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Abstract (152 words):

Since the 1990s, scholars and international organizations such as the World Bank have recognized the centrality of institutions for development. While important, this "institutional turn" has generally minimized the diversity of development challenges and the corresponding need for different institutional capacities. Yet distinguishing among developmental tasks is a critical step in understanding the kinds of institutions necessary to accomplish policy tasks. We identify five dimensions of task difficulty that affect the degree and nature of policy challenges and, as a result, the institutional capacities necessary to accomplish such challenges. We assess the utility of this framework through a qualitative analysis of two cross-national / single sector comparative cases: irrigation construction and maintenance in Taiwan versus Thailand and upgrading in the natural rubber industry in Malaysia versus Thailand. This framework constitutes a diagnostic tool for identifying areas in need of institutional strengthening, emphasizing the importance of "fit" between institutional capacities and developmental tasks.

Keywords: Developmental tasks, institutions, policy implementation, institutional capacity, East Asia, Thailand

Highlights

- Developmental tasks pose varying levels of difficulties for states.
- Those difficulties can be assessed across five attributes for each task.
- Utilizing those attributes, we provide a diagnostic tool identifying the institutional capacities needed for specific developmental tasks.
- Two empirical comparisons demonstrate the utility of the tool.

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I. Introduction

An enduring puzzle of development is variation, among as well as within states, in the ability to carry out development policies. A few states have performed well across the board (the East Asian NICs), some flounder at a majority of tasks (many in Africa, some in Latin America), and many are somewhere in the middle, exhibiting "islands of effectiveness" or "pockets of excellence" in certain areas with limited success in others (Evans, 1995; McDonnell, 2017). For instance, as described in this paper, Thailand has experienced great success at upstream agricultural production and diversification, but it is not so effective with other policy tasks that could enhance agricultural productivity, such as agro-industrial upgrading and irrigation management (Poapongsakorn, 2019; Molle, 2005). In contrast, neighboring Malaysia, which also has a historically strong agricultural industry, has been quite successful at agro-industrial development (Yusuf and Nabeshima, 2009, pp. 113-117). Why do we see this variation within and between countries?

We contend that an important part of the explanation for such differences lies in identifying the difficulties inherent to different policy tasks and the institutional capacities that "fit" these tasks. Some kinds of policies, such as managing interest rates or setting tariffs, require a high degree of technical knowledge but are "stroke-of-a-pen" measures that involve relatively few actors and thus pose few collective action problems; others, such as maintenance of irrigation canals, are technically simple but require coordinating numerous actors over long periods of time. The diversity among policy task difficulties poses distinctive obstacles requiring states and relevant stakeholders to develop appropriate institutional capacities.

We propose a framework through which to distinguish among the challenges posed by developmental tasks. It can thus alert observers as to what institutional capacities are required and where institutional reform is most critical (Andrews, 2013; Rodrik, 2004). When

positioned within an understanding of local contexts, the schema can help guide decisions as to the (local) feasibility of institutional design (e.g. public vs. private influence, types of delegation), as well as reform (Mahoney and Thelen, 2010). Should, for example, an agency be abolished and replaced in the face of pressures, such as the need to meet global quality standards or the prohibition of local contents requirements, or internal, such as inequality-inspired populism? Should new forms and functions be layered on to existing ones? Should new actors take over the agency and convert its objectives? What impact would such reforms have on levels of consultation among key actors? The goal, in sum, is to address the need to "get institutions right" (Rodrik, 2004) by identifying fits between difficult tasks and institutional capacities.

The paper proceeds as follows: Section II explores the growing sensitivity to policy-specific challenges within the broader literature on growth and institutions (i.e. the norms, rules, and organizations that govern economic transactions). Building on this literature, we propose a framework to diagnose difficulties specific to development tasks in Section III, followed by a review of the institutional capacities required to address various tasks in Section IV. This discussion generates a set of expectations that we assess in Section V through a "most-similar-different-outcome" design involving two single-sectoral, cross-national comparisons of challenges, institutional responses, and performances: irrigation construction and maintenance in Taiwan vs. Thailand, and upgrading of the natural rubber industries in Malaysia vs. Thailand. These countries share a regional context, and, as discussed below, the sectors in question – irrigation (rice) and rubber -- have been strategically important for each. In our concluding section (VI) we summarize key findings and address some weaknesses of our analysis.

II. Developmental Challenges

For decades, development experts, with rare exceptions (e.g. Hirschman, 1967), viewed the policy tasks necessary to achieve economic growth as largely undifferentiated technical challenges.[1] This began to change in the 1990s as scholars focused on stage-specific challenges of development. Naim (1994), Nelson (1999), and Grindle (2003) highlighted the need for stronger, more effective institutions, especially states, to address the challenges of second-generation reforms in areas such as education and health which lack clear policy and institutional templates, in contrast to calls for reduced state involvement in first-generation reforms emphasizing free markets and sound money (see also Andrews, Pritchett, and Woolcock, 2013). Rodrik (2003, p. 17) extended this line of thinking by arguing that achieving rapid growth in a low-income country may be quite different than the "process of reigniting or sustaining growth for a middle-income country." Inspired by growing attention to the "middle-income trap" (Kharas and Kohli, 2011), more recent scholarship pursued this distinction by distinguishing the challenges of cross-sectoral economic diversification required for movement into middle income from those of "upgrading," i.e. within-sector productivity improvement, especially by domestic firms, required for progressing to high income (Doner & Schneider, 2016).

Complementing this stage-specific analysis has been a new pragmatism in development policy that emphasizes differences among the challenges posed by development tasks (Levy, 2014). Pritchett and Woolcock (2004) demonstrate that public services can be differentiated according to the degree to which they are transaction intensive (i.e. involving multiple, ongoing interactions), and discretionary (i.e. lacking codified templates). Batley and McLoughlin (2015) expand this, arguing that specific service characteristics, such as

[1] Scholars have long recognized variation in public policies, such as that between the provision of public goods, common pool resource management, and private goods provision (Ostrom, 1990), but by and large, technical analysis overtook context-specificity in development circles (Meier, 2000).

visibility of outputs, determine the political salience of a particular service, which, in turn shapes the provision of the service. In a similar vein, Bruns, MacDonald, and Schneider (2019), demonstrate that quality reforms in education are much more difficult than quantity reforms due to political challenges often ignored in policy efforts.

Such work goes well beyond the early recognition that "institutions matter" to imply institutional implications of distinctions among policy challenges. Evans (1995), for example, hinted at the importance of tighter public-private linkages for more advanced levels of development. This emphasis on institutional networks and linkages is also found in the "national innovation systems" literature (e.g. Nelson 1993). Pritchett and Woolcock (2004) address the issue of institutional design by suggesting that policies involving extensive transactions and provider discretion of require some degree of decentralization to manage the tension between local responsiveness and state accountability. Similarly, Andrews (2013) emphasizes the ways in which the entire development policy process requires a broad range of local actor involvement in iteration and experimentation, via a process labeled "problem driven iterative adaptation" (PDIA).

