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The Politics of Productivity Improvement: Quality Infrastructure and the Middle-Income Trap.

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Abstract

The "middle-income trap" can be considered a stage of development in which firms, sectors and countries remain in low-productivity activities and dependent on foreign technology. As a result, prescriptions to escape the trap typically involve measures to help firms upgrade their processes and products through improvements in human capital (education and training), R&D, and infrastructure. This paper seeks to fill two gaps in the middle-income gap literature. First, it explores the roles of a particular type of "soft" or "quality infrastructure:" public testing and research centers (PTRs). PTRs have historically been important mechanisms through which firms upgrade. Second, the article explores why PTRs do (not) develop. The paper explores these questions through a one-sector (rubber) / two-country (Malaysia and Thailand) comparison. In explaining Malaysia's superior performance in higher value added rubber products, the paper highlights the central importance of institutional and political contexts within which such quality infrastructure is (not) built. These political considerations include the coalitional importance of specific groups within the sector (e.g. rubber farmers), the relative importance of the sector for the national economy, and options for growth without upgrading.

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1. Introduction[1]

The concept of the "middle-income trap" refers to countries caught in middle-income for an extended period of time, especially when compared to earlier developers.[2] There is general consensus that a key source of the problem involves productivity slowdowns (e.g. Agenor and Canuto, 2012: 3-5). Further, such slowdowns are, to a significant degree, the result of countries exhausting the gains from growth into middle-income through diversification.[3] This diversification into new sectors is typically based on the mobilization of capital and low-cost, low-skill labor, as well as extensive dependence on foreign technology. Two related components are usually missing from this strategy: the development of technological capacities by local firms; and linkages between foreign firms and local suppliers. The result is that middle-income countries are caught in a developmental nutcracker: "unable to compete with low-income, low-wage economies in manufactured exports and unable to compete with advanced economies in high-skill innovations..." (Kharas and Kohli, 2011: 282).

Thai scholars have shown that these features fit Thailand well (e.g. Somchai, 2012). On the positive side, the country has been "quick on its feet." Along with poverty reduction, it has achieved middle-income status by mobilizing capital and labor into new sectors and by adapting its trade and investment regimes to promote exports from these sectors (Doner, 2009). But Thai growth rates have stagnated for over almost two decades (Somchai, 2012: 14). Its growth has been derived "mainly from cheap labor" (Nonarit and Chatra, 2015) whose costs have risen relative to low-wage rivals. Having "industrialized without developing its own technology" (Somkiat and Bisonyabut, 2015: 6), the productivity of Thailand's labor now lags more advanced competitors such as Malaysia, while linkages between Thai input suppliers and Thai-based foreign producers are thin.[4] As a result, Thailand's gains from diversification have shrunk ("Specialize 'to avoid

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[1] Prepared for the Thailand Research Fund. In addition to secondary sources cited in the reference, the paper draws on interviews conducted in Malaysia and Thailand during July-August 2012, 2013, and 2014. The paper builds on a note presented at the International Workshop on "Middle Income Trap" in Southeast Asia, National Graduate Institute for Policy Studies (GRIPS), Tokyo, March 28, 2014. Some of the empirical material is drawn from George Abonyi and Richard F. Doner, "Upgrading Thailand's Rubber Industry: Opportunities and Challenges," Case study presented to the Executive Development Program (EDP), Fiscal Policy Research Institute (FPRI), affiliated with Thailand's Ministry of Finance, August 16-18, 2013, Bangkok. The paper also draws on a paper co-authored with Ben Schneider: "The Middle-Income Trap: More Politics Than Economics" (Forthcomign). I have greatly benefited from discussions with George Abonyi, Archanun Kohpaiboon, Gerald McDermott, Rajah Rasiah, Ben Schneider, Philip Shapira, and Chayo Trangadisaikul. Finally, I am grateful to Elvin Ong for research assistance.

[2] The first reference to the concept seems to have been in Gill and Kharas (2007: 17-18). The term was applied to Asia by, among others, Yusuf and Nabeshima (2009). For applications to Latin America, see references in Doner and Schneider (Forthcoming). For skeptical views, see Summers and Pritchett, and Bulman et al. (2014).

[3] On the limits to growth from diversification, see especially Imbs and Wacziarg (2003).

[4] Thailand, according to one study, ranks 66th and 34th out of 139 countries in "firm-level technology absorption" and "FDI and technology transfer," compared with rankings of 30th and 16th respectively for Malaysia (Pornthep and Winai, 2013: 48).

middle-income trap'" 2014). These conditions are especially problematic as Thai firms struggle to meet stringent product and process standards imposed by their participation in global value chains and their exposure to ever-greater competition through regional integration (e.g. bilateral FTAs, AFTA, AEC 2015) and open investment regimes. Further, the country's reliance on exports, which amount to over two-thirds of GDP, renders it especially vulnerable to market fluctuations. These problems have translated into weak income gains, persistent inequality, and political conflict (Chongvilavan, 2013).[5]

To escape the trap, scholars and practitioners have emphasized the importance of increasing productivity through three related sets of mechanisms:

1.Policies to improve education, infrastructure, savings and investment, and R&D are required (e.g. Agenor and Canuto, 2012). But such policies are difficult to implement: they require the participation of multiple actors, access to site-specific information, the capacity to manage distributional costs.

2. Institutional strength is required to implement these policies. Indeed, it is now recognized that moving to a higher stage of development requires different sets of institutions than those that worked for a lower stage (e.g. Harrison and Rodriguez-Clare, 2010). Complexes of institutions are often labeled "national innovation systems." The NIS includes a country's firms, private sector associations, government agencies, specialized financial mechanisms, and educational institutions (universities, technical training institutes and research organizations). Extensive empirical and theoretical scholarship has demonstrated that the strength and mix of these technology-related institutions, and the linkages and knowledge-flows between them, are key influences on economic performance. At a minimum, sector-specific institutions require a significant degree of cohesion and expertise.

3. Political considerations are key influences on institutions. Drawing on the success of recent high-income graduates such as South Korea, Ireland and Singapore, most studies of the trap acknowledge the need for long time horizons on the part of political leaders, which in turn require business-government collaboration and at least a degree of inclusive politics (Doner and Schneider, Forthcoming).

In this article, I focus on a particular type of institution -- "quality infrastructure" (QI) -- the complex of institutions that directly engage firms in the process of absorbing and disseminating technology new to the firms. I am specifically interested in that part of QI – public testing and research centers (PTRs) – that help firms undertake what Philip Shapira (1992) has termed "catch-up research" and Gerald McDermott has called "experiential research."[6] Developing strong PTRs can be a critical component in the efforts

[5] On earlier predictions that its fragmented production structure risked resulting in Thailand becoming a perennial unstable countries, such as the Philippines, (Doner, 2009: 288).

[6] This type of institution is also labeled "innovation and diffusion institutes (Ruingrok and Tate ,1995), or technology and innovation advisory services (Shapira and Youtie, 2013).

of Thai firms to upgrade their processes and products and to and raise Thailand's potential for moving beyond middle-income status. By assessing the benefits of PTRs, the importance of their institutional contexts, and the role of political factors in their creation, this article aims to suggest lessons for Thai firms, business associations, officials and political leaders anxious to promote sustained development.

I explore the role of PTRs through a sector-specific and cross-national analysis of the rubber sectors (or industries) of Malaysia and Thailand. This sector – understood as a value chain incorporating upstream, midstream and downstream activities, along with ancillary linkages – is an appropriate analytical focus for several reasons: First, rubber has been important to the economies of both countries. It is a significant source of employment and revenue. 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, accounting for roughly 4% of total export earnings in 2013.[7] 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 (discussed below); and the government has identified it as one of 12 "national key economic areas" in its economic transformation programme.[8]

Second, the two industries differ in significant ways. Thailand's NR production and export have now far exceeded those of Malaysia. But the Thai industry remains highly dependent on (upstream) exports of semi-processed NR. Malaysia, on the other hand, has pioneered key innovations that have raised value added throughout the rubber value chain, including value added by local firms producing (downstream) rubber products. Whereas Thailand has largely remained an exporter of NR, Malaysia's NR is consumed internally by largely locally owned rubber product producers. For Thailand, NR is a natural resource to be exported. For Malaysia, NR has become a feedstock for a more fully-integrated value chain where value added is generated and captured domestically. This is not to discount Thailand's significant achievements in rubber or the challenges facing the Malaysian industry (discussed in the conclusion). It is rather to highlight the more extensive upgrading in Malaysia's rubber industry.

This upgrading has been facilitated by Malaysia's quality infrastructure, especially testing and research facilities. Those facilities are in turn made possible by both broader institutional cohesion and pressures on political leaders to sustain the industry through long-term reforms. Together, these have resulted in Malaysia's rubber sector constituting a sort of "pocket of excellence." This is reflected in a World Bank report highlighting the

[7] After computers (8.8% of export earnings) and ahead of pick-up trucks (3.5%).
[8] See Sumormo (2012); and MRB National Rubber Statistics 2015.

fact that whereas Malaysia "is at the top of the league when measured by the share of high-tech exports to total exports, a comparison of domestic value-added to total output value suggests that Malaysia remains reliant on low- and semi-skill intensive assembly-type manufacturing . Only in a few sectors…(including) rubber…did the share of domestic value added rise" (2010: 78) [emphasis mine].

Thailand's QI is, by contrast, significantly underdeveloped in the face of institutional fragmentation. There is more pressure on the country's political leaders to support short-term fixes than to undertake more difficult upgrading measures. Specifically, with an eye to China's huge NR demand, Thailand has de facto emphasized upstream development, if only by ignoring downstream firms. Thai moves to increase value added in downstream sectors have been sporadic and short-lived. They have emerged only in the face of falling prices and supply gluts that threaten the millions of Thai farmers dependent on NR cultivation, and even then they are overshadowed by populist measures such as subsidies and price supports.

