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Epilogue: implications for promoting firm-level technological capabilities

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This conclusion draws theoretical and policy implications for technological capability building from the host-site institutional support and production linkage experiences in China and Southeast Asia. While connecting with production chains have been instrumental in the integration of developing sites in global markets, sites that managed upgrading from low to high value-added activities in the automotive, clothing and semiconductor industries relied strongly on institutional support at host sites. Hence, the global value chain approach is useful in understanding integration in the capitalist world economy. However, only sites with effective industrial policy successfully transformed subsequently to designing and R&D activities.

Keywords: host-site institutions; regional linkages; technological capabilities; value chains

The extant literature on technology and innovation has focused strongly on firm-level variables, such as firm characteristics and organization, while leaving external influences into a black box in explaining technical change (cf. Acs and Audrestch 1988). While there is also a dearth of works that explains government policies under the rubric of industrial policy to explain technological catch up and leapfrogging in particular industries (e.g. Gerschenkron 1952; Abramovitz 1956; Johnson 1982; Amsden 1989), they tend to be based on broad-based approaches rather than on firms’ assessment of external influences. Some have captured technological catch up through the lenses of institutional change by casting a wide net screening innovation systems (Nelson 1993; Malerba and Nelson 2012). However, while attempts have been made to integrate firm-level observations with the broader industrial and institutional analyses, few works have actually examined institutional structures from the lenses of firms; especially, they have manifested on the ground in general on firm-level technological capabilities specifically. This link is important especially in the face of neoclassical works that claim that markets shall attract efficient allocation responses by firms (Dollar 1992), which inevitably dismiss any active role by governments to address collective action problems, especially in the delivery of public goods and utilities. It is in this light that a range of articles were prepared taking account of the need to understand firm-level technological capability development against host-site institutional support and regional production linkages. While the former addresses the critical element of interventions essential in supporting R&D as argued by Schumpeter (1942), the latter addresses the influence of integration in import and export markets to stimulate firm-level technological upgrading.

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Two different methodological approaches were adopted owing to the specificity of industry and the type of access researchers enjoyed to data. Nevertheless, the findings have been somewhat methodology neutral as they are not partisan to either the quantitative evidence or the qualitative evidence. The empirical evidence offers support for the positive influence of both host-site institutional support and global, regional and domestic production linkages on firm-level technological capabilities in the automotive, clothing and semiconductor industries.

We first summarize the findings by the type of industry in this article, namely, automotive, clothing and semiconductors. The subsequent section is devoted to drawing implications for theory before an attempt is made to draw implications for government policy.

Automotive

Host-site institutional support has been important in firm-level technological building in the automotive firms in China and to some extent in Indonesia and Thailand. In addition to the rapidly growing large domestic market, central, provincial, municipal and county governments have also played important roles to stimulate clustering among firms and critical meso-organizations, such as universities, and designing and training centres in China. Also, the introduction of incentives and grants has stimulated technological capability building in automotive firms.

Because of massive integration in global markets, China’s trade linkages show a strong influence from connecting to global value chains – initially FDI inflows and imports and since 2000 also exports. Furthermore, as Li, Kong and Zhang have argued, connecting to global value chains has helped knowledge flows for the upgrading of China’s national firms, which the government has subsequently leveraged to step into designing and R&D activities through collaboration with universities and designing centres. While global value chains have assisted national firms by providing the initial foundations, the subsequent upgrading into designing and R&D activities have benefited considerably from the government’s efforts to build linkages with research universities and designing centres and the provision of financial incentives and grants.

The supplier capabilities developed during the localization periods in Indonesia and Thailand have been utilized well since liberalization began in the 1990s and 2000s, respectively. As explained by Intarakumnerd and Kriengkai, The Thai Automotive Institute has played a key role in carrying out designing work and R&D through collaboration with universities, national firms and MNCs, which has helped national firms to strengthen their in-house designing and R&D capabilities. While intermediary organizations have not been very dominant in Indonesia, Rasiah, Shahrivar and Amin show that coordination links between MNCs and national firms through the automotive association has been important in the development of local models by MNCs, and quality and precision upgrading among national and joint-venture suppliers in Indonesia. The availability of management and technical personnel produced by Indonesian and Thai institutes have also been important in this upgrading process.