Underlying these approaches is a recognition that many policies are designed to address coordination problems, a point Haggard (2018, p. 33) develops by arguing that different coordination problems require not only a range of public and private institutions and designs, but also different types and levels of institutional *capacities*, such as monitoring. One of the most explicit discussion of capacities is Grindle's emphasis on the need for "consultation, negotiation, and consensus building" to formulate policies in areas such as education reform, as well as "continual and time-consuming monitoring and capacity building…" to implement such measures (2003, p. 373). Grindle's argument in turn reflects explicit emphasis on consultation and credibility, as well as monitoring in the work of New

Institutional Economics scholars such as Williamson (1985), Ostrom (1990), and Clague (1997, p. 3) who speaks of the "institution-intensiveness" of various policies.

This article draws on key aspects of this literature to develop a diagnostic tool linking policy-specific challenges to institutional capacities, which generates testable propositions. But we also aim to push this literature further. First, we synthesize ideas from different strands of literature, recognizing that the link between policies, institutions, and outcomes is vital to understanding successful reform efforts. This is somewhat akin to the PDIA recommendations (Andrews, 2013; Andrews, Pritchett, and Woolcock, 2013), which are centered on the process of reform, but fail to provide a framework through which to distinguish among developmental tasks. Our proposed framework highlights the difficulties inherent in specific tasks which can be identified, as evidenced by applying this lens to unique challenges linked to local productivity improvement: irrigation maintenance and agro-industrial development by local firms. We also tie these challenges to institutional capacities, something omitted from some discussions of task specificity (e.g. Batley & McLoughlin, 2015). Second, unlike much of the existing literature, we test propositions linking policies, institutions, and outcomes. We do so through a cross-case ("most-similar") design that provides initial confirmation of our arguments, while highlighting the need for more extensive evaluation to address problems of excluded variables and endogeneity (issues we address in the Conclusion). Third, we go beyond acknowledging the importance of institutional capacities to explore their role in specific policies.

III. A Developmental Task Framework

Drawing from the literature, we identify five factors of task difficulty: (1) The numbers of actors required to accomplish a task, (2) The time it takes to implement the task, (3) The winners and losers from implementation, (4) The visibility of task outcomes, and (5)

The information required for effective policy design and implementation (Table 1). These features constitute the "demand" side of the institutional capacities (discussed in Section IV).

Table 1. Policy Task Difficulty Framework

	Number of Policy Actors	*Duration of Implementation*	*Distributional Consequences*	*Visibility*	*Information Requirements*
Easy	Few	Short	Costs borne by Many, Benefits enjoyed by Few	High	Codified technical knowledge Non-site specific
Difficult	Many	Long	Costs borne by Few, Benefits enjoyed by Many	Low	Tacit knowledge Site specific
Required Institutional Capacities	Monitoring	Credibility Monitoring	Credibility Monitoring Consultation	Monitoring	Consultation

Number of Policy Actors: The number of policy actors who must support and contribute to a policy's implementation serves as the first hurdle for any policy task. By policy actor, we mean an individual or agency involved in making and carrying out policy. In many cases, this means high-level bureaucrats and politicians, but in instances where a great deal of discretion is practiced during implementation, such as in education, policing, and healthcare, policy actors also include "street-level bureaucrats" whose discretion and autonomy is central to carrying out policy (Lipsky, 2010; Pritchett & Woolcock, 2004).

The "large-numbers" challenge of policy actors, then, exists in part at the policy formulation stage where multiple decision makers can constitute veto players capable of blocking appropriate policy change and flexibility (Tsebelis, 2002). But where policies require a great deal of on-the-ground discretion among deconcentrated actors (Andrews, 2013, p. 117), implementation is also vulnerable to this potential obstacle. As the number of policy actors necessary for policy action increases, so does the difficulty of the task. Among

narrow groups, information sharing and coordination is relatively simple, allowing for a room full of "smart people" to act quickly and efficiently, such as in the case of setting interest rates or tariffs. But when the incentives of a vast bureaucracy full of street level officials must be brought in line with the desires of politicians and top-level officials, coordination becomes much more difficult and opportunities for free riding increase (Lipsky, 2010; Pressman & Wildavsky, 1980).

Duration of Implementation: If a policy can be implemented overnight or within a few days or months, as in the case of macroeconomic measures, problems of coordination and collective action are more easily solved. But if the policy requires long periods of time to carry out, such as education reforms, there is a greater chance of renewed debate each budget cycle, of "policy champions" being promoted, retired or fired, and of support coalitions breaking down (Nelson, 1999). Maintaining a coherent alliance of policy supporters over an extended period takes sustained efforts and continued vigilance, and the initiators of the reform may leave office before they can reap the rewards of their work (Bruns et al., 2019). In sum, *ceteris paribus*, the risks of "time inconsistency" rise with the length of implementation.[2]

Distributional Consequences: Policies that benefit society at large or a large proportion of society do not necessarily get adopted. The logic of collective action highlights the ways in which group size and concentration, as well as distribution of benefits, conditions the politics of opposition and support (Wilson, 1995) and thus the capacities of winners and losers to engage the policy process (Grindle, 2004).

When one small group benefits from a project while a broad-based group pays for it, the project's promoters are more likely to mobilize in support, while antagonists have a

[2] By stating that short time horizons make policies easier to implement, we do not necessarily mean shorter is always better; indeed, rapid policy changes can create their own challenges.

difficult time coordinating coherent opposition. On the other hand, benefits distributed to members of small groups will be more concentrated, with each member receiving a larger proportion of the outcome and thus have stronger incentives to support the policy, however inefficient (Olson, 1965). For example, private actors, such as large contractors, can effectively coordinate their actions to lobby for targeted expenditures as in a large, albeit wasteful, infrastructure project for a specific rural region. Rural residents may join construction companies in supporting the redistribution of funds to their area, while nation-wide citizens would be unlikely to collectively oppose the targeted spending, as individually each citizen would only bear a very small proportion of the cost.

In contrast, when benefits are spread widely through society, but the costs are borne by a concentrated few, policy promoters might face strong opposition. For example, changing classroom instruction to enhance learning would primarily benefit children and parents and indirectly benefit all of society. Teachers unions, a smaller group with concentrated, immediate interests, on the other hand, might suffer from stricter standards and would likely organize to oppose such changes (Grindle, 2004). The political constraints of coalition sizes are fundamental to understanding the "political will" for any policy task.

Visibility: A highly visible task is one that is either extremely tangible, high profile, or both. Tangible tasks are those composed with "bricks and mortar" that can serve as a source of rents as well as be easily seen by constituents. This makes them more attractive for policy makers. As Nelson (1999, p. 19) writes, "Most people are more impressed with a vigorous school-building program than with organizational changes to improve supervision or the introduction of national examinations to assess the performance of schools and teachers." A visible task will receive broader support, especially in the political realm, as politicians can easily take credit for a new hospital, highway, or infrastructure project (Franzese, 2002, pp.

379-380; Selway, 2011, p. 182). They are able to hold ribbon-cutting ceremonies and post signs proclaiming, "Your Tax Dollars at Work!"

Further, by lowering monitoring costs and thus impeding free riding, task visibility facilitates collective action (Wade, 1987). In highly visible projects, it is easier to oversee bureaucrats, officials, and contractors implementing the activity. In contrast, tasks involving more incremental quality improvements, such as changing classroom teaching practices, are more difficult to implement as they are less visible to superiors as well as potential beneficiaries and the casual observer (Batley & McLoughlin, 2015; Bruns et al., 2019). Some organizations may even leverage opaque practices to hinder reform efforts (Andrews, 2013, pp. 115-116).