The article proceeds as follows: Section 2 first reviews the challenges required to move into high income. It then draws on cross-national research to review the operations and benefits of PTRs and to propose an explanation for why this type of infrastructure is stronger in some places than others. Sections 3-4 are the paper's empirical core. Section 3 compares the two countries' performance in rubber with regard to upgrading, and links those outcomes to the relative strength of quality infrastructure. Section 4 first reviews the characteristics of these facilities. It then explores their origins within the broader institutional and political contexts of the two countries. More specifically, I am interested in understanding the incentives facing political leaders whose support is critical for institutional strengthening. Section 5 concludes by discussing the policy implications of the comparative analysis for Thailand.

Before proceeding, I offer two disclaimers: First, my claim is not that quality infrastructure is the only variable accounting for differences between the two countries' rubber sectors. Certainly, the legacy of British rubber research has helped Malaysia. But after independence in 1957, rubber and related public institutions were the responsibility of Malaysians, not British.[9] Second, this paper is limited by the fact that research on Thai rubber institutions and the broader contexts in which they operate is relatively thin. It thus highlights the need for more rigorous accounts of the institutions that "govern" this important sector.

2. Upgrading, Technology, and the Importance of Testing and Research

2.1 Upgrading and Technology Challenges: Moving out of middle-income status, at least without access to a very lucrative commodity in consistent export demand, requires

[9] The best analytical account is Rajarao (2013). For others, see cites in Section 4.

upgrading, defined generally as the production of goods and services with increasing value added, domestic linkages, and export levels of efficiency (price, quality, delivery).[10] Such upgrading implies improvement in the ability of firms, sectors and countries to absorb, adapt and disseminate technology as reflected in, among other things, improved processes and higher value-added products. But even assuming favorable macroeconomic conditions, obstacles -- the market imperfections and failures inherent in such efforts -- are numerous, especially for developing countries. These obstacles include a lack of information about sources of technology appropriate to local contexts; the need to adopt technology to contexts different from that in which it was originally developed; the need for experiential knowledge through active, hands-on "tinkering;" large fixed costs and scale economies; long gestation periods with uncertain returns; shortage of technical personnel due to externalities (i.e. [fear of] poaching); lack of complementary goods / services (e.g. physical infrastructure); difficulties of financing, especially in the face of imperfect financial markets; short-term contracting or lack of support from principal customers; the tendency of multinationals to transfer the innovation, not the innovation process to host countries; and relatedly, the ability of multinationals to internalize technology development and absorption (Rasiah and Pietrobelli, 2012; Lall, 2000; Shapira and Youtie, 2013; Hausman and Rodrik, 2002).

These conditions are onerous for developing country firms. And even if entrepreneurial initiative does result in technological upgrading by one firm, such progress may not scale up or disseminate to the broader sector, especially to other SMEs.[11] PTRs can help local firms overcome these challenges. Indeed, they are common in successful developers, especially late developers, such as Japan, Korea and Taiwan.

Table 1. PTR Functions

Applied, contract research
Cooperative Research
Information dissemination
Equipment loans
Training and use of laboratories
Technology transfer and diffusion
Diagnostic benchmarking
Instrument calibration (metrology, verification)
Testing and inspection (comparison measurements, proficiency tests)
Certification / accreditation (ISO, HACCP)

Source: Adapted from Ruigrok and Tate (1995); Shapira and Youtie (2013); Abonyi and Doner (2013)

[10] For a more specific definition of upgrading as applied to primary commodities, such as rubber, see Section 3.
[11] SMEs "tend to lack the financial resources or personnel that larger firms may reserve for product and/or process innovation. Consequently, SME innovations tend to develop less systematically, are less controllable, and tend to depend more on individual entrepreneurial initiative" (Ruigrok and Tate, 1995:3).

2.2 Functions of Public Testing and Research Centers: PTRs facilitate technology absorption, diffusion and development in a number of ways, ranging from technology transfer from diagnostic benchmarking, to applied contract research, to instrument calibration, to testing and inspection (Table 1).[12] These functions are especially important as developing country firms, under increasing pressure to export, need to meet global standards such as the U.S. FDA's Hazard Access and Critical Control Point (HACCP) mandated for food producers, as well as specific product and process standards required in global value chains as final producers devolve greater responsibility to suppliers.

Consider the benefits of one PTR function - diagnostic benchmarking. This involves certifying the quality and accuracy of equipment used by firms and, most critically, testing to help firms meet client firms' certification and accreditation requirements with regard to product quality and other technical specifications. These functions are especially important when contrasted with the more typical process in which local firms submit products to the client for certification. Submitting products to clients for certification typically involves sending the sample back to the client's home country, whereas testing via PTRs allows local firms to save scarce time and money. Even more important, testing by clients typically result only in reports of "pass" or "fail." PTRs, on the other hand, can generate extensive information on the specific problems that led to a "fail." When combined with engineering and other technical support at a PTR, local firms can use test results as a source of learning, including from other firms' experience as well.[13]

2.3 PTRs and Successful Developers: Given these potential benefits, it is not surprising that PTRs have been ubiquitous in high-income countries, beginning with early industrializers such as Denmark, Germany, Italy, the Netherlands, Canada, the U.K, the U.S. and Japan (Shapira and Youtie 2013). First established in the late 19th century and then expanded under the pressure for industrialization in the 1930s, these institutions have been especially important in Japan, where "PTR centers for agriculture, industry, and health has (sic) been a continuous feature of modern Japanese history" (Ruigrok and Tate, 1995: 9). By 1993, some 180 industrial PTR centers were operating in 47 prefectures providing research services, testing, training, and technology assistance to enterprises with 300 or fewer workers (Ibid: 11).[14] It is noteworthy that these centers promote collective gains by facilitating inter-firm cooperation among firms in a localized industry, thereby generating knowledge spillovers among firms in the same cluster (Yamawaki, 2002).

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[12] PTRs have also been labeled Innovation and diffusion institutes (Ruigrok and Tate, 1995) or technology and innovation advisory services (Shapira and Youtie, 2013).

[13] This learning process is potentially the same process that occurs, for example, in the "failure analysis labs" of large electronics firms, such as producers of disk drives and related components Interview, FA lab engineer, Read-Rite, Bangkok (summer 1999). See also McKendrick, Doner and Haggard (2000).

[14] As an example, Shapira (1992) describes how the staff of a center conducted X-ray and laser analyses to help one firm solve a problem with its bolts that were breaking too often.

PTRs have also been important in more recent developers. Testing and certification centers in Taiwan, for example, have been key to the country's success in developing and exporting auto parts. As early as 1996, Taiwan's Metal Industrial Research and Development Center (MIRDC) gained authorization from US Certified Automotive Parts Association to measure and test auto components for export to the US. The MIRDC also helped small Taiwanese firms pass the challenging inspections and audits required to comply with the American Automotive Industry Action Group's Heat Treatment System Assessment. This allowed Taiwan's SMEs to move into higher-value added products less subject to stiff competition from China. These services were complemented by Taiwan's Automotive Research and Testing Center (Noble, 2015). In South Korea, the Korea Testing and Research Institute (KTR), which serves all fields of industry, is complemented by centers in sectors ranging from apparel to automotive, where PTRs include the Korea Automotive Testing Institute and the Korea Automobile Testing and Research Institute.[15] An important player in the growth of China's automotive industry has been the Automotive Technology and Research Center (ATARC), established in 1985 when China first opened its auto industry to joint ventures with foreign firms and now employing a staff of over 2,000.[16] Similarly, in China's giant rubber industry, centers range from the government-run Beijing Research and Design Institute of Rubber Industry, to numerous centers operated by the large quasi-private group, Chem China and MESNAC.[17]

It is important to recognize that PTRs operate through different institutional arrangements (Shapira and Youtie, 2013: 8; Doner, Noble and Ravenhill, 2015). In China, PTRs are operated by central and regional governments as well as large private firms. In Japan they are operated by local governments under a national framework. In Taiwan, they operate under quasi-governmental auspices. In England, they operate by regional private consortia with government support. But evidence suggests that whatever the specific arrangement, strong public-private engagement and inter-firm cooperation are necessary components of successful PTRs.

2.4 Explaining PTRs: If the "major rationale for public support in providing technology and innovation advisory services is market failures" (Shapira and Youtie, 2013: v), and if such market failures are ubiquitous, why do such services exist and operate efficiently in some sectors and countries but not in others? In other words, how do we account for variation in institutions that are important if not necessary for sectors and countries to move beyond middle-income status? To address this question we need to identify the factors that account for the creation and evolution of (developmentally) effective institutions.

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[15] On KTR, see www.kgtr.or.kr/eng/; For apparel, see http://www.katri.re.kr (accessed June 10, 2015). Information on automotive institutes from Doner, Noble and Ravenhill (2015: Ch. 3).

[16] Doner, Noble and Ravenhill (2015: Ch. 3); and www.tw-ita.org/about/institutes/617 (accessed June 10, 2015).

[17] On China's rubber testing and research institutions, see Rubber World, various issues.

From the perspective of neo-classical economics, there are two somewhat contradictory answers to the question of institutional origins.[18] The more optimistic perspective presumes that such institutions will emerge under the initiative of political leaders who have long time horizons and a good deal of autonomy. Such leaders are presumed to recognize that institutions, such as PTRs, are efficiency-promoting mechanisms that can generate gains from trade for interdependent firms.[19] The more pessimistic view assumes that such institutions rarely emerge because political leaders, as short-term interest maximizers who care mainly about re-election, view institutions mainly as mechanisms to generate rents and reward powerful supporters.