The Indonesian and Thai experiences by Rasiah, Shahrivar and Amin, and Intarakumnerd and Kriengkai, respectively, reinforce the significance of host-site institutional support in dealing with the promotion of upgrading from low to high value-added activities. Integration in regional production linkages helped provide the scale, scope and access to knowledge flows through imports and exports in both countries. However, the national and joint-venture suppliers who ventured on their own to undertake new product
development in Thailand through the MNC buyer route hit a dead end. In fact, the contacts of the few firms that chose to independently develop their own branded parts using external sources of knowledge were terminated by their Japanese buyers. Hence, as Intarakumnerd and Kriengkrai explain in their article, not only that national firms’ door to Japanese buyers on frontier technologies were closed, but also they lost their links with Japanese buyers once they developed their own branded parts. Hence, the evidence suggests that governments should strengthen institutional support if they wish to see their national firms upgrade to reach the technology frontier.\(^1\)

However, as is typical of feeble and bad industrial policies in general, the contribution of Ofreneo shows that mistakes have undermined the role of institutional support in stimulating technological upgrading among national assemblers, and parts and components suppliers in the Philippines. Whereas the Philippines has been derailed by a series of government failures that has caused chronic negative deindustrialization in the country, the government still has the opportunity to correct the mistakes and take advantage of rapid industrial growth in the country to promote the automotive industry.

The Philippines has also benefited from integration into regional value chains, though the latter has yet to appropriate significant export synergies from automotive production. Also, the lack of effective industrial policies to strengthen the essential institutional support instruments has discouraged technological capability building in national firms in the country.

**Clothing**

The clothing industry in China, Laos and Myanmar has grown and enjoyed technological capability upgrading considerably since 2000. China took advantage of its huge domestic market and labour force to account for 37.8% of world exports of clothing in 2012 (WTO 2013). Although China has yet to break into the use of own brands on a large scale, the contribution by Zhang, Kong and Chenayah shows that Chinese firms have managed to upgrade into all aspects of production innovations and designing. Rapid expansion led to rising wages and land costs in the coastal provinces of China. The government took advantage of this development to attempt a reduction in regional disparities through the provision of financial incentives to locate production in Central and Western China. Central China has benefited from such institutional change as significant production has relocated there, though the importance of sea freight in clothing trade has made such a geographical shift slow.

Integrating into global value chains no doubt has helped industrial expansion. However, as Zhang, Kong and Chenayah have argued, Chinese firms began to experience significant technological upgrading into designing and R&D only after the coordination efforts of the provincial, municipal and county governments to establish clusters to stimulate innovation synergies.

The clothing firms in Laos and Myanmar are still in their infancy, and production is driven significantly through connecting with global value chains. However, because of the importance of East Asian contractors who supply buyers in these countries, Nolintha and Jajri, and Tin and Yap, respectively, show that regional production linkages have been important in stimulating technological upgrading in production technologies in Laos and Myanmar. However, clothing firms in these countries are not engaged strongly in designing and R&D activities, which is a consequence of both their infancy and the lack of host-site institutional support to promote such activities.
Semiconductor

The semiconductor industry is a major export-oriented manufacturing industry in China, Malaysia and Singapore that very much evolved through connecting with global value chains. MNCs originally relocated the labour-intensive stages of production in these countries to take advantage of cheap labour, though financial incentives were also important.

While global production linkages were important in turning China into a giant production base, the contribution from Kong, Zhang and Chenayah shows that the lack of research support has been identified as the reason why Chinese firms have not reached the technology frontier to launch products new to the universe. Despite becoming the world’s largest production and export base, China has not succeeded in stimulating its national firms to the technology frontier in semiconductors a la South Korea (Samsung Semiconductor in memories) and Taiwan (e.g. the Taiwan Semiconductor Manufacturing Corporation in logic chips). The lack of sophisticated research labs in universities and strategies to relocate operations by similar universities in the developed countries are some of the reasons for such a development.