Information Requirements: Successfully drafting and implementing policies requires access to both technical expertise and site-specific knowledge, categories that roughly correspond to codified and tacit knowledge. Codified knowledge is easiest for states to render applicable to a developmental task, as this type of information can be found in textbooks (and blueprints) and has likely been taught to the engineers and technocrats who have specialized training to deal with their areas of expertise. Tacit knowledge, on the other hand, is typically more difficult to access, as it is based on experience and place-specific experimentation. And because it reflects local conditions, is often difficult to transfer between countries (Amsden, 2001). Further, as such knowledge often leaks out to free-riding competitors, firms may be reluctant to invest in it. Such market failures (externalities) are especially challenging for farms and firms attempting to absorb (i.e. apply and commercialize) technology and managerial practices that are both new to them and require adaptation to local conditions. Indeed, these problems are central to endogenous growth theorists' emphasis on the centrality of institutions for technological change (Romer, 1994). Here, we go further by specifying the types of information and institutions required: *Ceteris paribus,* when a policy task demands

more site-specific information or tacit knowledge, it is much more difficult – and institutionally demanding – to accomplish than tasks based primarily on codified knowledge.

Finally, it is worth noting that these difficulties rarely operate in isolation from each other. For instance, measures whose implementation requires a long time are often vulnerable to distributional pressures, as reflected in Hellman's (1998) identification of a "winners-take-all" dynamic in which those gaining from initial reform act to block subsequent shifts. Another example is education reforms involving changes in curricula and in-class pedagogy: Where teachers bear significant costs of developing new textbooks and learning new techniques, but the results of such changes are not immediately visible, the odds are stacked against such reforms (Grindle, 2004).[3] When these difficulties operate in concert, resolving them requires institutions with greater capacities.

IV. Institutional Capacities

We have argued that development policies differ in types and degrees of difficulty that constitute the "demand" for institutions. But what institutions? Our answer does not specify the nature or type of institutional participants or hierarchy. That is, we make no judgment as to the superiority of public, private, or public-private arrangements. Nor do we privilege particular types of institutional design. Instead, following the insights of the new institutional economics noted above, our emphasis is on institutional capacities – consultation, credibility and monitoring – whose optimal combination depends on the nature of the policy challenge (Doner, 2009).

Consultation: Both coordination and collective action dilemmas are contingent on the exchange of information among different parties. Effective policy requires that key actors be

[3] Regime type matters here, as authoritarian states are less likely to feel pressure from oppositional interest groups (Bruns et al., 2019).

informed of the demands of service recipients, the capabilities of line agencies, and the desires of other policy actors. Information sharing may occur through market mechanisms, but in order to ensure the broadest access to data, extensive consultation among policymakers, bureaucrats, and service recipients is often required (Evans, 1995). Capacity for consultation is also vital when dealing with groups who face concentrated costs, as the state must assess their needs and objections in order to design acceptable policy solutions.

Credibility: To achieve optimal outcomes, actors must feel assured that their counterparts will actually do what they said they would do, i.e. that they will be rewarded for doing so or sanctioned for not doing so (North, 1993). State agencies must be able to ensure their credibility to businesses, farmers, and individuals for those entities to abide by rules as well as make the often-risky investments in money and time necessary to implement policies. For example, because it is expensive and risky, companies will hesitate to invest in R&D unless they are reasonably assured that the state will help to provide complementary assets, such as new infrastructure, and protect their opportunities to benefit from positive results. Credibility also matters for tasks that take a long time to implement, such as education reforms. If the state does not have the credibility to sustain support for reform over a long period, those charged with implementation are likely to drag their feet, waiting for policy reversal.

Monitoring: Without monitoring, enforcement of credible commitment is unlikely (Ostrom, 1990). The ability of institutions to credibly reward or sanction actors' behavior depends on access to information about, and thus monitoring of, the behavior of relevant actors, whether firms, unions, farms, or public agencies. At the same time, service recipients must also be afforded the opportunity to monitor state agencies. Monitoring is the linchpin of credibility.

Monitoring is especially challenging, but important, when dealing with larger numbers of policy actors, as in an extensive bureaucracy in which street-level bureaucrats such as agricultural extension agents or vocational trainers play key roles (Pritchett & Woolcock, 2004). Centralized monitoring is difficult, so institutions might need to allow for alternative feedback methods. Similarly, when task visibility is low and implementation is drawn out, institutional capacities must be designed to overcome the propensity for bureaucratic agents to hide or disguise objectionable behavior.

Our core argument is thus that institutional forms which exhibit high levels of these three capacities will, *ceteris paribus*, bolster the ability of policy actors to address the five types of development task difficulties. The three capacities map onto our framework, with some capacities being especially important for specific task characteristics (Table 1).

V. Applying the Framework

We now turn to applications of our framework based on two single-sector cross-national comparisons: irrigation construction and maintenance (Taiwan and Thailand) and upgrading in the natural rubber industry (Malaysia and Thailand). In doing so, we capture variation between one state that has experienced relative success in a policy arena and one that has struggled to accomplish the same task.[4] The comparisons are illustrative in the sense that they allow us to show how the framework outlined above can identify difficulty levels across a variety of tasks, ranging from the fairly easy (irrigation infrastructure construction) to the quite difficult (industrial upgrading). This also highlights the need for different levels of institutional capacities across tasks. Our cases also suggest the utility of design attributes such as the nature of decentralization as well as promotion and performance incentives.

[4] This echoes Wade's (1992) comparisons of irrigation bureaucracies in India and South Korea.

Finally, we view this framework as largely diagnostic with some prescriptive implications. Ideally, it directs our attention to institutional innovations and potential space for reforms required to address specific developmental challenges. In this, we parallel Hausmann, Rodrik, and Velasco's (2008) demonstration of growth diagnostics wherein applying a single framework to multiple countries can provide lessons for policy analysis. Such lessons, when ultimately linked to local contexts, can inform the "purposive muddling" that characterizes PDIA (Andrews, Pritchett, and Woolcock, 2013).

