Taiwan, policy makers should question whether the distribution of contracts between domestic and foreign firms is appropriate. Should more domestic firms be awarded contracts, for instance? Policy makers can contextualize NSPO's work within larger government initiatives to make such a determination. They should also question the suitability of NSPO requiring firms to have significant experience in the business areas it is developing. Perhaps it would instead be appropriate to contract Taiwanese firms that do yet not have considerable experience, since doing so could speed along indigenization. NSPO's tendency to prefer working with Taiwanese and US government entities also has implications for policy makers. Should, for instance, US government entities continue to play such central roles? To answer this question requires policy makers to consider many other factors besides space-sector development, such as Taiwan's foreign policy.

In South Korea, KARI's preferences have implications for policy makers. Like in Taiwan, analysts should question whether the distribution of contracts between domestic and foreign firms is appropriate and ought to be changed. Policy makers should also question the appropriateness of KARI's requirements in terms of firms the agency contracts having relevant experience. Perhaps contracted firms ought to have more experience, for instance. KARI's preference to work with other government entities only from South Korea is also something worth policy makers' consideration. Should KARI take a page from NSPO's playbook and work more with government entities from other countries?

### **Implications for Research**

This article contributes to the developmental state literature because it shows that although both Taiwan and South Korea are developmental states, they have different sets of ideologies, mechanisms, and preferences. These findings generate several questions worthy of further research. Four in particular stand out with regards to gaining a better understanding of how Taiwan and South Korea go about developing their space sectors. The first question has to do with confirming whether these differences do indeed exist. More information must be collected



and analyzed to confirm that NSPO's and KARI's ideologies, mechanisms, and preferences are indeed how this article portrays them. Might it be, for instance, that KARI does in fact significantly work with foreign government entities?

A second research question worth studying, particularly if further research confirms this article's portrayals of NSPO and KARI are accurate, is why the differences exist. The literature indicates that there should be consistency between ideologies, mechanisms, and preferences. Is it possible that consistency still exists, even if NSPO's and KARI's ideologies, mechanisms, and preferences are not as anticipated? Might it be, for instance, that the differences in terms of NSPO's and KARI's mechanisms and preferences simply reflect slight differences between the two space agencies' ideologies?

A third research question this article raises is whether NSPO's and KARI's approaches to intervention have changed over time. Both space agencies are approximately 30 years old. Has the past decade differed from the first two? If there have been changes, why did they occur? Have the changes, if they exist, paralleled each other in Taiwan and South Korea, or have each changed in their own particular ways?

A fourth research question worth studying has to do with transposing this article's findings from agency-specific to government-wide analysis. There are differences between South Korea and Taiwan in terms of their overall government structures and how the space agencies are situated within these structures. It might be that Taiwan and South Korea are more similar or different than portrayed in this article if one takes a government-wide perspective. It is possible, for instance, that space-sector intervention projects are concentrated in the space agency in Taiwan but are widely dispersed across various agencies in South Korea. Looking at government-wide approaches to intervention in the space sector might identify more or less similarities between Taiwan and South Korea than are identified in this article.

Besides these four suggestions for further studies of Taiwan and South Korea, this article concludes with a suggestion for a grander area of future research: comparing space-sector development efforts by a wider variety of governments, including those in both developmental states and in regulatory states. The reason for this suggestion is that, to date, there has been little direct comparison of developmental states like Taiwan and South Korea on the one hand and regulatory states like the United States on the other. Much of the scholarship in the literature, as mentioned in the review section at the beginning of this article, is country- or region-specific. The literature has shied away from making theoretical propositions about how governments go about intervening outside of any particular empirical context.

More comparisons between developmental and regulatory states would help advance this unpursued endeavor; by explicitly comparing space agencies in the two political economy types, it may be possible to arrive at theorized propositions that can be applied to many contexts. For example, it may be possible to gain a better understanding about the relationships among ideologies, mechanisms, and preferences. Such a focus would be useful for the literature, since it would expand its relevance and allow it to begin tackling new subject matter. It would also be useful outside academia, since better understandings of space agency intervention would improve awareness of how different national space sectors are likely to develop. This would in turn give insight into how the space sector on a global level is likely to develop. More broadly still, such research would contribute to ongoing discussions about the differences between different governments' approaches to market intervention. ♣

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