R&D and capital grants helped attract upgrading by both foreign and national firms to upgrade into the high value-added activities of wafer fabrication, chip design and R&D. The statistical evidence provided by Rasiah and Yap from Malaysia and Singapore shows that there is a strong relationship between host-site institutional support and firm-level technological capabilities. While regional production linkages were also correlated with technological capabilities in Malaysia, only domestic production linkages and technological capabilities were correlated in Singapore. The higher supply of human capital and R&D support from host universities have stimulated greater upgrading in Singapore than in Malaysia. However, even in Singapore the lack of advanced research labs in universities has discouraged firm-level development of products new to the universe.

However, national ethnic Chinese firms have faced shortcomings in Malaysia as the R&D and designing grants have either gone to a couple of foreign firms or to a firm owned by the government’s sovereign wealth fund. Efforts must be taken to extend such incentives and grants to all firms in Malaysia to spearhead technological upgrading into R&D activities.

Using the ‘groping for stones in the river’ approach, China has managed to correct mistakes throughout the period since economic reforms were started in 1978 in the automotive, clothing and semiconductor industries (Zhang 2014). Also, the decentralization of policy-making has offered provincial, municipal and county governments important roles to play in building connectivity and coordination with basic and high-tech infrastructure institutions.

However, China has to figure out the path to achieve the same success in pushing its firms to the technology frontier so that its products can enjoy premium innovation rents.

Implications for theory

Before any attempt is made to draw implications for theory, it is useful to establish the rules of discussion on the main theories we began with in the introduction article. By simply claiming that industrial policy is irrelevant because its introduction in several countries have failed is not only not helpful but also misleading. As with the countries that succeeded in becoming developed through the introduction of industrial policies (e.g. the UK, the USA, Germany, Japan, France, Sweden, South Korea, Taiwan and Singapore), it
is how and when governments have, through coordinating with industry, introduced dynamic conditions that has been important in explaining such a role (Johnson 1982; Amsden 1989; Reinert 2007). As Smith (1976) has argued, markets and government are two opposite sides of the same economy whose effective coordination is essential to deliver the desired growth and structural change (see also Amsden 1985).

Integration into global and regional value chains has been important in attracting the scale, scope, market competition and technological learning opportunities in all three industries, albeit the nature and context has been different. Hence, the role of government, both directly and through coordination with meso-organizations jointly led by public and private organizations, has been important in stimulating firm-level technological capability building, especially in designing and R&D activities. This evidence clearly supports the relevance of industrial policy. For example, the clustering of firms, and learning and innovation support established through collaboration links arranged by the provincial, municipal and county governments were important in the automotive, clothing and semiconductor firms upgrading to participate in designing and R&D activities. Financial incentives and grants strengthened this transformation further. Although on a smaller scale, similar efforts by intermediary organizations have helped national firms to enjoy significant technological upgrading in the automotive industry in Thailand and Indonesia. The lack of institutional support has undermined the capacity of national automotive firms to upgrade in the Philippines.

While both the global value chain (Gereffi, Humphrey, and Sturgeon 2005) and the global production network (Henderson et al. 2002) approaches are useful in elucidating the opportunities they offer for the participation of emerging firms in the developing economies, they offer little explanation on how these linkages can support technological upgrading of host-site firms. Nevertheless, it is important that the production and export opportunities that can be identified using particularly the global value chain approach is used productively to establish the initial connectivity with global markets. The production-sharing approach dealing with the creation of a division of labour on the basis of factor endowments provides no additional value to what has already been discussed profoundly by neoclassical economists. Indeed, existing relative factor endowments are important but as the evidence shows unless there is institutional change to stimulate upgrading, national firms in the developing economies are unlikely to participate in R&D and designing activities.