Irrigation Capacities

Irrigation has long played a pivotal role in the agricultural sectors of Taiwan and Thailand. Historically, it was crucial to expanding rice exports and state revenues in both countries, but in recent decades, as agriculture in both countries has shrunk in economic importance, investments in irrigation continue for national (food) security and political economy reasons (Lam, 2006; NESDB, 2016). Nevertheless, the two countries exhibit significantly uneven irrigation outcomes.[5]

[5] In addition to sources cited in the text, information for the Thailand case is drawn from field research conducted in June-August 2009, January-June 2012, and September and December 2014, which included shadowing RID officials, attending RID meetings, as well as author interviews with 62 respondents, partially listed here. Interviewees in 2009 included: Irrigation Researcher, Kasetsart University; Senior Agriculture Researcher, Thailand Development Research Institute; Director, Institution of Industrial Water Resources and Supplies, Federation of Thai Industries; Director of Planning and Evaluation, Department of Groundwater Resources; Senior Irrigation Official, RID; Five Mid-level Irrigation Officials, RID; and Two District Office-level Irrigation Officials, RID. Interviewees in 2012 included: Former President, Thailand Development Research Institute; Advisor to the Minister of Agriculture and Cooperatives; Former Member of National Water Resources Committee; Director, Office of Public Participation Promotion, RID; Former Director General of the Department of Agricultural Extension, Ministry of Agriculture; Former Head of Operations and Maintenance

While both have a long history of successfully expanding irrigation infrastructure via construction,[6] the story is quite different when it comes to maintenance. Taiwan has been praised for its exemplary irrigation systems, which received efficiently ratings as high as 90 percent in the 1970s (Abel, 1975; Moore, 1989).[7] According to Levine, Ko, and Barker (2000, p. 497), "for 30 years … Taiwan's irrigated agriculture epitomized the ideal." Infrastructure is kept in good condition, and "Taiwanese irrigation management is widely admired and is perhaps the most efficient in the world" despite topography and climate challenges which could feasibly hinder good maintenance (Moore, 1989, p. 1741).

In contrast, Thailand's Royal Irrigation Department (RID) has struggled with maintenance over much of its irrigation infrastructure. Despite deploying a large workforce of over 50,000 employees through much of the 1990s, maintenance outcomes were poor relative to the likes of Taiwan.[8] Even following the 1997 financial crisis when pressure

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Group, RID; Assistant to the Vice Director General, RID; Two local Heads of Operations and Maintenance Sections, RID; Researcher, Thai Universities for Healthy Public Policies; as well as 18 additional RID officials and employees. Interviewees in 2014 included: Former Civil Service Commission Member; Irrigation Researcher, Thammasat University; Irrigation Official, Office of Public Participation Promotion, RID. A full list of interviewees, with identifying details redacted in line with IRB requirements, can be obtained from the authors upon request. The Taiwan case is drawn from secondary sources, as identified.

[6] By 2010, arable land equipped for irrigation reached over 60 percent in Taiwan and over 40 percent in Thailand. Thailand's irrigation infrastructure coverage had expanded from 1.6 million hectares to 6.4 million hectares from 1960 to 2010 (FAO, 2017).

[7] Irrigation efficiency is measured as the ratio of effective water use over the actual water withdrawal from a system. In other words, it is a calculation of how much water is used for irrigating crops rather than lost through poor management and insufficient system maintenance.

[8] The World Bank (1996, p. A39) evaluated RID's maintenance activities in two irrigation schemes, noting that despite improvements, RID maintenance was limited, and the report predicted that the "quality of agency-level [operations and maintenance] can be expected to deteriorate."

emerged to improve maintenance outcomes and enhance service provision (Abonyi, 2005), RID officials have failed to coordinate with farmers on maintenance tasks (Molle et al., 2002; Ricks, 2015). Maintenance, especially of smaller systems, has deteriorated, and the average irrigation efficiency rating in 2008 was below 50 percent (Kumnerdpet, 2010, p. 81). Although the RID performs better than some of its counterparts in the developing world, it is far behind Taiwan (Shivakoti et al., 2005).

Why has Thailand been successful at construction but struggled with maintenance? What comparative institutional lessons could Taiwan's success hold?

Construction vs Maintenance

Irrigation construction typically involves planning, designing, and building weirs, small dams, canals, and the associated water diversion points.[9] Once an agency has built an irrigation system, in order for the infrastructure to continue contributing to agricultural productivity, it must be maintained through activities such as dredging silt from canals, cleaning weeds and refuse, and repairing leaking or cracked canal walls, otherwise the infrastructure can quickly become unusable requiring new construction or rehabilitation projects.[10] A technical evaluation of these two tasks might suggest that construction requires greater institutional capacity due to financial costs and specialized engineering skills and

[9] Major dam projects built for electricity production or supplying water to cities are not considered here, as they have different constituencies and are subject to different types of policies.

[10] Most of the literature on irrigation pairs maintenance with operations. We chose to focus on maintenance alone for the sake of space. It is also important to note that both construction and maintenance share another characteristic wherein they are processes that are frequently contracted out by irrigation agencies. Decisions over construction and maintenance are made by irrigation officials who then act somewhat as project managers overseeing the internal implementation of the project or contracting a private firm to carry out the designs.

knowledge. Our framework, though, predicts that maintenance demands higher institutional capacities, which helps explains why many developing states struggle to provide adequate maintenance for irrigation systems (Huppert, Svendsen, & Vermillion, 2003).

Following our framework, infrastructure *construction* requires relatively rudimentary institutional capacities. First, decisions regarding construction can be centralized among the upper echelons of irrigation agencies, involving a relatively small number of individuals. Second, implementation is generally brief. A permanent canal structure can be completed within a matter of months, fitting easily within the planning budgets and administrative timelines of a centralized bureaucracy and limiting the number of conflicts that can occur about implementation.[11] Third, distributional benefits are generally geographically concentrated among those farmers and villages that withdraw water from a system as well as the bureaucrats and construction companies who benefit from contracts. These groups are easily organized to promote canal-building, and, in the case of construction companies, coordinate with government officials for the construction of such canals. Irrigation officials benefit from construction as they apply their skills and demonstrate their capacity, which often translates into bureaucratic promotions and increased earnings (Lam, 1998). As money for these projects comes from the national budget, the costs of the project are spread out broadly across the population and often across time, meaning that organizing an opposition to such projects involves massive mobilization and collective action costs. Thus, few voices oppose construction.[12] Fourth, infrastructure is also very visible. Politicians love projects

[11] There are exceptions, of course, such as when an entire system is being constructed, which may take multiple years to complete. Even so, construction projects, relative to maintenance, take less time to implement.

[12] Loans from international donors, like the World Bank, further reduce the propensity for opposition to these projects. While displaced people (e.g. the Assembly of the Poor in Thailand or the Narmanda Bachao Andolan

such as canals or dams, as they are clear symbol of goods provision for constituents. Construction is relatively easy to monitor; managers know exactly when the project is completed and whether it adhered to the proposed schedule. Fifth, the information requirements to build irrigation infrastructure are not complex. While permanent structures with concrete-lined walls do require technical expertise, the knowledge required is of the codified sort, easily found among engineers. It requires little investment in research or knowledge that might be sensitive to capture. Thus, the cost of obtaining the information is insufficient to deter policy actors from the task. Also, although it would be advisable to have local input about water needs, such projects can move forward without site-specific data.