A more useful political economy approach recognizes both obstacles to and stimulus for the creation of effective institutions. This approach begins by recognizing that the creation of effective public testing and research centers is typically quite difficult for a number of reasons (e.g. Doner, 2009). First, the creation of such institutions requires a lot of context- and technology-specific information. There is no clear blueprint for the design of such institutions. Their creation requires bottom-up creativity by actors acquainted with the sectoral, spatial and temporal context in which potential beneficiaries operate. Such creativity typically requires "room" -- political space – to experiment, to fail, and to learn. Second, the creation and operation of such institutions involves a long and complex implementation chain that requires the participation of multiple actors -- firms (both local and foreign), academic institutions, links between academic institutions and firms, different levels of the bureaucracy. Coordinating such actors is thus a major challenge. And it is especially difficult given the fact that large players – multinational corporations – often have little interest in devoting resources to public or collective technology support services. Third and related are distributional problems. Potential beneficiaries of PTRs, small and medium sized local firms who stand to benefit from public technology support and the resulting strengthening of the indigenous supply base, are often politically weak. As a result, political leaders and officials who would have to help pay for these institutions and thus forego shorter-term benefits, will often balk at the cost of institutional creation. Fourth, creating institutions that help local firms to absorb technology and improve competitiveness lacks the kind of high visibility of, say, the successful attraction of new investments by MNCs that yield more employment and foreign exchange.

Finally, path dependence and complacency can be obstacles: The willingness of key players to pay the costs of creating effective PTRs is often undermined by prior successful development. Such success can generate foreign exchange and jobs that reduces pressure to improve local competitiveness. But it can also be a trap (Doner, 2015), resulting in arrangements, such as complacent and/or fragmented bureaucracies, that make the creation of new institutions difficult.

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[18] For a useful discussion of the schizophrenic perspective of neoclassical economics, see Evans (1995).
[19] Alternatively, some presume that institutions are not that necessary, since knowledge and innovation will disseminate through a process of competitive emulation (e.g. Pack, 2000: 87)

What factors might stimulate the "political will" and resulting bureaucratic cohesion required to create effective PTRs, despite the preceding obstacles? Some threat or crisis seems to constitute a necessary, but probably not sufficient, condition for political leaders to expend scarce resources on institutional innovation. Such threats typically involve some combination of 1) economic pressures, such as a lack of easily exportable commodities, a loss of comparative advantage in labor-intensive goods, or loss of a particular export market that leads to trade and/or foreign exchange deficits; 2) popular pressures (i.e. "contentious politics") in which regime legitimacy requires addressing demands for jobs, certain levels of crop prices, social safety nets etc.; and 3) external security concerns about national autonomy or independence."[20]

The following sections apply the preceding arguments to the Malaysian and Thai rubber industries. My interest is not to deny either Malaysia's weaknesses or Thailand's achievements in rubber. It is rather to shed light on the policies, institutions and politics through which the Malaysian rubber industry has become a more complete, innovation-based sector than its Thai counterpart. If my analytical approach is useful, it should 1) identify key performance differences, especially with regard to increasing value added at export-levels of efficiency on the basis of local initiatives; 2) show how those differences are associated with the presence / absence of innovation-related quality infrastructure, such as PTRs; and 3) show how differences in QI result from broader institutional contexts and political considerations.

3. Comparative Performance and PTRs

This section reviews rubber sector performance in the two countries and explores the roles of PTRs in these outcomes. I evaluate rubber sector performance through several metrics, beginning with purely quantitative growth in (upstream) production and exports of semi-processed NR, whether as dry rubber or latex. I then move to indicators of upgrading:[21] increased value-added through new forms of existing commodities; localized commodity processing; design and production of downstream (manufactured) rubber-based products; local linkages (local sourcing of intermediate and capital goods); and local ownership and/or involvement.

3.1 Upstream production and exports: Up through the 1980s, Malaysia led the world in NR production, accounting for roughly 40% of world NR production in 1980s compared to Thailand's share of 13% and Indonesia's share of 27% (Table 2).[22] Key to this growth were the testing and research activities by the government's overall coordinating agency

[20] This list draws on Doner, Richie and Slater (2005). For an application to the cases of Israel and Singapore, see Doner, Hicken and Ritchie (2009).

[21] These metrics are adapted from one of the few systematic framework for assessing upgrading in natural resource sectors (Gibbon, 2001).

[22] Pior to WWII, peninsular Malaysia (then known as Malaya) accounted for about 60% of world output (Sumormo, 2010a: 31).

for rubber development: the Rubber Research Institute of Malaysia (RRIM), renamed the Malaysia Rubber Board (MRB) in 1998.[23]

Specifically, the RRIM's Experimental Station at Sungei Buloh pioneered the development of high-yielding clones, subsequently adopted by other countries, including Thailand (Stifel, 1973: 126). Further, as part of the RRIM's effort to ensure appropriate clone selection, tapping systems, and other advanced practices, a government-owned company, the Malaysia Rubber Development Corporation (MARDEC), was established in 1969 with two core functions: to upgrade the quality of smallholders' rubber, and to obtain fair prices for smallholders' rubber by providing them with a stable marketing outlet through the establishment of group processing factories (Rajarao, 2013: 37).[24]

Table 2. NR Production ('000 tons)

Year	Malaysia	% share of total	Thailand	% share of total	Indonesia	% share of total
1980	1,530	40..2	501	13.1	1,020	26.8
1991	1,256	24.4	1,341	26.0	1,283	24.9
1995	1,089	17.9	1,805	29.7	1,455	24.0
2005	1,126	12.6	2,937	33.0	2,271	25.5
2010	939	9.0	3,252	31.3	2,736	26.3

Source: Global Trade Atlas, cited in Karim and Yusof (2012: 30).
Note: In 1980, the three countries accounted for 80.1% of world production; in 2010 their share had fallen to 66.6% due to the expansion of production from Vietnam, China and others.

Table 3. NR Exports ('000 tons)

Year	Malaysia	Thailand	Indonesia
2001	821	2,549	1,454
2005	1,128	2,952	2,025
2010	901	2,734	2,353

Source: Global Trade Atlas, cited in Karim and Yusof (2012: 30)

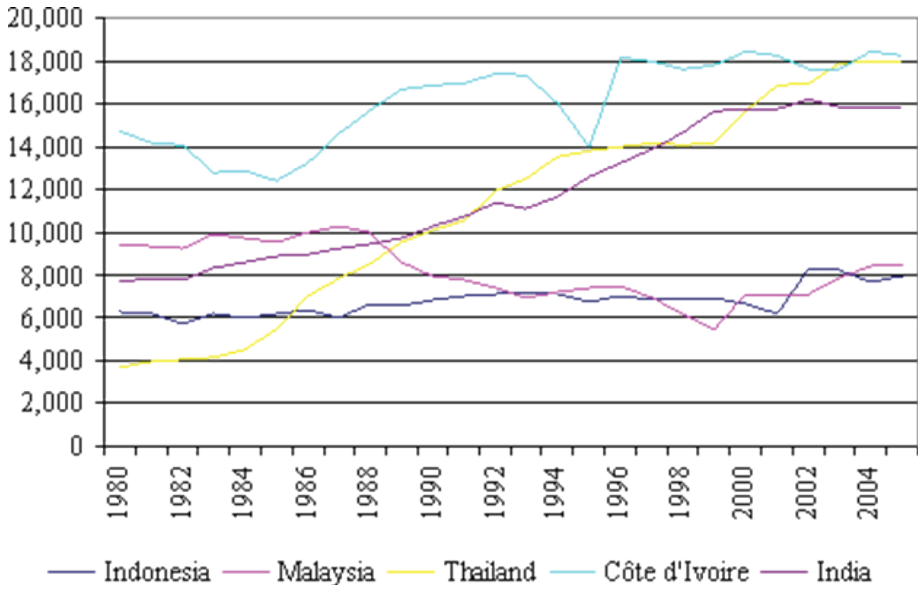
[23] The RRIM was created in 1927 by the British colonial authorities. In 1974, the RRIM came under the supervision of the Malaysian Rubber Research and Development Board (MRRDDB), an agency created to facilitate technological development in the sector. The MRRDB also oversaw the Malaysia Rubber Producers' Research Association, a London-based institution now known as the Tun Abdul

[24] Note that MARDEC worked closely with other organizations, such as the Rubber Industry smallholders Development Authority (RISDA), an offshoot of the RRIM whose goal was to help smallholders put into practice specific productivity-enhancing measures, such as the adoption of new clones (Rajarao, 2013: 35). Rubber estates (i.e. large plantations) reduced the area under NR from 348,700 hectares to only 59,600, while smallholders reduced their planted NR area from 1.49 million hectares to 0.962 million (Sumormo, 2010b 33).

Razak Research Center (TAARC), as well as a newly established Malaysian Rubber Exchange and Licensing Board whose function was to register and license rubber dealers, coordinate marketing, and co-operate with national and international agencies. To improve coordination, all of these agencies were merged into the Malaysia Rubber Board (MRB) in 1998.

Yet by 1991, Malaysia's share had dropped to third place just behind Thailand and Indonesia, and by 2010, Malaysia had dropped to a distant third behind Thailand and second place Indonesia. The export picture is largely the same, with Thailand dominating and Malaysia in third place (Table 3). Several factors account for Malaysia's decline in NR production and export volumes. One is simply the increase in Thailand's planted area. This has contrasted with the decline in Malaysia's planted areas as large estates converted acreage to other crops, especially oil palm, and to housing. Indeed, Malaysia has reduced acreage devoted to NR cultivation as part of deliberate crop diversification strategies under various Industrial Master Plans (Sumormo, 2010a: 31).[25] A related problem for Malaysia has been low Malaysian yields relative to its competitors (Figure 1; and see Sumormo, 2010a: 34). This is in part due to inefficiencies by Malaysian smallholders who account for over 90% of the country's MR (Sumormo, 2010a: 35). Further, depressed prices and labor shortages led to neglect or even abandonment of small estates by younger farmers moving to urban areas, leading to a large percentage of older, less productive farmers and trees (Mohammad and Sarjiman: 2007: 6-7; Ahmad 2012). The Malaysia Rubber Board is responding to these problems through a range of initiatives, including Automated Rubber Tapping Systems (ARTS), low-intensity tapping systems, new mechanisms to improve planting material traceability, and a chemical latex yield stimulant system (RRIMFLOW) (Sumormo, 2012).

