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Emergence of Innovative Manufacturing Firms across Asian Countries

by

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Emergence of Innovative Manufacturing Firms across Asian Countries

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Abstract

The recent phase of globalization has witnessed increasing influence of Asian countries in the global economy. This is supported by the rise of Asian firms and their increasing presence in economic activities across the globe through innovations in manufacturing. This paper attempts to trace the rise of Asian firms and their innovation capabilities while examining the theory of the growth of the firm and empirical literature. The comparative analysis of innovations across innovative manufacturing firms of seven Asian countries-Japan, South Korea, Malaysia, Indonesia, Philippines, China and India is based on data collected through Oslo manual approach survey conducted and compiled by UNESCO in 2013. This unique data set covers technological and social innovations which is more comprehensive and expands the scope of the concept of innovations. Important empirical evidence that has emerged from the analysis is that Asian manufacturing firms are having higher level of social innovations than technological innovations. Level of economic development is positively correlated to transition from process to product innovations across firms of both developed and developing countries. The low variations across active innovative firms in product and process innovations imply that technological innovations are stable and rising in Asia. This is supported by high degree of intensity of in-house R&D expenditure. The most important barrier to innovative and non innovative manufacturing firms is the deficiency of internal and external finances except firms of Japan and South Korea. The innovation environmental constraints are more visible across Asian firms where the national innovation system is at nascent phase. The finding based public policy suggestion is that the public policy should accord high priority in investing higher proportion of resources in innovations to relieve the firms from such constraints.

Keywords: Systems of innovations, rise of Asian firms, technological innovations, social innovations, public policy, Asia, Manufacturing innovations, internationalization of firms.

JEL Classification: O1, O2, O3, L6, F6, D8

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Introduction

The economic development experience of the global economy during the last three decades has underlined a dramatic shift of the sources of economic expansion from western developed countries to the Asian continent. The economic influence of Asian economies has been increasingly becoming stronger. The outward foreign direct investment flows from Asia has increased to US$ 383 billion in 2014, which are 31.9 per cent of the total outflow in the global economy and were higher than both of Europe and North America (23.3 per cent and 28.8 per cent respectively) (UNCTAD 2015:30). Asian economies contributed 38 per cent of the world GDP, 32.9 per cent of world exports and 32.6 per cent of the world's manufacturing value added in 2010 (Nayyar 2013). The sustained rise in the contribution of Asian economies to the world economy provides it the status of the 'engine of growth' of the global economy.

Asian economies, during the period of last three decades, have also undergone dynamic economic transformation. The structural change in the composition of output clearly brings out the increasing importance of industrial production- it was 41.3 per cent of GDP in 2010 (Nayyar 2013:103). Among the top ten most competitive industrial economies of the world, five are from the East and Pacific countries (Japan, South Korea, Taiwan, Singapore and China). The other East Asian countries that fall in the list of top 50 most competitive industrial economies of the world are Malaysia, Thailand, Indonesia, Philippines, and India from the South Asian countries (UNIDO 2013:ix-xii). The presence and influence of the Asian firms (Multinational corporations from Asia) in the global market is so significant that Forbes and Fortune Global 500 list includes and ranks these companies. The 2015 Fortune Global 500 list includes 98 companies from China, 54 from Japan, 17 from South Korea and 7 from India. The total number of Asian MNCs in the Fortune Global 500 list is more than 172 (Cui, Chan and Zhang 2014).

The increasing role played by the Asian countries and their firms in shaping the destiny of the global economy has attracted the attention of a large number of scholars and global institutions to explore the underlined factors of this explosion of economic growth and transformation (World Bank 1993; Young 1993; Kim and Lau 1994; Krugman 1994). The most important source of rapid economic growth of the newly industrializing East Asian countries (Hong Kong, Singapore, South Korea and Taiwan) was capital accumulation, in contrast with the advanced industrialized countries where technological progress played a dominant role. This was also recently reaffirmed by Bosworth and Collins (2014) while using long term estimates of sources of growth across Pacific Rim countries covering the period 1960-2008. From East Asia, China has remained the only exception to this rule where technological progress (total factor productivity) as a source of growth remained higher than the capital accumulation (Bosworth and Collins 2014: 187). However, in the post financial crisis of 1997-98, the sources of growth in most of the East Asian countries turns out to be predominantly technological progress, except for Taiwan.