In contrast, irrigation system *maintenance* exhibits characteristics that pose significant challenges. Indeed, most states chronically underperform irrigation maintenance, instead falling into the pattern of building an irrigation system, neglecting it, and then rebuilding it after it deteriorates (Huppert et al., 2003). First, organizing and monitoring large numbers of street-level irrigation officials to monitor the maintenance of infrastructure is difficult (Wade, 1992). Each local irrigation official becomes a potential weak link in the implementation chain, as bureaucratic career incentives may conflict with the requirements of maintenance tasks, with most irrigation agencies prioritizing and rewarding construction opportunities rather than the activities necessary to maintain systems (Lam, 1998; Ricks, 2016). Second, maintenance is a lengthy process. While construction has a clear start and end date, maintenance is ongoing. Decisions about the budget must be reissued each year, and, due to the nature of irrigation systems maintenance, it is easy to shortchange the maintenance budget as the effects are not immediately apparent. Third, maintenance exhibits low visibility. Effective maintenance is seen more in the absence of events than in events themselves. If a

group in India) and environmental groups have become more vocal in opposing dam projects, other infrastructure, such as smaller weirs and canal systems, face almost no resistance.

canal is properly maintained, its life is extended by many years or, in some cases, decades; a lack of rehabilitation is the sign that infrastructure has been well-maintained. Beyond this, changing weather patterns, rainfall, and seasonal fluctuations on water availability can wreak havoc on identifying an obvious and immediate benefit from effective canal maintenance. Fourth, while maintenance requires a low degree of technical knowledge, it necessitates extensive site-specific information. Street-level officials must collect data about water levels in canals, weak points, fallen trees, garbage dumping, and locations where livestock are likely to damage waterways. Such monitoring is not an easy task, and it requires deep familiarity with a local area; in many cases, it necessitates a willing and able farmers' organization inclined to work with the bureaucracy.

These four challenges, then, suggest that for successful maintenance of irrigation systems, institutions in the irrigation agency need be designed to provide substantial monitoring of street-level bureaucratic behaviors, encourage consultation with local farmers, and provide incentives to engage in long-term and low-visibility activities (see Wade, 1992).

Finally, the distributional consequences of maintenance are less clear. Costs, especially time and opportunity costs of not accomplishing other activities, are highest to both the local officials charged with visiting the field and muddying their boots as well as to the farmers who may be involved in the laborious process of cleaning canals. The benefits, though, are not immediate. Theoretically, improved maintenance would result in better water provision to farmers, higher productivity, and reduced costs to the state as the life of the system is lengthened, but such rewards only appear after an extended effort to implement the task. Improved maintenance may also diminish the irrigation agency's budget over time due to increased longevity of systems and reduced need for new construction, a very unattractive prospect for irrigation officials due to bureaucratic reward structures that privilege infrastructure projects but ignore maintenance work and collaboration with farmers (Huppert

et al., 2003). Indeed, bureaucrats often have incentives to provide poor maintenance through both skimming money from maintenance budgets as well as extorting bribes from farmers before providing adequate service (Repetto, 1986; Wade, 1982). As such, there seem to be few, if any, actors who experience a clear benefit from championing better maintenance of a system. Institutions, then, must provide the capacity for an agency to provide sufficient incentives to officials and farmers to offset individual costs of maintenance.

Our framework predicts, then, that building irrigation infrastructure is easier than maintaining it (Table 2). Institutions that focus on construction can be highly centralized, reward smaller groups of policy actors, and bear relatively small monitoring costs. In contrast, the difficulties of maintenance highlighted by our framework require institutions be designed with an eye toward consultation to identify optimal coordination, credible commitments by all parties concerned, and monitoring to provide information about the actions of relevant parties. Such organizational rules are required to ensure local flexibility and the capacity for sustaining sustained attention to these operations. We see the impact of institutional variation in the contrasting cases of Thailand and Taiwan.

Table 2. Irrigation Task Difficulties

	Number of Policy Actors	*Duration of Implementation*	*Distributional Consequences*	*Visibility*	*Information Requirements*
Construction (Easy)	Irrigation officials (Few)	Months (Short)	Costs borne by taxpayers, benefits enjoyed by bureaucrats, community, and construction firms	High	Codified
Maintenance (Difficult)	Irrigation officials, especially street-level bureaucrats & farmers (Many)	Years (Long)	Costs borne by local officials & farmers	Low	Site-specific

Institutional Capacities in Thailand vs. Taiwan

The rules and systems embedded in irrigation bureaucracies determine whether an agency can satisfactorily address the challenges highlighted above. Our focus here, then, is on the bureaucratic institutions that facilitate capacities to build and maintain irrigation systems.

Taiwan, as noted above, performs well in irrigation construction and maintenance, serving to illustrate the types of institutions that have been designed to accomplish these goals. Taiwan's irrigation bureaucracy is organized into a decentralized series of parastatal Irrigation Associations, which are further subdivided into local units. These organizations rely heavily on co-production of – and thus consultation about – irrigation maintenance activities between officials and farmers. Irrigation station chiefs are embedded in farmer communities through a series of reciprocal and dense social relationships as they are posted to particular stations for long periods of time and most of their staff hail from the local community (Lam, 1996; Moore, 1989). These relationships operate within a broader bureaucratic framework in which officials, including irrigation station chiefs and field staff, are evaluated based upon, among other things, the speed at which water user fee payments occur each year, which relies on the goodwill of farmers. A small number of unhappy farmers could drag their feet on fee payment and create real costs for officials (Moore, 1989). Of course, these associations have evolved in recent years due to economic growth, societal shifts, and national politics; yet many Irrigation Associations have maintained their institutional capacities (Lam, 2006; Lam & Chiu, 2016). In other words, the institutional design, especially the degree of decentralization and strategies of official remuneration and promotion, provides monitoring and consultation at the local level, allowing the Taiwanese state to effectively deal with both the easy task of construction as well as the much more difficult task of maintenance.

In contrast, Thailand's irrigation agency exhibits a strong tradition in expanding irrigated area with relatively limited capacities in maintenance. The Thai case, then, demonstrates how paying attention to the policy challenges of maintenance can help us diagnose the pathologies inherent in the bureaucracy that inhibit its ability to accomplish the policy task.

Thailand's RID is highly centralized, with few mechanisms designed to monitor local officials' behavior regarding maintenance. Surveillance of irrigation officials by farmers as well as consultative relationships are rare, in large part due to a history of antagonism resulting from poor treatment of farmers by the agency. Irrigation officials rotate posts relatively frequently, and few have strong links with the communities they serve, which has undermined periodic efforts to improve farmer cooperation (Molle et al., 2002). RID officials find construction projects easier and more rewarding than engagement with farmers (personal communication, March 20, 2012), and they complain that working with farmers is a "waste of time" as they receive no material benefits from the agency for such activities (RID official, personal communication, June 5, 2012). RID officials are overwhelmingly engineers, recruited and trained to deal with infrastructure construction. Indeed, the agency's promotion and pay raise structure is determined by involvement in construction projects; there is no similar recognition for maintenance work or collaboration with farmers. Most officials are incentivized to build infrastructure rather than maintain it. Central agency budgetary guidelines also prioritize relatively short-term planning horizons, disadvantaging the office handling maintenance that must consider uncertainties that arise due to the long-term nature of maintenance activities (RID official, personal communication, May 12, 2012). The RID's institutions, then, foster a focus on construction and discourage officials from engaging in the more challenging tasks of effective maintenance, especially working in conjunction with farmers.