Figure 1: NR yields in selected countries (Hg/Ha), 1980-2005



Source: UNCTAD secretariat (Data: FAOSTAT database)

[25] Rubber estates (i.e. large plantations) reduced the area under NR from 348,700 hectares to only 59,600, while smallholders reduced their planted NR area from 1.49 million hectares to 0.962 million (Sumormo, 2010b 33).

But if part of Malaysia's decline in NR production and exports resulted from internal shifts, they also reflected factors specific to Thailand. Unlike Malaysia, Thailand has had the advantage of expanding production area. In addition to the South, the traditional area of rubber cultivation which accounts for around 11 million rai (2.7 million hectares) out of a total area of around 17 million rai, the more recently developed Northeast accounts for 3 million, the East with 2 million and the North with 600,000 rai. Indeed, from 2004 to 2007, new rubber planting areas expanded at an average of over 231,000 rai/year (RRIT, 2007: Tables 22, 23). Expansion to the Northeast, Thailand's poorest region, is also politically popular, as reflected in pledges to increase rubber production in the Northeast and North by one million rai per year for several years.[26] Thailand has also historically benefited from greater access to labor than has Malaysia, although migrant workers have been critical in overcoming a labor shortage estimated as roughly 90,000 in 2006 (Preecha and Wanno, 2014).

Thailand has made effective use of these available factors by improving NR yield through improved cloning, disease control, more effective planting and efficient latex collection. Institutions, including some testing and research centers, have played key roles in this success. The key agencies have been the Office of Rubber Replanting Aid Fund (ORRAF), which leads smallholders (who account for the majority of Thai rubber production) in replanting and new cultivation, and the Rubber Research Institute of Thailand (RRIT), which helped develop new, high-yielding clones and agricultural extension services quality of inputs. These agencies, whose work was praised by the World Bank, are complemented by a dense network of extension services and cooperatives that help to disseminate new techniques and to collect various forms of NR.[27] Finally, the establishment of Central Markets by the RRIT has helped to strengthen farmers' incomes by providing timely price information.[28]

3.2 Upstream value-added through new forms of existing commodities: Two significant innovations in rubber's upstream segment have come from Malaysia's RRIM/MRB. The first and certainly the most important was the development of "technically specified rubber: (TSR), also known as "block" rubber in 1965. Traditionally, rubber was produced largely in the form of smoked sheets or, to a lesser degree as milled crepe. The quality of these forms was assessed visually, a process that had several disadvantages: Downstream customers, such as tire producers, had difficulty in knowing precisely the quality of their raw materials; smallholders, who had no means of assuring quality of their product, were exploited by dealers and traders; and the product was expensive to transport.

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[26] See for example, "Stampede to join rubber farm scheme," The Nation, Feb. 16, 2011, which describes "Hundreds of thousands of people and farmers based in the North and Northeast..." scurrying "to apply for rights to rubber farming under a government permission" (sic).

[27] A World Bank evaluation emphasized ORRAF's "careful and systematic agricultural extension work" involving close engagement with smallholders and effective monitoring (IEG, 1994: 2).

[28] Malaysian officials, struggling to offset oligopolistic market power of rubber brokers, have been eager to learn from Thailand's Central Markets (author interviews, MRB officials, October 2012).

All of these problems led to NR losing competitive advantage to synthetic rubber whose production had expanded during the Cold War.

To address these problems, the RRIM's Sungei Buloh Experiment Station, developed, piloted and tested TSR, a form of NR whose viscosity could be stabilized, whose quality could be accurately assessed based on physiochemical analysis, and which could be conveniently wrapped in standardized, polythene -wrapped bales, facilitating storage and transport (Rajarao 2013). The RRIM not only developed TSR but also demonstrated the feasibility of its production through one of its pilot plants.[29] It then became necessary 1) to ensure that the NR produced by smallholders was of high enough quality for processing into the new (TSR) form, and 2) to process this product in large volumes. Here again, a state institution - the Malaysia Rubber Development Corporation (MARDEC) – played a key role. Established in 1969, MARDEC worked with smallholders to upgrade the quality of their product to meet SMR requirements and to provide them with a stable marketing outlet through the establishment of processing factories.

3.3 Localized commodity process - midstream upgrading: Working with the RRIM, MARDEC also upgraded the country's midstream processors by taking over and transforming existing group processing centers into facilities capable of high-volume production of the new product. This required testing of the new processing methods as well as ongoing product reliability and consistency evaluation.[30] By the mid-1970s, MARDEC had 16 factories and was Malaysia's largest producer and exporter of SMR. Subsequent testing for plant accreditation has occurred has continued through an RRIM network of accredited SMR laboratories responsible for sampling, testing, grading and certifying SMR quality throughout the country. The RRIM is also responsible for calibration and reliability of test equipment (Rajarao, 2013).

This innovation was a huge success as reflected by the fact that Malaysia switched almost totally to TSR from sheet rubber by the mid-1980, by the adoption of TSR schemes by almost all other rubber-producing countries, and by its adoption by global tire manufacturers. TSR now accounts for over 70% of Malaysian rubber exports and since the mid-1980s for 50% of the world's production for the bulk of traded rubber (Sumormo 2012: 3). In response to consumer demands for ever high quality, TSR specifications are undergoing continued revisions with RRIM/MRB laboratories playing key roles in this process.[31] Indeed, as it became more dependable feedstock for the tire industry, TSR was critical in restoring the relative position of NR relate to its synthetic rival (Goldthorpe, 2009: 281; and Sadhan and White, 2001: 24) and thus a major contributor to the continued growth of NR production throughout Southeast Asia.

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[29] On the RRIM's pilot plant: author interview with former RRIM official, July 27, 2010.
[30] On the RRIM's pilot plant: author interview with former RRIM official, July 27, 2010.
[31] Malaysian laboratories, working with producers and consumers, were leading efforts in the development of processability parameter tests (Anon. 1987: 2).

This effort to increase upstream value added has continued, most prominently in the MRB's development and ongoing testing of chemically modified, specialized rubbers (Ekoprena and Pureprena) that can increase value added in processing, improve performance (better wet grip), compete more effectively with synthetic rubber, and thus offset the volatility of the NR market. Although their production levels are still modest, 12,000 tons in 2012 (Sumormo, 2012), the initiative illustrates both the effort to transform rubber from a commodity to an advanced polymer effective as feedstock for mid and downstream producers and the role of public institution in research and testing.[32]

Thailand followed Malaysia by developing its own version of TSR, known as Standard Thai Rubber. However, the process has been much slower than in Malaysia. In 1975, one study concluded that "private investment in block rubber factories in Thailand has been discouraged by the poor quality of the raw materials, the government's pessimism concerning profitability, and differential export taxes which initially discriminated in favor of sheets" (Stifel, 1975).[33] Whereas TSR constitutes over 70% of Malaysian NR exports and ribbed smoke sheets 0.3% ("Production" 2012: 5), it accounts for only 37% of Thai export revenues, with ribbed smoke sheets around 20% (RRIT data cited in TRA, 2015). Finally, based on available information, Thailand has not been in involved in the development, much less dissemination of specialty rubbers such as Ekoprena.

The key point here is that while Thai (upstream) NR production and exports far exceed those of Malaysia, higher value-added products have been pioneered by Malaysia and play a much more significant in Malaysian NR than they do in Thai NR.

Malaysia, led by Malaysian firms, has become the world's largest producer. Indeed, gloves dominate other products, including tires, accounting for almost 80% of the country's rubber product exports, in contrast to under 5% for tires (Sumormo, 2010a: 41.)

The growth of Malaysian glove exports was stimulated by demand generated by HIV/AIDS outbreak in the 1980s. But the industry was challenged in the early 1990s by the growth of latex protein allergies, especially in the U.S. The threat to this growing sub-sector prompted responses by a variety of public and private institutions with two related goals: to reduce the protein content in the actual latex (raw material); and to improve the manufacturing process. The key actor was the MRB operating both on its own, with other institutions, and with the private sector.[34] Specifically, the RRIM

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[32] As one MRB scientist noted, the catalyst for these specialized rubbers is the midstream processors (author interview, July 28, 2010). Note also that these specialized rubbers are not for tires, which typically include only 15% NR (as opposed to synthetic rubber).

[33] Stifel (1975, 640).

[34] Information on Malaysia's response to protein allergy problems in latex gloves is drawn from interviews with official of the Malaysia Rubber Products Export Council (MREPC) July 6, 2010; technical advisor to Kossan Industries (and former RRIM official), Oct. 10, 2013; officials of Malaysian Rubber Glove Mfgs. Assoc. (MARGMA), July 28, 2010; former marketing director, Hartalega, July 29, 2010; MRB 2000: 70-71; Mohammad and Sarjiman 2007: 11; and various issues of the MREPC's publication Stretch http://www.mrepc.com/stretch/pdf/2014_V8I1.pdf

* with Malaysian and Finnish universities, identified latex protein allergens;

* through its Chemistry and Technology Dept., worked on basic latex quality (e.g. vulcanization, preservation, stability;

* developed and tested equipment for a new approach to measuring the quantity of extractable proteins in NR products;

* with local glove producers and their association, MARGMA, tested, modified and adapted process technology from Taiwan designed to facilitate both continuous-chain glove production and R&D;

* with MARGA, as well as final consumers, the FDA and standards organizations such as American Society for Testing and Materials, set standards for and launch a Standard Malaysian Glove;

* established testing centers to certify the quality of SMGs;

* developed an active public-private export network, led by the Malaysian Rubber Export Promotion Council (MREPC), an agency under the MRB that operates an Outreach Advisory Service and provides research and testing advice for firms with strong export potential.