On the other side, a large number of scholars who have examined the East Asian newly industrializing economies following the capability approach argued that each country has a significant number of industrial firms which acquired technological capabilities to produce technologically complex products, and are competing very successfully with the firms from industrially advanced countries (Kim and Nelson 2000). Furthermore, the catch up literature following the evolutionary and systems of innovation learning approach has argued that specialization in unique short cycle technologies which emerged from the East Asian

country firms allowed South Korea and Taiwan to pass through the so called middle income trap (Lee 2013). There is an increasing tendency of scholars to examine specific category of manufacturing firms while selecting small sample of firms/companies from Asian countries and arrive at conclusions regarding the innovations as an important factor in the rise of manufacturing firms (Li and Cantwell 2012; Kale 2012; Rasiah 2012; Lee and Mathews 2012; Liu 2014; Rho, Lee and Kim 2015). The firm level innovation studies are mostly based either on case studies or on using thin sample and therefore lack generalization.

The present study, based on a large country wide sample survey, which is comprehensive in coverage and scope, of manufacturing firms conducted across Asian countries and made available by UNESCO (2015)[1], strives to fill this gap. This paper attempts to provide empirical evidence of manufacturing innovations across Asian firms while using the systems of innovation approach. It seeks to answer the question of extent of innovations, sources of innovations, height of barriers to active innovative and non-innovative firms, and interaction of innovative firms with institutional and non institutional organizations. The paper is organized in the six sections. The section two followed by introduction examines the theory of growth of the firm as well as empirical studies to identify the gaps in research. The variations in innovations across manufacturing firms of Asian countries are presented in the section three. In section four, the sources of innovations of manufacturing firms of Asian countries are examined. The analysis of the barriers faced by the innovative and non-innovative firms across Asian countries is presented in section five. Concluding remarks are presented in the sixth section.

I. The Rise of Asian Firms: Theory and Empirical Review of Literature

As the evolution of global economy is taking place, there is emergence of Asian firms as global players in both capturing markets and innovation domains. The emergence of Asian firms seems to have benefited in forming capabilities from the import substitution regime to internationalization of business during the recent phase of globalization (Amann and Cantwall 2012). This transition needs to unravel the underlined processes and to do this one can take recourse to economic theory of the firm. There are three broad strands of theoretical literature that throw light on the growth of the firm. The mainstream theory of the firm is associated with the names of Coase (1937) and Williamson (1975, 1985). This theory considers firms as 'islands of conscious power' in a sea of markets transactions. An important feature of this kind of thinking is that firms insulate from market transactions because the price mechanism for allocating resources is costly both to establish and use as well as several transactions underline commitment in uncertain future. The internalization of transactions generates economies of scale and thus size of the firm expands so long as it reaps the economies of scale. However, diseconomies of scale from over-internalization will restrict the size of the firm. The central emphasis of this theory is on the cost of making and monitoring transactions. Despite the fact that Williamson emphasized the distinction between markets and hierarchies, but the Coase-Williamson tradition can be summarized as transactions costs approach since it has stressed on the costs of formulating, enforcing and monitoring contracts. This tradition has reformulated the question of production of more resources to the question of allocation of given resources and emphasized on different governance modes to minimize transactions costs given the technology (Hodgson 1998).

In contrast to the contractual theories of the firm, the evolutionary and capability/ learning based theories of the firm claim that they provide better ways to understanding technological and organizational change for the growth of the firm. A sound foundation to the

evolutionary-capability-learning approach has been provided, in their seminal contribution, by Nelson and Winter (1982), and Freeman (1987) and Lundval (1992) further connected it to the national innovation system (NIS) approach. The roots of this approach can be traced in Smith (1776) who argued that expansion of the firm can take place through division of labour which leads to specialization and enhancement of skills (capabilities) through learning-by-doing. Knight (1921) extended the scope of capability based theory of the firm while explicitly stating the role of knowledge and uncertainty in the existence and growth of firms. Penrose (1959) also has emphasized on the role of tacit knowledge and elusive nature of skills within the firm. She has incorporated the dynamics of tacit knowledge and a set of other capabilities as the core of her theory of the growth of the firm. Nelson and Winter successfully identified technical routines for producing goods by the firm and assigned the role of these routines that genes play in the biological evolutionary theory. They have emphasized that routines act as durable repositories of knowledge and skills and have a capacity to be replicated and further developed through searching and investing in innovative activities. The national system of innovation approach in which economic agents of production interact to acquire, create, diffuse and utilize knowledge for expansion has emphasized on building the innovative and learning capabilities and also treat it as path dependent. Therefore, the evolutionary-capability-learning based theory of the firm paid more attention to the processes of learning and development within organizations.