An attempt to reform part of the RID's section of Operations and Maintenance in 2008 resulted in the creation of the Office of Public Participation Promotion (OPPP), which was supposedly designed to enhance the agency's cooperation with farmers to promote better maintenance outcomes (RID official, personal communication, March 13, 2012). The reform effort, though, did not result in improved maintenance outcomes, as OPPP staff have struggled to convince field-level (street-level) irrigation officials of the importance of working with farmers. Officials frequently resist the OPPP's offers to train them on how to work with farmers (RID official, personal communication, June 19, 2012). The office's budget was also subject to seizure, with the money redirected toward infrastructure projects, and the office struggled for over six years to obtain official status as a permanent entity in the RID (RID official, personal communication, 19 December 2014). The reforms seem to reflect an attempt at "isomorphic mimicry," wherein a reform effort was superficial, while deeper challenges were left unaddressed (Pritchett, Woolcock, and Andrews, 2013). The institutions of the irrigation agency continue to direct officials toward the construction of irrigation infrastructure rather than promoting the tasks necessary to maintain the systems.

In sum, Taiwan's Irrigation Associations are designed with a series of mechanisms allowing for monitoring of local irrigation officials by farmers and deep consultation between the two. Thailand's RID, on the other hand, is structured to provide hierarchical control of officials via a centralized system focused on agency headquarters in Bangkok. Taiwan's irrigation institutions have the capacity to effectively build and maintain systems, while Thailand's capacities address primarily construction, as outlined in Table 3.

The framework implicitly suggests institutional design choices that would be necessary for improved irrigation maintenance in Thailand. Reforms would necessitate decentralized management, embedding officials within the communities they serve so that they could access site-specific knowledge as well as be subject to monitoring by farmer

groups. Additional changes might include altering the maintenance budgetary cycle, including measures of farmer satisfaction in promotion and wage raise decisions, and reducing the incentives within the agency for construction projects (Ricks, 2015). Such alterations would be dependent on national (and local) conditions different from those of Taiwan due to context, such as the RID's historical focus on construction and the agency's political ties.[13] Even so, if reformers seek to improve irrigation maintenance outcomes in Thailand, their goal must be to develop institutional capacities to improve monitoring of local officials and consultation between these street-level bureaucrats and the farmers who both use and help maintain irrigation structures.

Table 3. Institutional Capacities for Irrigation Maintenance

	Number of Policy Actors	*Duration of Implementation*	*Distributional Consequences*	*Visibility*	*Information Requirements*
Taiwan	Decentralized monitoring by farmers & bureaucratic monitoring based on regional irrigation associations	Tolerance for long time horizons	Field offices share costs with local farmers.	Evaluation of irrigation officials includes rate of farmer fee payments.	Field-level officials embedded in local communities
Thailand	Centralized monitoring through RID	Short time horizons based on construction projects	Irrigation officials receive benefits from construction using money from the central government budget.	Weak monitoring of maintenance activities. Emphasis on construction projects.	Engineers dominate RID. Centralized rotation of irrigation officers, little collaboration with farmers.

[13] For instance, the RID had long been known to be close to politicians like former prime minister Banharn Silpa-archa, and a politically connected RID official, Theera Wongsamut, was appointed Minister of Agriculture and Cooperatives (2008-2012) before becoming head of the Chart Thai Pattana political party (2013-2018).

Industrial Upgrading in Rubber

Asia accounts for over 90% of the world's natural rubber (NR) production and exports, with Thailand the world's top producer and Indonesia, Vietnam, and Malaysia second, third and fourth respectively (Malaysia was the global leader into the 1980s). Rubber is quite important to both Thailand and Malaysia in terms of employment and revenue.[14] Yet, and this is the central focus of our analysis, the countries differ with regard to their strengths in specific segments of the rubber value chain.[15]

Whereas Thailand leads in (upstream) cultivation and processing of NR, Malaysia has pioneered key midstream product and process innovations (Rajarao, 2013; Goldthorpe 2015). Especially important for our purposes is the fact that Malaysia, led by indigenous firms, is stronger in the (downstream) production of rubber-based goods, such as tires, dipped-rubber products, especially gloves and condoms, and "hard rubber" engineering products such as seismic bearings. Malaysia is not only the world's largest producer of high-quality rubber gloves, but these products come from locally owned firms backed up by local institutions. Similarly, the world's largest condom-producing company, Karex, is Malaysian (Chen,

[14] In Thailand, some one million families (six million people) are employed in the cultivation and processing of (semi-processed) natural rubber (NR) in Thailand and some 400,000 smallholding families (one million people) in Malaysia. Rubber is Thailand's single largest agricultural export and one of the country's top export earners. The position of rubber has declined in Malaysia (from 25% of national exports in 1970, to 15% in 1980 to 5% in 2011). But NR accounts for 25.5% of Malaysian commodity export revenue. The sector has been a key source of revenue for Malaysia during recent periods of economic crisis, and the government has identified it as one of 12 "national key economic areas." See the review in Doner (2016).

[15] This chain involves 1) an upstream component in which rubber is cultivated and harvested as a raw material, 2) a midstream component in which raw rubber is collected and processed into various forms (sheets, blocks, liquid latex), and 3) a downstream component in which these intermediate goods are transformed into manufactured goods such as tires, rubber bands, shoes, engineering products, condoms and gloves.

2016). Thailand is, to be sure, one of the world's largest producers of condoms and the second largest producer of gloves, but most of this production is by foreign firms (Doner, 2016; Weerathamrongsak & Wongsurawat, 2013). Indeed, key innovations in downstream rubber-based production, such as process innovation to reduce allergy-producing proteins that threatened to kill the market for rubber medical gloves, have come from Malaysia (MRB, 2000; Goldthorpe, 2015).[16]

How then has Thailand managed to overtake Malaysia in cultivation and export of (semi-processed) natural rubber, whereas Malaysia has gone well beyond diversification to excel in productivity in downstream rubber-based products? To address this question, we first review the development challenges in these two segments. [17]

[16] Malaysia also pioneered key midstream product and process innovations (Rajarao, 2013).

[17] In addition to secondary sources cited in the text, the analysis of the two cases is drawn from author interviews in Malaysia (Kuala Lumpur) and Thailand (Bangkok). Thai interviewees in November 2015 include Director, Rubber Technology Research Center; Senior Researcher, Rubber Research Institute of Thailand; Adivsor, Minister of Agriculture and Cooperatives; Former advisor, Dept. Secretary, Ministry of Agriculture. In 2017, interviewees include President, Dr. Boo Co; Chairman, SK Polymer; Director, Panyapiwat Institute of Management; Member, Thai Latex Association; Chair, Saen Thai Rubber; Chair, Automotive Industry Club, Federation of Thai Industries; Former chair of Thai Rubber Farmers Group. 2018 interviewees include Director, Rubber Technology Research and Development Division, Rubber Authority of Thailand; Official, Thai Research Fund; former President, Michelin Siam; Manager, Eastern Polymer Group; Manager, Otani Tire; Official, S.R. Tires; Former Chai, Rubber Products Industry Club; Official, Thailand Board of Investments; Manager, Bangkok Synthetics Thailand. In 2018 and 2019, Malaysian interviewees included: Technical Director, Malaysia Rubber Glove Manufacturers' Assoc (MARGMA); Standards Director, MARGMA; former official of Malaysia Rubber Board (MRB), Technical Advisor, Khossan Rubber Industries and President, Malaysia Rubber Products Mfg. Association); Director, Doshin Rubber Products; CEO, TongYong Rubber; Former Director, Malaysian Rubber Development Corporation (MARDEC); Technical Director, MRB; Deputy

Upstream vs. Downstream Production

Increasing (upstream) output of raw rubber can be accomplished through expanding the area under cultivation and/or through increasing the amount and quality of rubber from each tree (yield). Expanding cultivation requires, among other things, ensuring property (land) rights and sufficient quantities of labor (especially tappers). Improving yields requires inputs, such as high-yielding clones, fertilizer and planting and tapping techniques, each of which depends on some level of labor quality.