Thailand is certainly no failure in glove production. The country is the world's second largest glove producer; some Thai-based glove producers are clearly world class; and almost all Thai firms can produce low-protein gloves. However, this process has been slower than in Malaysia; Thailand tends to export in lower quality glove categories; Thailand's glove exports to major markets have been lower than those of Malaysia (Somsak, 2009: 2-15). Thailand has not developed its own equivalent of the Standard Malaysian Glove;[35] and much of the growth of Thailand's glove production occurred under foreign auspices rather than Malaysia's combination of locally owned firms cooperating with testing and research facilities.[36] Nor has Thailand done all that well with regard to dry rubber-based products. In addition to Somsak's gloomy conclusion (2009), a recent study concluded that even in tires, local Thai companies "are currently capable of manufacturing only bias ply tires, but not he more technologically advanced radial tires" (Pornthep and Winai, 2013: 58).

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[35] Author interview with manager, Thai Rubber Latex Corp., July 15, 2010.

[36] There are roughly 20 Thai glove producers, including four large firms, Top Glove (Malaysian), Casino, Ansel, and Siam Supermed, the largest firm, along with 16 or so smaller, Thai-owned producers that focus primarily on examination gloves.(Author interview with officials of Thai Glove Manufacturers' Association, July 16, 2010). Note that as of 2010, Supermed relied on Austrian technology and did not have the capacity to produce surgical gloves. However, its engineering arm, the Premier Engineering Group, was involved in equipment modification.

(author interview with production manager, Siam Sempermed, July 19, 2011). Malaysia's leading glove makers are Top Glove (22%); Supermax (10%) ; Kosan (8%); Haralega (4%); Latexx (4%); and Adventa (2%). (See "Glove Makers: Are They Overstretching?" 2010).

The weakness of Thailand's rubber products sub-sector relative to Malaysia are illustrated in the structure of each country's rubber product exports: As noted earlier, gloves account for almost 80% of Malaysia's rubber product exports, with tires under 5%. In contrast, tires comprise over 60% of Thailand's exports; latex goods, including gloves, just under 20% (Thai Rubber Association, 2015; Goldthorpe, 2009: 95).

3.5 Ownership and linkages: Both Malaysian and Thai rubber sectors exhibit dualism in rubber products, albeit to fairly different degrees.[37] A recent analysis concluded that 80% of Malaysian rubber products firms are locally owned. Foreign capital is concentrated in tire and industrial products (e.g. auto parts) production, whereas local firms dominate dipped products, especially gloves (Goldthorpe, 2009: 153), while also strengthening in engineering items, such as seismic rubber bearings. The same study found that Malaysian-owned firms used local sources of intermediate goods, such as compounding materials to a much greater extent than foreign firms but resembled their foreign counterparts in relying on imported capital equipment (Ibid. 237).

However, interviews and other materials indicate that Goldthorpe's picture is incomplete. Specifically, it seems that the development of new upstream and downstream products in Malaysia has both stimulated and benefited from a growing availability of domestically produced capital equipment. In developing TSR/SMR, for example, the RRIM purchased and promoted local produced equipment such as hammer mills and rollers, a move that reportedly spawned some 60-80 local equipment makers.[38] The need to improve the glove production process to address the latex allergy problem involved both modifying equipment, in some cases purchased from Taiwan, and developing new equipment. Firms did this in part through reliance on MRB process and testing facilities, in part through internal capacities, and in part by drawing on and helping to develop outside firms.[39]

But the more direct role of PTRs, at least with regard to promoting local production of capital equipment, is not clear. There is a government institute devoted in part to the production of agricultural equipment –the Malaysian Agricultural Research and Development Institute (MARDI), but it was only in 2014 that an agricultural machinery test center was slated to open; and its focus seems to be on food, rather than industrial crops such as rubber.[40] Thus, the impact of PTRs in Malaysia's linkage promotion seems to have been indirect.

Yet supporting industries seem to be even weaker in Thailand, although I am aware of no systematic study of the Thai rubber industry's linkage akin to Goldthope's (2009) study of Malaysia. Somsak (2009: 5) concluded that "most machinery and equipment for

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[37] Although upstream (cultivation) and midstream (processing) are largely under local control in both countries, a growing presence of Chinese processors may change this picture in Thailand.
[38] Author interview with former RRIM official (July 31, 2011).
[39] Author interview, former sales and marketing director, Hartalega (July 29, 2010).
[40] Hamid and Ahamad (2014); author interview, former MARDI official, August 1, 2011.

rubber products still have to be imported," a position echoed by Pornthep and Winai (2013: 58) who state that "the suppliers of production machinery, and molding and testing equipments (sic) all depend on imported technology."

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I have advanced two arguments in this section: First, as reflected in initially high yields, higher value added NR innovations, improved mid-stream processing, and highly developed downstream products, especially gloves, the Malaysian rubber industry has upgraded to a much greater extent and constitutes a more balanced value chain than is the case in Thailand. Second, local institutions in the form of quality infrastructure, especially testing and research centers, have been a critical contributor to these achievements. The following section turns first to a more explicit consideration of these sector-specific institutions. It then explores the broader institutional and political contexts in which they emerged.

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4. Institutions and Institutional Origins

4.1 Quality infrastructure: The Malaysian Rubber Board (formerly the RRIM) has been the critical agent in Malaysia's rubber sector upgrading. Indeed, Goldthorpe's survey found that "Malaysian manufacturers depend heavily on the technical advisory services of the MRB for help in manufacturing operations," whereas foreign firms tend to source technology and technical assistance from parent companies or overseas partners (2009: 189; see also 237). Several aspects of the MRB's merit special note.

First, its testing facilities cover a wide range of functions, including some 16 laboratories.[41] These facilities initially addressed challenges only in upstream and midstream segments. By the early 1980s, the RRIM expanded to create the Rubber

[41] Laboratories cover physical testing, tire testing, calibration, chromatography, SMR control, raws rubber, latex, agroanalytical, protein testing, spectroscopy analysis, thermal analysis, pollution control, biological analysis (www.lgm.gov.my/gtacr/) accessed June 22, 2015.

Technology Centre as part of an explicit effort to promote value added in rubber through research and testing for downstream products.[42] Second, 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. Third, as noted above, testing has typically involved strong coordination with the private sector, including the use of companies' facilities. The Technical Advisory Service (TAS) has been an important mechanism linking public and private sectors.[43]

Fourth, complementing these Malaysia-based operations has been the MRB's cooperation with overseas institutions, such as UC Berkeley's Earthquake Engineering Research Center,[44] and perhaps most critically, the Tun Abdul Razak Research Centre (TAARC), a UK-based, MRB-associated facility that conducts research and testing on downstream products, including engineering products. Finally, an indication of the role of testing is the frequent discussion of the topic in one of the MRB's major journals, the MRB Rubber Technology Developments.[45]

With some exceptions, the Thai rubber industry exhibits much less institutional strength. Expansion of upstream production, especially through higher yields, has been the main area in which extension, testing and research facilities have been important for the Thai rubber industry. ORRAF and the RRIT have been central to this process. It is significant that both of these agencies operate within the Ministry of Agriculture and Cooperatives (MOAC), which focuses largely on the upstream segments of agricultural products. As yield increases indicate, these organizations have performed quite well.[46] But there is little research and testing in support of midstream processors and, most critically, downstream rubber product manufacturers. Somsak's analysis of Thai rubber products depicts downstream firms as largely on their own.

> The extent of technology transfer from foreign investors has …been limited. Research and development activities are few and there is a lack of laboratories equipment as well as manpower for product quality inspection…Dearth of R&D in rubber product

[42] Information on the creation of the Rubber Technology Centre from interviews with Officer, Technology and Engineering Division, MRB, August 4, 2011; and Technical Advisor, Kossan Rubber Industries, August 3, 2011.

[43] The RRIM's development and testing of rollers was reportedly key for the expansion into engineering products of one of the largest Malaysian producers, Kossan (author interview with MARGMA official, August 2, 2011).

[44] The Stretch (published by Malaysian Rubber Products Export Council), 2008. 2:3, p.2.

[45] See for example Vol. 11, Issue 1 (2011).

[46] The strength of upstream efforts, especially by ORRAF, was highlighted in a World Bank evaluation. But that report also noted a number of looming problems, including the need for subsidies to rubber and consequent financial weaknesses in ORRAF; rising labor costs (estimates are that 85% of producers rely on sharetappers); frequent tapping leading to falling productive life of trees, reduced latex yield per hour of tapping, resulting in labor shortages, forcing farmers to increase the implicit wages of sharetappers (IEG, 1994).

industry. Labs necessary for R&D, product and raw material testing are still lacking… (The industry)...also suffers from lack of supporting industries (Somsak, 2009: Intro - 5).[47]

The weakness of PTRs in Thailand is not because of ignorance as to the industry's need for upgrading and quality infrastructure. Experts and observers have stressed "the need to change from raw rubber to value-added products."[48] There has also been one persistent, but only partially successful, effort to establish testing and research facilities – the Rubber Technology Research Center (RTEC), especially its affiliated Research Development Center for Thai Rubber Industry (RDCTRI), which focuses on rubber products manufacturing industry. Led by a polymer chemist and supported by both private sector associations and the Thai Research Fund, these centers explicitly view testing as a mechanism through to learn and disseminate new process and products. Despite very active support by local downstream firms, especially those in the Thai Rubber Products Manufacturers' Club (within the Federation of Thai Industries), these efforts remain limited; and it has been a struggle to obtain systematic and robust support, financial or otherwise, from political leaders.[49]

Accounting for these differences requires reviewing their broader institutional contexts, as well as the pressures and opportunities facing political leaders.

4.2 Broader institutional contexts

4.2.1: Malaysia: The MRB and its related components have historically exhibited a high degree of coordination. This is in turn a reflection of the ministry under which they operate - the Ministry of Plantation Industries and Commodities (MPIC). Despite the lack of published institutional assessment of this ministry, several notable features emerge from interviews with public officials and private firms in the rubber industry.[50]

Coordination: This one ministry overseas the entire rubber value chain.