The theory of the growth of the firm outlined above does not throw much light on the question as to when and why internationalization of the firms occurs. The theoretical foundations in this direction were provided by Dunning's eclectic theory (1980, 2001) among others (Vernon 1966: Johanson and Vahlne 1977). Based on advanced country firms experience of internationalization, Dunning's OLI theory focuses on the exploitation of unique competitive advantage possessed by the firms from their existing firm specific assets. Further extending this argument (Dunning and Narula 1996), they have identified three motives on the internationalization of the firm as efficiency seeking, market seeking and strategic asset seeking.

This kind of theoretical foundations triggered empirical literature to verify the underlined causes of internationalization of firms from the emerging markets economies of East Asia and other developing countries. The recent spurt of outward orientation of the firms from the Asian countries, especially China and India and their investment in industrially advanced countries has prodded the economists to examine the underlined causes. It is a widely accepted fact that there are numerous factors that induce a firm to invest abroad. But acquiring strategic assets and innovation capabilities have emerged as the most dominant ones (Gill 2014; Gill and Singh 2012; Nayyar 2008; Mathews 2006). The limitation of such studies is that these studies have only examined one dimension, that is, outward orientation mainly based on investment. However, before outward orientation of firms from the emerging economies, there was a deep inward internationalization, that is, multinational corporations' (MNCs) investment in the emerging economies. Most of the Asian countries except South Korea have had a long experience of learning from the interaction with the advanced industrialized country MNCs through joint ventures, technology licensing and technology purchase. The empirical studies that recognize both internal and external internationalization of Asian firms have followed the systems of innovation approach and identified the role of evolution of innovative capability building in the firms through global interaction (Amann and Cantwell 2012) are relatively very recent.

Li and Cantwall (2012) have examined foreign direct investment and innovation capability building in China. They have collected information from 51 international joint ventures (IJVs) regarding knowledge acquisition and their success in generating innovation capabilities. The authors found from this empirical investigation that all the sampled IJVs have been able to produce at a higher level of efficiency and replicate production of products along with remaining substantially successful in advanced innovative capability building. This success was essentially attributed by Li and Cantwall to the Chinese FDI policy imposing an important condition on MNCs to transfer technology of the most sophisticated kind to Chinese firms. Complementary to this, four auto manufacturing firms examined by Xu and Li (2014) bring out the fact that there exists a different path of state owned enterprises (SOEs) and private owned enterprises (POEs) in terms of building innovative capabilities. They have confirmed the findings of Li and Cantwall so far as SOEs are concerned but POEs have carved out an alternative path to innovations while imitating the domestic mature technologies. This was achieved through in-house accumulation of research and development expenditure.

The two highly successful countries in transforming firms from imitation to innovative are South Korea and Taiwan. Lee and Mathews (2012) have examined the process that leads to sustained catch-up of firms of these two countries. The sustained catch-up is defined as a continuous upgrading in the same industry and also entry of same and new firms into new and promising industries. For this process to be successful, the firms need 'design capabilities' for product differentiation and product innovations that cannot be acquired either through networking or through international subcontracting. Rather it requires either cross-subsidization of huge amount of R&D or promoting R&D consortia with the help of public research institutions (PRIs). It is emphasized by the authors that South Korean firms relied on the first but Taiwanese firms used the latter route. However, reaching to frontier areas of knowledge and innovations, the successful innovative firms from both the countries employed multiple channels, but most important underlined by the authors are radical break on the basis of decisive investment and shared risks through forming consortias, entry into new industries by the established/networked firms and using the window of opportunity provided both by industry cycle and technological paradigm shifts. An important policy lesson that emerged from the case study is that in the successful and sustained process of catch-up of firms, the crucial element is government support.