While the experiences examined vindicate industrial policy, it is a qualified one. There is no place for the old fashion import-substitution policies targeted at using the domestic market to achieve scale economies and technological capabilities building. Not only are several poor countries too small to support inward orientation, but also they appear deficient in engendering the demonstration effect, competition and knowledge flows to support firm-level technological upgrading. Also, simply exporting without at least gradual efforts to open up domestic markets for imports may not be sustainable as the developed countries are no longer willing to allow this. The successful examples are all integrated in foreign MNCs’ equity and trade linkages and enjoy good institutional support from the host site. In addition to the examples documented here, Rasiah (2011) provided the same evidence on Brazil’s, India’s and South Africa’s successful technological deepening experience in the automotive industry. Hence, firstly, integrating into import and export markets – either global or regional – is essential for successful technological capability building. Secondly, institutional support, especially in high-tech infrastructure, is important to stimulate firms’ participation in high-technology activities, such as designing and R&D.
Implications for policy

The empirical evidence offers important policy-relevant conclusions. While industrial policy has come out strong, it also shows that governments can make mistakes as the Philippines experience with the automotive industry shows. However, leaving industries to market forces is not the solution as is the case with the Philippines experience. Despite the favourable conditions for capitalist integration into the global economy in the 1960s and 1970s, the automotive industry in the Philippines has failed to upgrade simply because of the government’s initial inward import-substitution approach and subsequently liberal export-oriented approach without any emphasis on stimulating firm-level technological capability building.

The clothing production experiences demonstrate that integration into global and regional value chains is a critical starting point in providing developing sites the opportunity to appropriate trade synergies. China, Laos and Myanmar managed to generate both employment and wage increments in the industry through participation in global and regional value chains. Thus, governments should not only create enabling environment to attract foreign firms but also stimulate linkages between national firms and importers in the value chains. Once integration is established governments must stimulate institutional change to stimulate technological upgrading, e.g. through financial incentives and grants to support R&D, and initiate collaborative links between firms and universities, and designing and training centres. The government should also ensure continuous upgrading in basic and high-tech infrastructure to ensure that collective action problems are solved for the smooth operations of firms. To ensure that cluster synergies are maximized, efforts must be taken through industry associations to strengthen network cohesion among firms and between firms and meso-organizations so that pecuniary and technical interactions are coordinated effectively (Rasiah 2009).

While the quest for attracting FDI has largely been achieved in the Chinese and Southeast Asian experiences through liberalization of FDI policies, successful technological upgrading has required the provision of incentives and grants as well as dynamic clustering initiatives between firms, and between firms and meso-organizations, especially research universities and R&D labs. China’s experience with the automotive, clothing and semiconductor industries demonstrate this point. The Thai experience with automotive upgrading into designing and R&D activities shows the importance of initiatives to connect and coordinate knowledge linkages between firms, and between firms and designing centres and universities. The lack of such efforts explains the lack of upgrading in the automotive industry in the Philippines. The Singapore and Malaysian experiences show that technological upgrading is possible through the development of the provision of high-tech infrastructure and financial incentives and grants.

While a large domestic market has provided China a strong leveraging point with foreign capital to seek conditions that can engender spillovers, the smaller economies of Southeast Asia should take advantage of preferential access (e.g. clothing in Laos and Myanmar) and financial incentives to do the same in their countries. As Hirschman (1970) had argued, integration will expand markets and learning opportunities through exports, which the host governments should take advantage of to promote backward linkages. Technology transfer should go beyond explicit contractual licensing agreements to include the development of tacit knowledge in national human capital so that MNCs can act as invisible colleges to produce hands on managers, professionals and human capital (Rasiah 1995; Best 2001). Such human capital will be critical to assist host-site national firms to
skip learning stages in their quest to shorten the catch up period and compete with leading firms.

Overall, the research questions we began with are substantiated by the empirical evidence. Integration into the regional and global capitalist system has been important to stimulate scale and scope economies for firms in underdeveloped locations to participate in global value chains. However, institutional support at host sites has been critical to stimulate technological upgrading once integration takes place. The evidence suggests that dynamic industrial policy requires effective coordination between economic agents and the government with industry type and timing being important conditioning influences of firm-level technological capability building.

Disclosure statement
No potential conflict of interest was reported by the authors.

Note
1. Kim (2003) had observed the same experience with Korean automobile firms that had to chart their own path of technological catch up when their Japanese technology suppliers stopped supporting them once they achieved a certain level of technological capability.

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