Focus on industrial crops: The ministry treats rubber as a feedstock, a source of value added, for downstream product manufacturers.[51] Food crops come under a different ministry (Agriculture).

Public-private linkages: The ministry encourages extensive public-private coordination on issues of standards, testing, and R&D priorities. This is reflected in the

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[47] These weaknesses in the Thai rubber industry's technology transfer mechanisms are consistent with problems in the overall economy noted earlier.

[48] Achara and Petchanet, 2011. See also Somsak (2009).

[49] Author interview, founder of RTEC, Mahidol University (July 2, 2008). There are also regional centers, such as the Natural Rubber Products Technology Transfer Center at Prince of Songkla University, also focused largely on upstream improvement. Another long-time industry participant recalls spending some 10 years trying to convince various governments of the need for a testing and research center (July 13, 2008).

[50] It bears emphasis that these are very preliminary claims, based on interviews conducted during the summers of 2010, 2011 and 2012.

[51] The ministry also oversees oil palm, timber, cocoa, pepper and tobacco.

MRB's work with the glove manufacturers' association (MARGMA), as well as by the fact that many leaders in the private sector got their start working within the RRIM/MRB.

Cohesion and relative lack of political interference: Interviewees reported that the ministry (as well as the MRB) exhibited little fragmentation along sub-sectoral or ethnic lines. A related point is that the ministry has, at least until the last few years, been relatively insulated from inter-ethnic politics or rent-seeking struggles within UMNO, the largest Malay-based political organization.[52] One factor facilitating such insulation has been the government's decision to ensure expert oversight for the RRIM/MRB in the form of Consultancy Advisory Councils composed of experts from overseas as well as within Malaysia.[53] This relatively de-politicized set of arrangements is striking, if not surprising in light of two facts: 1) the upstream segment of the rubber value chain is Malay dominated whereas ethnic Chinese tend to dominate midstream and downstream segments (e.g. Goldthorpe, 2009: 153); and 2) UMNO has effectively politicized other sectors, especially autos.

4.2.2 Thailand:[54] Despite its significance as the key source of income for some one million Thai families and a key source of export earnings, the Thai rubber industry is remarkably unorganized.

Public sector fragmentation: There is no effective, high-level oversight body for rubber. This contrasts not only with the Malaysian situation but also Thailand's own sugar industry which is coordinated by the Cane and Sugar Board operating within the Ministry of Industry. Several bodies, such as a "National Rubber Authority," "Rubber Products Institute," "Rubber Board" and "National Rubber Council" have been proposed. But these have been mooted only at times of crisis, only to lose support when NR prices recover.[55] The lack of a coordinating body is further reflected in the absence of any effective sectoral planning. There have in fact been a number of "master plans" for the sector, but they are so general as to be, in the words of an official involved in the drafting of a 2004 plan, just "a dream."[56]

Fragmentation and competition among multiple ministries is one key reason for the lack of overall coordination. The most important government agency dealing with

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[52] Interviewees suggest that ethnic politics have recently led to greater politicization, as indicated by 1) the head of the MRB in 2010 was a (Malay) Member of Parliament (author interview, officer of Latex Science and Technology Unit, July 27, 2010); and 2) plans by the government-run Employees Provident Fund to close part of the MRB Research Station in Sungai Buloh and use the land for property development. See e.g. "EPF's move to develop land in Sungai Buloh will set new benchmark," The Star online, Jan 18, 2014.

[53] Author interviews with former RRIM official, July 27, 2010; official Processing and Research Unit, MRB, August 4, 2011.

[54] Unless noted, this section draws directly from Abonyi and Doner (2013).

[55] For example, an officer of the RRIT in Hat Yai called the "National Rubber Council" the "National Dream Council" (saphaa nai fan) (author interview, Jan. 19, 2009). See also author interview, professor of economics, Thammasat University and consultant to Office of Industrial Economics, May 9 2009; author interview, director of Rubber Products Division, RRIT, May 6, 2009; author interview with Deputy Sec. General, Rubber Products Manufacturers' Club and former manager of Lanxel, Jan. 22, 2009.

[56] Author interview, RETC official, July 2, 2008.

rubber, the Ministry of Agriculture and Cooperatives (MOAC), focuses largely on upstream development - farms. The Ministry of Industry, which in principle has responsibility for the downstream - factories (e.g. production of rubber-based manufactured goods), has had limited interest and involvement in the promotion of downstream rubber production to date. The Ministry of Commerce cares most about exports. The result is general neglect of potential links between downstream and upstream.

In addition to problems among ministries, there are problems of within the MOAC. The Ministry's Rubber Research Institute of Thailand (RRIT), a key source of R&D, has suffered from funding shortages and personnel gaps. Also, there has been overlap between the RRIT and ORRAF. Furthermore, there are multiple types of cooperatives – some naturally emerging, some supported by ORRAF, some supported by the Dept. of Cooperatives, and some supported by the Dept. of Agricultural Extension.

As in the case with sporadic initiatives to set up a sectoral coordinating bodies, weak NR prices have stimulated efforts to improve coordination within the MOAC by merging ORRAF, the RRIT and the Rubber Estate Organization. Such a merger got cabinet approval in 2010 after having been proposed several years earlier. It received preliminary parliamentary approval in 2012, as large protests by rubber planters in the South prompted the Prime Minister to propose more domestic use of NR, especially in road building. The proposal but was then dropped until a 45% fall in rubber prices prompted support for the merger by the military government in 2015. As of June 2015, the merger has still not been implemented.[57]

Rubber as an export commodity: The principal focus of Thai policies and institutions has been on the upstream: to strengthen and expand the cultivation and export of NR. Moves to promote NR as an industrial feedstock are as sporadic and superficial as those to create a cohesive, sectoral oversight body. Thus, only in times of crisis, such as recent declines in NR prices, have political leaders called for greater support for R&D and for efforts to link farmers and downstream producers. These moves are overshadowed by 1) a populist combination of stimulus packages, cash handouts, and $1 billion of state-supported rubber purchases, all of which contribute to fiscal deficits without encouraging productivity improvement ; and 2) measures to boost NR exports to China by support for Chinese firms establishing Thai-based processing plants and by a soft-loan arrangement under which China would provide funding for the construction of three rail lines in Thailand, with repayment to be made in-kind with rubber and rice.[58]

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[57] See "AG agencies told to shape up," The Nation, July 17, 2009; "Thai rubber agencies to merge," www.rubberjournalmalasia.com/thai-rubber-agencies-to-merge/ (Jan. 30, 2012, accessed June 25, 2015; "Angry Rubber Planters Rally to Force Gov'ts Hand," BP, August 19, 2012; and Fuller (2013). "NLA passes first reading of rubber bill," www.englishnews.thaipbs.or.th/nla-passes-first-reading-rubber-bill
Accessed June 25, 2015; and personal communication from Prof. Somsak Tambunlertchai, June 15, 2015.

[58] See for example (Achara and Petchanet, 2010; Petchanet 2014; and "TDRI proposes govt spending reform" 2015).

Unbalanced private sector organization and public-private sector links: The emphasis on upstream growth is reflected in the fact that the Thai Rubber Association, representing upstream and midstream/processing interests, along with exporters, is by far the most influential private sector rubber group. The TRA and its member firms are less focused on linkages with and upgrading of downstream rubber than with expansion of NR cultivation, processing and export marketing. Thai producers of rubber manufactured goods, such as the Thai Rubber Manufacturers' Club, are the principal source of pressure for quality infrastructure such as testing and research support.

But this group is quite weak relative to both upstream interests in the TRA and foreign tire producers. As one Club leader stated, the tire industry dominates the Club and multinationals dominate the tire industry (author interview, July 25, 2011).

Parties, factions and political interference: Rubber in Thailand has been called a "political crop" (yang pharaa baen pheut kan muang). One reason for this politicization is that rubber industry governance is heavily influenced by parties and factions maneuvering to control the MOAC and its various components. The fact that different parties typically control the MOAC, the Ministry of Industry and the Ministry of Commerce further impedes any sort of coordination among different segments. In addition, Thailand's frequent coups and constitutions make it near impossible for political leaders, much less bureaucratic officials, to adopt the long time horizons necessary for sectoral planning. In some cases, as with a bungled contract to supply rubber saplings for an expansion of NR cultivation in the Northeast, the result is outright corruption.[59]

Attributing cross-national differences in rubber-related quality infrastructure to variation in broader institutional contexts begs the question of how to explain such variation.

4.3 Political Origins of Institutional Capacities: To understand variation in institutional capacities, it is necessary to drop neoclassical assumptions that strong institutions emerge through interdependent, rational actors' recognition of the gains of trade resulting from cooperation. If such recognition was sufficient, we would presumably see all middle-income countries creating the kinds of governance mechanisms identified by agencies such as the World Bank as key to moving into high income. In fact, as Bates (1995) argued long ago, institutions themselves are collective action problems that emerge from the "rough and tumble of politics." The question then is: When does political logic encourage economic efficiency? What factors encouraged Malaysian leaders to forego immediate rents and related political advantages and instead promote a cohesive, efficient Ministry of Plantation Industries and Commodities, a Malaysia Rubber Board that has

[59] In this well-known case, the final bid for a US$ 50 million contract to supply saplings was one by an affiliate of the largest Thai agri-business firm, a company with no rubber experience but extensive political connections. The firm supplied defective saplings that were also mixed with fake sprouts. The subsequent corruption investigation found no guilty parties (see The Nation 2009, various issues).

been one of the outstanding commodity agencies in the world, and its various testing and research facilities? How are these conditions different from those in Thailand.

As discussed below, broad coalition pressures – specifically the political importance of rural ethnic Malays - were critical for explaining Malaysia's early investments in quality infrastructure in rubber. But unlike in Thailand, where the role of Thai rubber farmers continues to be critical, coalitional pressures in Malaysia have declined relative to the need for downstream growth, especially in light of the absence of non-upgrading options.