The arrival of Indian firms in the international scene may essentially be attributed to long drawn technological capabilities while using the inward and outward internationalization of business. On the basis of examining two manufacturing sector firms-automobiles and pharmaceuticals, Kale (2012) argued that import substitution regime along with government support allowed to build technological capabilities in these two sectors. It is important to note that even during the import substitution regime, government of India allowed selective participation of multinational corporations and this interaction has made learning affects. Collaboration and competition in domestic market has promoted firm level learning capabilities. The outward expansion of firms in the liberal environment allowed firms to acquire strategic assets, foothold in international market and access to advanced technology. However, the author noted from the case study of two Indian manufacturing sector firms that accumulation of knowledge and development of knowledge is the deliberate effort of the firms to invest in several mechanisms of learning.

The brief review of theory of the growth of firms and empirical evidence brings home the fact that growth and internationalization of firms is a complex and multidimensional

phenomenon. An important direction that emerged from the analysis is that the firms function in an institutional arrangements and environment which is dynamic. The successful transition of firms from imitation to innovation capabilities requires co-evolution of actors (firms) and its environment. However, a significant conclusion that emerges from the case study approach is that the state and public research institutions play an important role in this transition of firms in terms of providing right kind of environment and requisite resources to mitigate risks arising on this path of innovative capability building. One may also bring out the limitations of the case study approach based empirical evidence. An important limitation of such kind of analysis is the well known selection bias. In this case most of the studies picked up winners to prove their point, however, there are various firms either in the same product line or in different manufacturing industries that might not have been successful in building capabilities in the areas of innovations. Therefore, there arises a gap in our understanding of the actual transition of the manufacturing system as a whole. This study strives to fill this gap in literature while using a comprehensive survey of manufacturing firms both innovative and non innovative, and also use a comparative framework to provide a wider picture of the situation of the Asian firms.