Table 4. Rubber Production Task Difficulties

	Number of Policy Actors	*Duration of Implementation*	*Distributional Consequences*	*Visibility*	*Information Requirements*
Upstream Production (Moderately easy)	Policy experts (Few) Extension agents (Moderate)	Years (Long)	Costs borne by tax payers; benefits enjoyed by rubber producers	High	Moderately technical & site-specific
Downstream Upgrading (Difficult)	Industrial promotion, standards, education, and financing (Many)	Years (Long)	Costs borne by companies and tax-payers; benefits enjoyed by industry	Low	Tacit, highly technical, & site-specific

Following our framework (Table 4), these tasks involve a mixed but generally moderate set of difficulties. On the one hand, these tasks are visible and easily measured. The decisions to protect property rights and adopt high-yielding rubber varieties are both done by a relatively few policy experts. Benefits are provided to a concentrated group of rubber

Director General, MRB; Director General, MRB; Former Publications Director, MARDEC; Former Director, Technology and Engineering Division, MRB.

producers while the costs are broadly spread to taxpayers. Yet there are also some real challenges. The development of new clones involves technical knowledge and the dissemination of new inputs and techniques requires mobilizing informed extension agents to encourage a large number of often-small farmers to adopt new technologies and to obtain site-specific information. Thus, improving upstream production is a relatively easy task, but it does require a higher degree of coordination and collective action, especially among extension agents and farmers, than, say, the construction of irrigation infrastructure.

Downstream upgrading, involving the production of rubber-based products that can meet export levels of price, quality and delivery poses even greater challenges. Developing and mass-producing downstream products, such as medical gloves, tires, condoms, and automotive components, whose quality and standards certification requirements are extremely high, pose significantly greater challenges than only building a plant. To encourage high-quality productivity by domestic firms, a state must move beyond merely providing stable property rights; it must also encourage the adoption of new technology and domestic research and development (R&D), provide for experiential knowledge, reduce the risks inherent in long-term investments, coordinate across industry, as well as develop local technical personnel. The information challenges – both technical and site-specific – of identifying and applying methods new to these firms are considerable. A wide variety of personnel, including polymer chemists, geneticists, process engineers, maintenance technicians, equipment producers, manufacturing extension agents, as well as upstream producers of feedstock, need to be identified and coordinated. Implementation chains, involving the diffusion of product and process technology among local firms, are typically long and complex. Distributional costs involved in firms experimenting and sharing process and product innovations need to be addressed. Finally, the results of innovation efforts

involving absorption of technology new to the firm are uncertain and usually take time to emerge.

Through the lens of our framework, downstream upgrading requires coordination among officials involved in industrial promotion, quality standards, education, and finance, not to mention their counterparts in the private sector. Investments in upgrading involve long gestation periods of years or even decades. Although taxpayers bear some of the costs, so do the companies involved in the endeavor, creating a concentrated group that might pressure states for faster results or easier outcomes. As knowledge produced by research is notoriously difficult to protect, benefits can slip out to free riders, broadening the pool of potential beneficiaries and reducing the ability of companies involved to extract exclusive rents from the endeavor. The tangibility of upgrading also makes it difficult, as it is complicated to highlight exactly when upgrading occurs. Finally, upgrading places high informational demands in all three areas that we have identified: tacit knowledge, technical knowledge, and site-specific knowledge.[18]

In shedding light on the different challenges involved in upstream and downstream development, our framework suggests the need for different and, in many ways, stronger institutions to promote rubber-based manufactured products. The following discussion explores institutional differences between Thailand and Malaysia to account for the superior performance of Malaysian manufacturers.

Institutional capacities in Thailand and Malaysia

[18] For example, a Malaysian producer of hard rubber-based seismic bearings had no trouble accessing the core technology for such products, originally developed in Europe. But Malaysia's climactic conditions, as well as weaker (migrant) employee skills, required significant process innovations (personal communication, Kuala Lumpur, July 2017).

Institutions, as well as a larger land area, have been central to Thai success in expanding upstream production, especially through higher yields (Doner, 2016; Weerathamrongsak & Wongsurawat, 2013). One institution is the Rubber Research Institute of Thailand (RRIT), the agency responsible for developing high-yielding clones and related planting techniques. The second is an impressive network of extension services in the Ministry of Agriculture and Cooperatives, especially the Office of Rubber Replanting Aid Fund (ORRAF), along with the Departments of Cooperatives and Agricultural Extension, responsible for disseminating these techniques by working with farmers on issues such as tapping techniques and fertilizer choice and application (World Bank, 1986). Though certainly not to be minimized, these upstream successes involve relatively low and fairly stable technology, while not requiring much cross-ministry coordination.

Malaysia, whose NR yields have declined, has lost its position as global leader in NR production and export due in part to a gradual weakening of formerly impressive upstream extension services (Rajarao, 2013). That weakening in turn reflects its more limited land mass, its decision to expand cultivation of oil palm, and a shortage of rubber plantation workers due to the migration of would-be rubber tappers to the industrial sector (Ahmad, 2012).

It is in the downstream, rubber-based products that one observes the most striking institutional differences (Table 5). Here the key distinction is between Thailand's RRIT which, as noted, focuses mainly on upstream cultivation, and the Malaysian Rubber Board (MRB), which regulates, promotes and nurtures *all* segments of the rubber value chain through extensive consultation and coordination. Indeed, Thailand has, until its recently (2017) established Rubber Authority of Thailand, had no single coordinating institution designed to assist private firms with moving up the rubber value chain. Especially noteworthy are the institutions that comprise the MRB's "quality infrastructure," i.e. the

complex of institutions that directly engage firms in the process of absorbing and disseminating technology new to the firms. Of specific interest are *public testing and research centers* (PTRs) that help firms undertake "catch-up research" (Shapira, 1992). The significance of these institutions is reflected in recent findings that Malaysian manufacturers rely heavily on MRB technical advisory services for help in manufacturing operations, whereas foreign firms tend to source technology and technical assistance from parent companies or overseas partners (Goldthorpe, 2015).