4.3.1 Coalitional Considerations:

Malaysia: Improvement of conditions for rubber farmers was a central political consideration for Malaysia after independence. Malaya's "Emergency" (1948-1960) highlighted the danger of rural unrest and the need for rubber-related revenues to finance the counter-insurgency as well as to provide income for Malay smallholders; indeed, some in the Malayan elite warned of the dangers of "a big social and political upheaval in the countryside" (Rudner, 1976: 251).[60] More broadly, it was recognized that "the survival of the rubber industry was crucial to the survival of Malaysia" (Courtenay 1984: 174). Attention to the needs of rural Malay smallholders grew with the shift from colonial rule to an elected legislature in 1955, independence in 1957, and full elections in 1959. These pressures led the Alliance government, consisting of Malay, Chinese and Indian elites – represented respectively by the United Malays National Organization (UMNO), the Malaysian Chinese Association (MCA), and the Malaysian Indian Congress – to reverse government policies supporting large estates. This shift took the form of an extensive set of programs to improve the plight of rural Malays. Strengthening rubber production was a central component in these efforts (Courtenay, 1984: 176).[61]

Pressures to address the needs of smallholders persisted well beyond independence. The incomes of the almost eight million smallholders producing rubber, as well as oil palm and rice, were well below those of urban residents. Reflecting the dissatisfaction over these urban-rural differences, in 1974 small rubber and rice farmers staged national demonstrations that "posed a challenge to the existing political order" (Rudner, 1976: 100; see also Barlow, 2010: 5). These coalitional concerns led not only to the establishment of public institutions devoted to improving smallholders welfare through research and testing in areas such as clone development. They were also direct influences on the successful development of TSR or "block" rubber. It was the real the possibility that growing supplies of inexpensive synthetic rubber would wipe out NR production and endanger the welfare of smallholders that prompted the RRIM to undertake development of TSR / "block" rubber. This product was not only critical to improving the livelihoods of Malay

[60] Although the Emergency was largely fueled by ethnic Chinese, some Malay peasants joined the communist-led insurgency in response to colonial limits on rubber planting by smallholders (Rudner 1970: 323-324).

[61] Rudner (1970: 325) notes that this new arrangement served the interests of ethnic Chinese, many of whom were involved in rubber trading and processing, without inhibiting the development of rural Malay villages (kampongs).

smallholders. It also gave rise to a vibrant midstream industry with the potential to supply growing demand from the automotive industry.[62]

This coalitional pressure has lessened significantly: As Malaysia's economy diversified, rubber has become less important for smallholders, many of whom are ageing and less willing to spend the long, difficult hours planting, maintaining and tapping rubber trees. But this has raised a further problem – namely, shortage of domestically produced NR, especially latex, required to feed the country's large and significant downstream rubber products sector. As of 2010, there were almost 60 NR processors, most of whom were operating at only 50% capacity. As a result, Malaysia has had to import 60% of latex used by its downstream producers.[63] Malaysia is also the 8th largest consumer of total rubber – NR and SR (Ang, 2010: 32; see also Goldthorpe, 2009: 82). The desire to reduce reliance on imported latex and to ensure inputs for downstream producers has prompted the MRB, through its various agencies, to develop more efficient tapping systems noted earlier.

Thailand: Although rubber cultivation in Thailand dates back to the early 20th century, it was only in the mid-1960s that Thailand laid the groundwork for its growth from a minor industry based on rubber smallholdings to become a global leader in less than 30 years.[64] One was the Thai government's hope that better rubber production would help to "eliminate widespread communist insurgency" in the country's south, the country's main rubber-growing area and the second poorest of the country's five regions (Barlow 1997: 1606). In addition, according to at least one source, global development institutions, especially the World Bank wanted to ensure a stable, growing supply of rubber as a strategic raw material.[65] The industry's growth spawned a significant political constituency of one million families who have constituted not only a key coalitional partner for the Democrat party, but an easily mobilized group whose protests in the face of NR price volatility command attention from whatever government is in power.

4.3.2 Rubber and the national economy:

Malaysia: As noted earlier, NR was a central source of foreign exchange during the first two decades following Malaysia's independence, accounting for fully one quarter of the country's export revenues. Reflecting the sector's weight, former Prime Minister Mahathir stated that in the past, the state of rubber export prices was a key consideration when officials were drawing up the national budget.[66] The industry's importance has, of

[62] Author interview with former RRIM official, July 27, 2010; Rajarao, 2013; and MRB, 2000.
[63] Author interview with official, processing and pollution research unit, MRB, July 28, 2010.
[64] The beginnings of rubber in Thailand resulted from the Siamese state's decision to construct a southern railroad line to ensure national unification in the face of British colonial expansion and the state's decision to support weak property rights in the south as a way to discourage British investments (Larsson 2008; Stifel 1973, 114-115).
[65] Emphasized by Dr. Sanit Somosorn (interview, July 14, 2008).
[66] Mahathir statement to the International Rubber Technology and Economics Conference, Petaling Jaya, Oct. 11, 2012. Export duties on rubber, tin and palm oil were key in financing government five-year plans into the mid 1970s (NEAC, 2010: 131-132)

course, declined significantly, falling to five percent of the country's exports in 2010. But the industry has remained important for at least two reasons.

First, it has been an important cushion in times of overall economic decline. As one report noted, plantation commodities, including rubber, "saved the country from global economic turmoil" after the 1997 Asian Financial Crisis (Said and Ghani, 2012: 104). What is especially important for our purposes is that this contribution resulted in institutional strengthening:: In 2003, recognizing the importance of rubber as well as other commodities, the government under Prime Minister Badawi converted the Ministry of Primary Industries into the MPIC in order to improve oversight and coordination of rubber, palm oil, and other commodities whose exports amounted to 15.9% of Malaysia's total export earnings.[67]

Second, the development of rubber-based products offers Malaysia an opportunity to move beyond a development model dependent on export markets for goods, especially electrical and electronics, whose import content is high, and primary commodities (petroleum and palm oil) whose value added is low.[68] Indeed, the Malaysian government explicitly views further expansion of rubber products as one of the key to escaping the middle-income trap, i.e. this "low-level vicious circle of competition based on costs alone…," (NEAC, 2010: 42).

Thailand: The rubber sector's overall significance for the Thai export revenues is around five percent, roughly the same as in Malaysia. While not dominant, this is a significant sum. But perhaps more important are two features of the structure of rubber exports. 1) Whereas in

Malaysia, in 2009, export earnings from (downstream) rubber products were 45% higher than earnings from (upstream) NR, (Sumormo, 2010b: 37), in Thailand, the ratios are reverse: Thai NR export earnings exceeded those from rubber products by 17% in 2009 and by 53% in 2013.[69] 2) In Malaysia, tires constituted a small percentage of rubber product export revenues (4.12%) as opposed to latex goods (83%) in 2009 (Sumormo, 2010: 41), whereas in Thailand tires accounted for roughly two thirds of rubber product revenues (TRA, 2015). The key point here is that the relative emphasis on upstream products reduces incentives to address downstream upgrading, a tendency that is only exacerbated by the fact that a predominance of downstream rubber product exports are vehicle tires whose production is dominated by large multinationals: Bridgestone, Michelin and Goodyear.

4.3.3 Alternatives to upgrading: The two countries also differ in their options.

Malaysia: At least two factors preclude the option of not upgrading the Malaysian rubber sector. First, for reasons discussed earlier (e.g. demographic changes, greater

[67] www.kppk.gov.my/index/php/about-us/profile/overview.html (accessed June 24, 2015).
[68] Petroleum – oil and gas – accounted for 40% of government revenue (NEAC, 2010: 132).
[69] For Malaysia, Sumormo (2010b: 37) – need to update data. For Thailand, TRA (2015) WWW.THAINR.COM/UPLOADFILE/20140603104512.PDF.

emphasis on palm oil), Malaysia can longer rely on exports of large volumes of semi-processed rubber, whether as dry (TSR) or liquid latex. Indeed, owing to the growth (and excess capacity) of its downstream producers, Malaysia needs its NR for domestic consumption. The country is now a major NR importer, and its export earnings from rubber products are well above those from NR. Second, as suggested above, the country is unlikely to move into high income status without moving away from a low cost-based approach to growth toward an innovation-based strategy. Recognition of the rubber sector's role in such a strategy is reflected in the government's 2010 decision (noted above) to include the rubber sector as a National Key Economic Area, i.e. a driver with the potential to help the country move into high-income status.

Thailand: Whereas Malaysia can longer rely on exports of large volumes of semi-processed rubber, whether as dry (TSR) or liquid latex, Thailand still has important avenues for expanding NR cultivation and export. First, Thailand has a human resource advantage over competitors. Thai farmers tend to engage in more diversified activities than their Indonesian and Malaysian counterparts, and they generally exhibit relatively high levels of management and technical skills.[70] Second, Thailand has the advantage of expanding production area, especially in the Northeast, which has roughly 2.65 million hectares still available for rubber production. Expansion to the Northeast, Thailand's poorest region, is also politically popular. This is reflected in pledges to increase rubber production in the Northeast and North by one million rai per year for several years.[71]

Finally, there is the continuing lure of China - the largest and fastest growing market in the world. Thailand is China's largest single supplier of NR and China is the largest market for Thai rubber, accounting for between one third to two thirds of Thai rubber exports (Table 4). The growth of China as a market for Thai rubber is striking, rising from half of Japan's total in 1999 to almost 10 times Japan's total in 2013. Equally important is the nature of these exports: China imports semi-processed Thai rubber, not rubber-based manufactured goods, a pattern that parallels the overall structure of Thai rubber exports. The key point is that large and, until recently, growing demand from China has led to complacency about upgrading by reducing pressure on political leaders to support the development of mid- and downstream sectors. Thai leaders have thus responded to weak global NR demand by efforts to bolster Chinese purchases of Thai rubber, whether by encouraging Chinese investment in Thai processing plants, or by agreeing to soft-loan arrangements for Chinese construction of railroad lines with repayments made in-kind with rubber and rice that will guarantee flow of exports at a determined value.[72]

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[70] UNCTAD Secretariat, "Marketing Structures in Malaysia, Indonesia and Thailand."