II. Variations in Innovations across Manufacturing Firms in Asian Countries

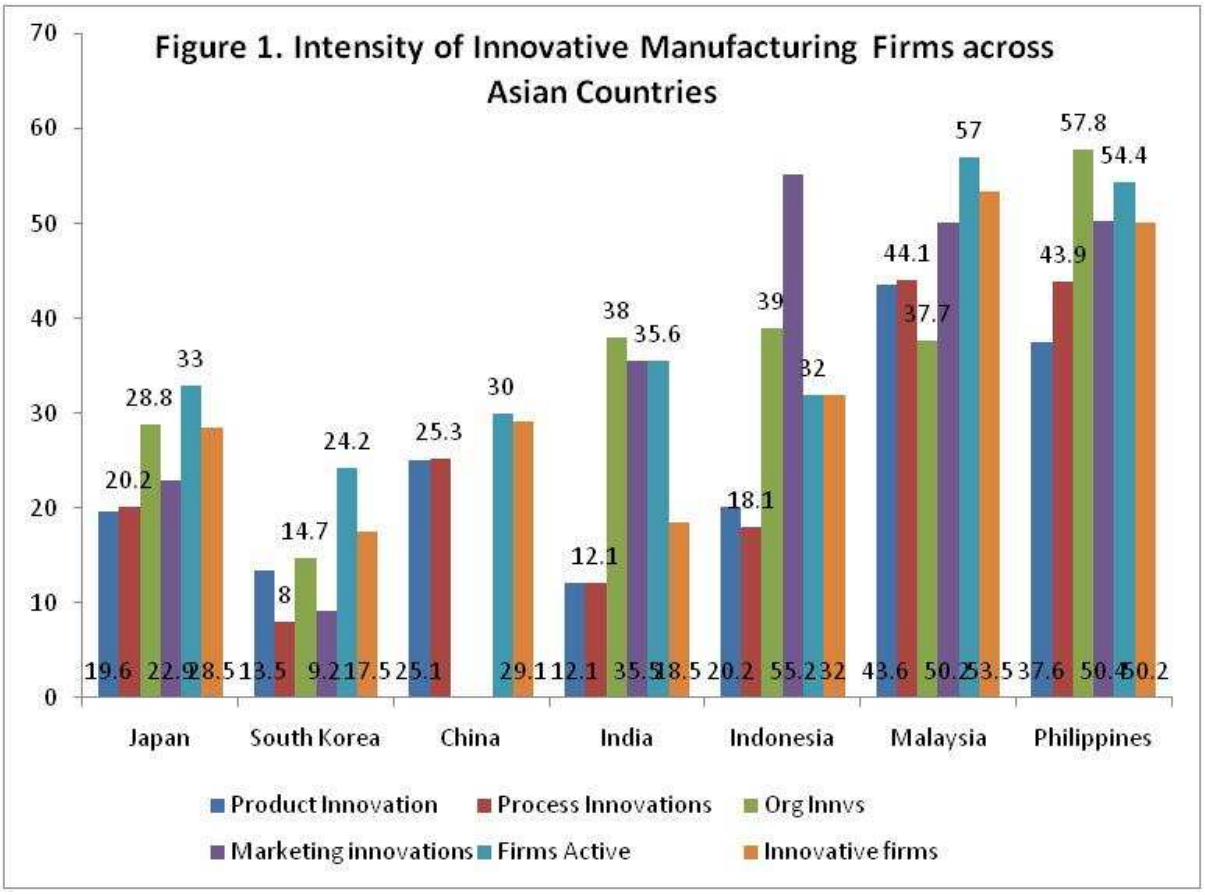
The concept of innovation has undergone dramatic changes. It has been becoming increasingly more inclusive. Between the period 1960s and 1980s only product and process innovations had been considered as the techno-physical components of the manufacturing systems of innovations (Bell and Figueiredo 2012). The social innovations have recently been recognized as an important component of innovations because it contains social technologies such as forms of division of labour and modes of coordination (Nelson and Sampat 2001). Therefore, in the empirical analysis, four types of innovations, that is, product, process, organizational and market innovations are included. The variations in innovations producing Asian firms regarding these four types of innovation categories are presented in Table 1 and through Figure 1. So far as introduction of product innovations are concerned, the proportion of Malaysian firms have reported highest innovations as compared with other Asian countries followed by Philippines, China, Indonesia, Japan and Korea. An important fact revealed from the analysis of the product innovations, based on a sample of 9001 manufacturing firms spread over to various product lines, is that the proportion of Indian firms introducing at least one product innovation is the lowest. The value of the estimated coefficient of variation is 48.64 per cent and shows wide variation in the category of product innovations across Asian country firms. An important fact that can be inferred from the analysis of process innovations introduced by the Asian country firms (Table 1) is that firms of two countries, that is, Malaysia and Philippines, have highest number of firms engaged in product innovations. South Korea has been having lowest proportion of firms engaged in process innovations. The surprising evidence in the case of India is that the process innovations implemented by the firms are quite low. India, in fact, is known for specializing in process innovations prior to the change in from process innovation patenting regime to product patenting regime. However, the coefficient of variation of process innovative firms shows higher value than that of the product innovations. Social innovations, especially of organizational innovations, clearly show higher intensity across all the countries under consideration except Malaysia. Similar trends can be observed in the case of marketing innovations. When we compare the coefficients of variation between organizational innovations and marketing innovations, and both categories of social innovations, the variations in the case of organizational innovations are lower compared with the marketing innovations. Furthermore, the analysis of the proportion of active innovative firms[2] reveals that across the seven Asian countries, there is a

high degree of participation of firms to engage in both product or process innovations. The value of coefficient of variation is 33.11 per cent which shows that the variations across this group of firms are quite small. It means that participation of Asian firms in implementation of product/process or abandoned or ongoing innovation activities to develop product or process innovations is stable and rising.

Table 1: Intensity of innovative manufacturing firms across Asian countries (figures in percentages)

Country	Product Innovation	Process Innovations	Organizational Innovations	Marketing innovations	Active Innovative Firms	Innovative firms	Per capita income US$PPP 2012
Japan	19.6	20.2	28.8	22.9	33	28.5	32545
South Korea	13.5	8	14.7	9.2	24.2	17.5	28231
China	25.1	25.3			30	29.1	7945
India	12.1	12.1	38	35.5	35.6	18.5	3285
Indonesia	20.2	18.1	39	55.2	32	32	4154
Malaysia	43.6	44.1	37.7	50.2	57	53.5	13676
Philippines	37.6	43.9	57.8	50.4	54.4	50.2	3752
Average	24.53	24.53	36.00	37.23	38.03	32.76	13369.71
Standard Deviation	11.93	14.41	14.12	18.21	12.59	14.16	12228.40
Coefficient of Variation	48.64	58.76	39.22	48.92	33.11	43.22	91.46

Source: UNESCO (2015).