Table 5. Institutional Capacities for Downstream Rubber Upgrading

	Number of Policy Actors	*Duration of Implementation*	*Distributional Consequences*	*Visibility*	*Information Requirements*
Malaysia	Malaysian Rubber Board coordinates the actors	Tolerance for long time horizons	Costs of R&D are mitigated by public testing and research centers	Malaysian Rubber Board monitors the tasks	Public testing and research centers provide R&D capacity
Thailand	No single coordinating institution	No institutional arrangement to mitigate long time horizons	R&D is driven primarily by private industry & Thai Research Fund	No monitoring of upgrading	Left to private organizations

In Malaysia, these PTRs cover a wide range of functions through some 16 laboratories and a Rubber Technology Center. These functions have been centralized within a Global Testing and Consultancy for Rubber, as part of the country's efforts to strengthen the position of the rubber value chain. Further, testing has typically involved strong coordination with the private sector, including the use of companies' facilities and coordinating with increasingly powerful producers' associations of rubber gloves and rubber engineering products (e.g. earthquake bearings). The MRB also cooperates with overseas institutions, such as UC Berkeley's Earthquake Engineering Research Center and the Tun Abdul Razak Research Centre (TAARC), a UK-based, MRB-associated facility that conducts research and testing on

downstream products, including engineering products. In sum, the MRB's success in developing a network of strong PTRs has involved its ability to coordinate a wide range of actors working to accumulate technologies new to local firms and to help these firms absorb and adapt such information.[19]

Thailand has not developed anywhere near this range and quality of PTRs (e.g. Yamamoto 2016). This weakness is not a function of ignorance as to the industry's need for upgrading. Thai officials and managers frequently exchange information and experiences with Malaysian counterparts, and Thai experts and observers have stressed "the need to change from raw rubber to value-added products" (Achara & Petchanet, 2010). There has been one persistent, but only partially successful, effort to establish testing and research facilities, the Rubber Technology Research Center (RTEC), which focuses on rubber products manufacturing industry. Despite active support by local downstream firms and their associations, these efforts remain limited and it has been a struggle to obtain systematic and robust support, financial or otherwise, from political leaders.

But these associations have remained weak for at least two reasons. First, powerful, locally based foreign producers of rubber products are uninterested in supporting domestic competitors and quality infrastructure and, are largely absent from these associations. Second, local downstream firms must contend with inter-ministerial fragmentation. The Ministries of Agriculture and Commerce are concerned primarily with the export of semi-

[19] It is important to note the dynamic nature of Malaysia's quality infrastructure. The technical competence, financial might and marketing capacities of Malaysia's rubber product producers, especially the glove manufacturers, have grown significantly over time. The resulting increase in private sector resources and autonomy has compelled the Malaysian Rubber Board to downgrade old functions, such as the provision of facilities for process improvement, and to expand others, such as R&D for higher-value added products (MRB officials, personal communications, November, 2019).

processed natural rubber, whereas the Ministry of Industry has had little interest (or expertise) in the promotion of agro-industrial goods, such as rubber-based manufactured goods, by domestic firms (e.g. Tambunlertchai, 2009). This fragmentation is reinforced by competition among political parties for control of ministerial resources. All of this results in weak consultative linkages among producers in different segments of the rubber value chain and a broader absence of planning, coordination, and follow up. Indeed, managers, officials and researchers commonly refer to official rubber product promotion plans as "a dream."

What might turn this dream into reality? Internal agency reforms are clearly needed. For example, increased training of technical personnel is required to make up for the retirement-based losses of experts from the Rubber Research Institute of Thailand.[20] But unlike in Malaysia, the key challenge involves inter-agency coordination. The establishment of the afore-mentioned Rubber Authority of Thailand (RAOT) in 2017, after years of deliberation, is designed to address precisely this fragmentation problem. Whether its achievements in downstream promotion reach anywhere those of the Malaysian Rubber Board remain to be seen given the pressure to bolster (upstream) natural rubber prices through subsidies, as opposed to the more difficult, long-term measures required to improve the capacities of local downstream producers, Much of course depends on the political backing for such institutional strengthening, an issue we address in the Conclusion.[21]

VI. Conclusion

[20] An important exception is the Rubber Technology Department in the Prince of Songkla University which has been the primary source of rubber technologists and expertise for local producers.

[21] The RAOT has initiated efforts to expand domestic consumption of natural rubber through things like the production of pillows and the use of rubber in road construction ("Ministry to propose…" 2019; "Government defends 'pillow' plan" 2019).

We have posited that developmental tasks vary according to a set of attributes influencing the challenges of coordination and collective action that in turn help to identify the institutional capacities necessary to accomplish these tasks. We have assessed this framework through cross-national performance variation in irrigation in Taiwan and Thailand and rubber production in Malaysia and Thailand. In irrigation maintenance, due to the number of policy actors involved as well as the information requirements of the task, institutions must be designed to allow for consultation and monitoring between farmers and officials. This includes creating incentives for officials to heed farmer needs and potential punishments if they do not. Such capacities (and incentives) were present in Taiwan but largely absent in Thailand. In the case of downstream upgrading of rubber product manufacturing, which faces challenges of long-term investments in R&D, high information costs, and coordination among industry actors, institutions must consult with a wide range of actors, credibly minimize the risks of innovation, and monitor producer performance. These have been key functions of the Malaysian Rubber Board, a sector-wide oversight body with no Thai counterpart.

The framework offered here provides an additional diagnostic tool for those interested in implementing policy reforms as well as researchers who study why reforms frequently fail. Andrews, Pritchett, and Woolcock (2013) have argued the necessity of changing the process of reform, using a problem-driven approach characterized by muddling through and bricolage. But such an approach necessitates tools that could inform such muddling. Our framework both draws attention to the difficulties inherent in specific policies and suggests which institutional capacities are needed to address those difficulties. Problem solvers could utilize the framework to identify next steps and institutional changes necessary to accomplish policy tasks as they engage in bricolage (Andrews, 2013). We thus provide a diagnostic tool to inform problem-driven approaches that can facilitate "getting the institutions right."

Our findings have at least two limitations, each of which suggests areas for further analysis. The first involves limitations on cross-case comparisons. The problem is the danger of assuming that we have identified all factors, i.e. those beyond institutional capacities, that contributed to performance differences. Despite the fact that our two sets of countries resembled each other in areas such as regional context and sectoral significance and experience, it is difficult to exclude the possibility that other factors affected outcomes. Such weaknesses suggest the need for analysis of additional cases and, most critically, within-case analysis that trace the temporal evolution of policies, institutions, and outcomes (Hall, 2013).

A related but separate limitation on causal inference is the endogeneity of our principal independent variable -- institutional capacities – to a range of contextual factors. This question of institutional origins suggests at least three areas for future research. One, briefly noted above and a key focus of Andrews (2013, chapter 3), is the broader institutional context in which irrigation- and rubber-specific institutions operate. What, for example, is the nature of agricultural ministries? What is the nature of linkages between agricultural and industrial agencies? A second factor has to do with the nature of politically relevant constituencies. How politically significant, for example, are rubber farmers relative to manufacturers of rubber-based products? How much influence over policy can RID officials leverage to protect the agency's focus on construction? Finally, what are the broader market and national security pressures on each country for improvement in irrigation and/or downstream rubber development? How important are agricultural exports for Taiwan's economy? Does the China market for unprocessed rubber reduce pressures on Thailand to promote the manufacture of rubber-based products?

In sum, we have provided initial evidence regarding the importance of "fit" between institutions and development tasks. In so doing, we have built on existing scholarship on stage-specific challenges, policy-specific difficulties, and institutional capacities. We have

also recognized that a more complete understanding of this issue requires attention to factors besides or in addition to institutional capacities that might account for performance differences, as well as to the factors that account for institutional capacities themselves. Indeed, recognizing variation in effective institutions prompts the need to address equally important question of where such institutions come from (see Doner, 2016; Ricks, 2017).

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