[71] See for example, "Stampede to join rubber farm scheme," The Nation, Feb. 16, 2011, which describes "Hundreds of thousands of people and farmers based in the North and Northeast..." scurrying "to apply for rights to rubber farming under a government permission" (sic). See also "Rubber industry welcomes CP involvement: Sapling Shortages curbing expansion," Bangkok Post, June 27, 2011.

[72] "Pressure on Thailand's rubber industry." Oxford Business Group, Dec. 20, 2014 (www.oxfordbusiness-group.com/news/pressure-thailand's-rubber-industry accessed June 20, 2015).

Table 4. Thai Rubber Exports by Country of Destination (metric tons)

Year	Japan	China	USA	Total
1999	509,701	243,318	236,382	1,886,339
2000	505,233	417,638	329,504	2,166,153
2001	435,453	368,114	302,174	2,042,079
2002	498,854	436,637	382,317	2,354,416
2003	542,837	650,898	278,693	2,573,450
2004	525,654	619,800	249,196	2,637,096
2005	540,485	573,385	237,858	2,632,398
2006	492,740	747,168	210,784	2,771,673
2007	405,599	827,369	312,080	2,703,762
2008	394,742	824,833	219,986	2,675,283
2009	256,894	1,160,339	156,069	2,726,193
2010	346,302	1,112,553	177,859	2,866,447
2011	333,669	1,247,188	205,410	2,952,381
2012	269.418	1,630,332	172,577	3,121,332
2013	281,091	2,075,776	145,639	3,664,941

Note: By 2003, Malaysia surpassed the U.S. as Thailand's third largest market.
Source: Thai Export Statistics, cited in Thai Rubber Association www.thainr.com/uploadfile/2015021814412.pdf

Table 5. Summary Comparison: Malaysia – Thailand

Innovations	**Malaysia**	**Thailand**	**Outcomes / Performance**
Upstream: raise yield	1. clones (1st mover) 2. effective ag. ext. 3. automated tapping, low-intensity tapping, gas stimulant (success?)	1. clones (follower) 2. effective ag. ext. .gas stimulant (follower)	Malaysia: leader in yield, production and export until mid 1980s. Thailand: subsequent and consistent leader
Upstream: new forms of NR	1. TSR (1st mover) 2. ekoprena, purprena	1. TSR (follower)	Malaysia: TSR majority of NR production (very low RSS). Thailand: slower to adopt TSR, TSR still accounts for minority (37%) of Thai NR exports (RSS 20%).
Midstream	1. TSR process and related equipment	1. TSR process (follower)	See above

Innovations	Malaysia	Thailand	Outcomes / Performance
Downstream: dipped rubber products engineering products	1. low-protein gloves: product and process innovation	1. follower	Malaysia: rubber product exports dominate NR exports. majority of NR consumed domestically. global leader in glove exports; gloves (largely from Malaysian firms) account for majority (80%) of rubber product exports vs. (foreign-owned) tires (5%) Thailand: NR exports larger than rubber product exports. tire exports larger than rubber products.
QI/PTRs	Strong: MRB labs, research center; MARDEC	Weak: RRIT	
Broader inst context	Public: Cohesive oversight by Min of Plantation Commodities; fairly insulated from politics (until now?)	Public: Fragmented oversight; bureaucratic rivalry; poltiiczation:	
	Private: Strong, cohesive, locally controlled downstream assocs.	Private: Fragmented; upstream / exporters dominate overall; MNCs dominate downstream assocs.	
Politics: Challenges / Options	Rural Malays initially critical; now less important. But rubber product exports important for economy. Exports not option.	Rural Thais still critical. NR exports important for economy. China attractive, key market for NR.	

5. Conclusions and Implications

The analysis has emphasized the ways in which testing and research institutions have contributed to the innovations and upgrading of Malaysia's rubber industry, the importance of the broader institutional context, and the political factors on which these strong institutions have been built (Table 5). This favorable picture of the Malaysian rubber industry relative to Thailand is not meant to minimize the problems now facing Malaysian rubber. These include shortages of latex due in part to low yields; weak domestic supply of dry rubber; reliance on imports and foreign technology for synthetic rubber; labor shortages and high energy costs for dipped rubber product producers; and weak supply of rubber-based auto parts due to low efficiency, poor quality and high price. Although the industry's impressive development means that the private sector's role in addressing these problems has grown, public and public-private sector institutions will remain important. And yet, there are significant concerns that the MRB and related institutions have been weakened by two factors: One is what seems to be growing political influence over the institutions that coordinate rubber. The other is the weakening of technical expertise with the retirement of British-trained experts.[73]

These looming challenges do not detract from the reality that public and public-private facilities for testing and research have been necessary components in the upgrading of Malaysia's rubber value chain. Acknowledging the fact that Thailand differs from Malaysia in multiple respects (e.g. persistence of a large upstream workforce, access to land for an expansion of NR production, more fragmented but less ethnically divided political system, greater proximity to the Chinese market), what lessons can Thailand draw from the Malaysian experience?

The obvious lesson is that the development of a more balanced rubber value chain through linkages between up- and midstream producers with more developed downstream rubber product manufacturers will not occur without quality infrastructure, including PTRs such as the fledgling Rubber Technology Center. And such QI will not develop in the absence of some high-level coordinating body able to overcome the combined dominance of upstream Thai interests and downstream multinationals. But as documented in this article, such efforts have been made and, at least up to now, have fallen short. A constructive set of alternatives will have to aim for a second best solution, one that takes into consideration the continuing lure of the China market even as it recognizes that, at least as far as rubber is concerned, Thailand will not escape the middle-income trap without avoiding the China trap. The approach will also have to acknowledge the entrenched power of the upstream firms and exporters, and the fragmented political system that favors short-term populism over long-term and less politically visible and beneficial upgrading efforts.

All of this suggests the benefits of an incremental approach designed to build up the economic and political leverage of downstream Thai firms and, in turn, institutions that can strengthen their capacities. And in fact, such an incremental, somewhat low-level approach, might

[73] For a review of these problems, see Doner (2012). On the weaknesses of rubber-based auto parts, see www.lgm.gov.my/whatsnew/MRB-DownstreamTAS.pdf

be politically palatable at a time when, in the absence of "high-level" reforms, such as major constitutional revisions, leaders seek to implement reforms that are likely hold up regardless of how the more politically charged issues play out. Such an approach might consist of the following, presented in order of their priority.

Adopt a narrow product and PTR focus: Focus on setting standards and testing / research around a small number of specific rubber products with the potential to tap into the country's automotive demand. Two obvious possibilities would be motorcycle tires, especially inner-tubes, and rubber hoses. These are issues on which to build relationships with well organized automotive associations.

Establish a small-scale coordinating body: Support for standards and testing in a small number of products requires coordination among representatives from the Ministries of Agriculture, Industry and Commerce, as well as from TISI and the Rubber Research Center. The goal here is to set up a low-level body capable of both "flying under the radar" relative to the more lucrative and high-profile activities of the MOAC. It may also be useful to learn from other sectors, such as food processing, in which such coordination seems to occur. Bring in an active participant from one of these sectors as an advisor. It may also be useful to include as participants local firms belonging to the Thai Auto Parts Manufacturers' Association as well as the Thailand Automotive Institute. And finally, mid-level participation from the NESDB might be helpful for strengthening the voice of downstream interests.

Identify and incorporate independent public actors: At least two organizations, the NESDB and the Thai Research Fund, can play roles of honest brokers. The TRF, with its extensive support for rubber upgrading, can be especially important.

Redirect and restructure a small part of the CESS: At present, the CESS is controlled by the MOAC and largely used for upstream improvement. It would probably be politically impossible to take the CESS away from the MOAC and use it for downstream-related activities such as research and testing. To avoid running up against political opposition, the best option would be to put a small a small percentage of the CESS into the hands of the small-scale coordinating body as a sort of pilot exercise to demonstrate proof of concept. Further, if rubber product producers opposed to having the CESS used for downstream development, consider alternatives. Perhaps transform part of the CESS into an export refund, albeit one that is more user-friendly than the present arrangement seems to be.

Strengthen FDI promotion: Thailand has traditionally been weak in encouraging technology spillovers from foreign firms. Given rubber's lower technological and capital entry barriers relative to electronics or autos, it would be helpful to focus BOI efforts on promoting spillovers for a particular set of rubber products. Such efforts would be combined with efforts to expand the quality infrastructure necessary to strengthen local firms' capacity for technology absorption. An emphasis on QI might be especially attractive to the BOI as a key part of its recent focus on developing Thailand as HQ and R&D center. Use Chinese investments to build clusters: Under a coordinating committee, a strengthened BOI might push Chinese investors to support locating rubber

product producers in proximity to newly established rubber processing facilities, especially in the North and Northeast.

Strengthen local firms in downstream associations: Despite ostensibly equal representation, foreign firms tend to dominate downstream associations. It may thus be necessary to establish either separate groups devoted to local firms or to establish sub-committees run by local firms, supported by the coordinating committee. This is a very charged issue in light of recent battles within the FTI. It therefore might be useful to bring the Board of Trade into the discussion, given the that the Board's strong export orientation.

Draw on foreign expertise and oversight: Consider following Malaysia's practice of establishing Consultancy Advisory Councils composed of foreign technical experts from overseas as well as within Thailand. The objective would be to draw on foreign expertise delinked from the specific interests of multinationals operating in Thailand. Given its recognition of the need for upgrading, it would be useful to draw on more active support from the World Bank.

The assumption underlying these proposals is that reform and upgrading in the Thai rubber industry is at least in part a political endeavor. It requires building up new interests, and restructuring the challenges and opportunities facing Thai leaders.

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