The relationship between innovative activity and the level of economic development approximated by per capita income of the seven Asian countries can be inferred from the data presented in Table 1 and Figure 2. This relationship, known as 'catch up', reflects the movement upwards for the innovation intensity. The analysis of figure 2 allows us to conclude that there is a trend towards catch up. The innovation intensity measured through active innovation firms and per capita income gives the coefficient of elasticity -0.11. The line figure shows that lower level of development encourages firms to implement product and process innovations. Therefore, the number of active innovative firms increases. But once a country is developed, the introduction of entirely new to the world innovations requires higher level of risky R&D expenditure. This empirical finding is also confirmed when we enlarge the scope to 21 developing countries. The value of the elasticity of the coefficient between the share of product innovative firms and per capita income is -0.0335. In this sample five Asian countries are included. Figure 3 presents this relationship and allows us to conclude that the direction for catch up is pretty clear. Contrary to this, the relationship between the proportion of firms implementing product innovations and per capita income of the developed countries is positive and significant (Figure 4). The value of the elasticity of this relationship is 0.7867 and r-squared is 0.41. Thus the incidence of innovative intensity rises more or less in line with per capita income. These kinds of trends in case of developed countries are also noted in other studies as well (Bell and Figueiredo 2012:38-39).

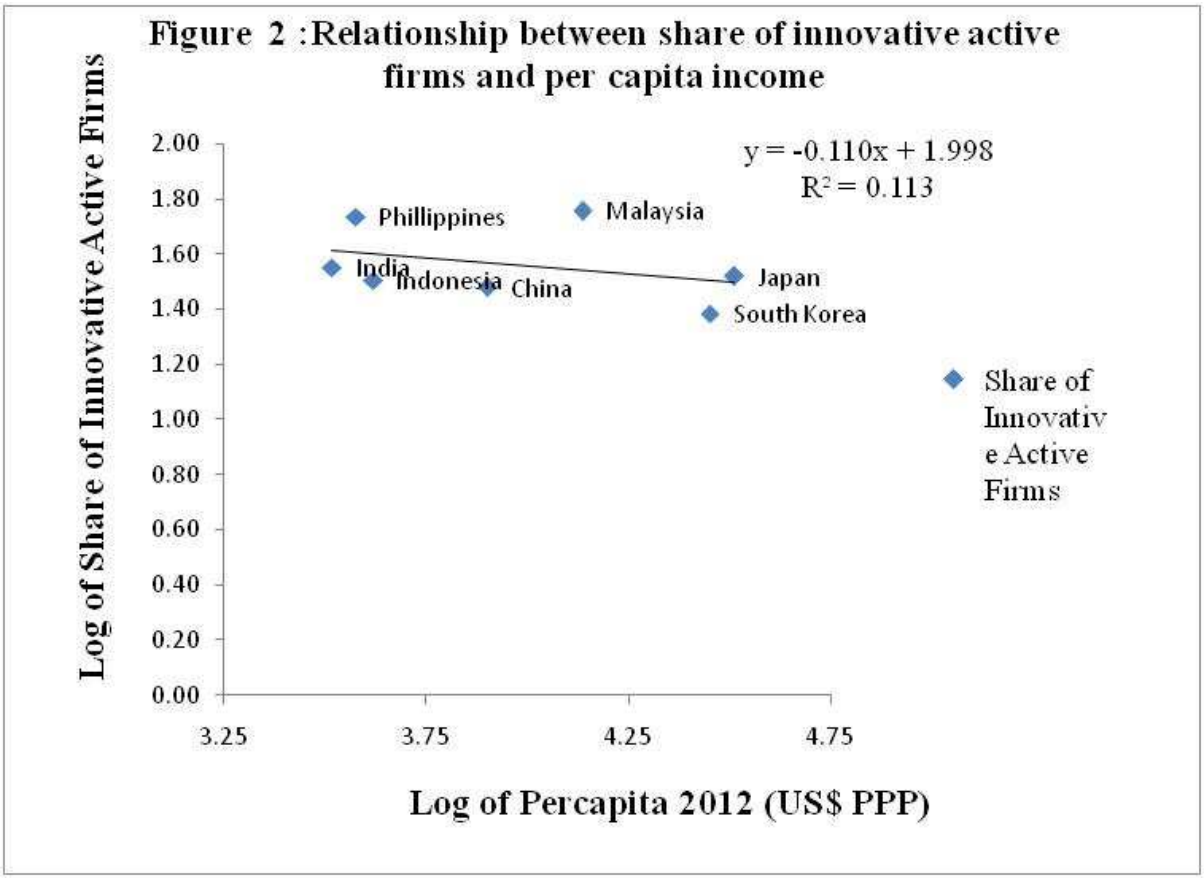


Figure 2 :Relationship between share of innovative active firms and per capita income
Log of Share of Innovative Active Firms
y = -0.110x + 1.998
R² = 0.113
Phillippines
Malaysia
India
Indonesia
China
Japan
South Korea
Share of Innovative Active Firms
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
3.25
3.75
4.25
4.75
Log of Percapita 2012 (US$ PPP)

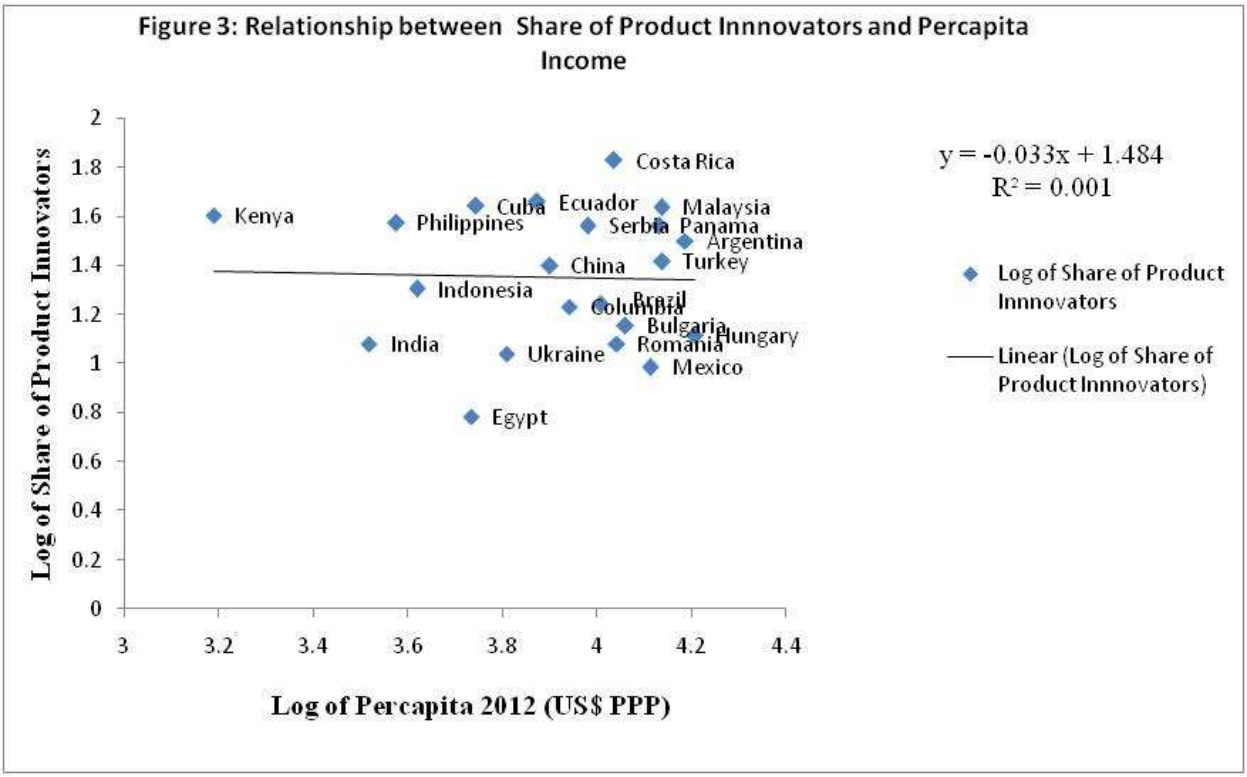
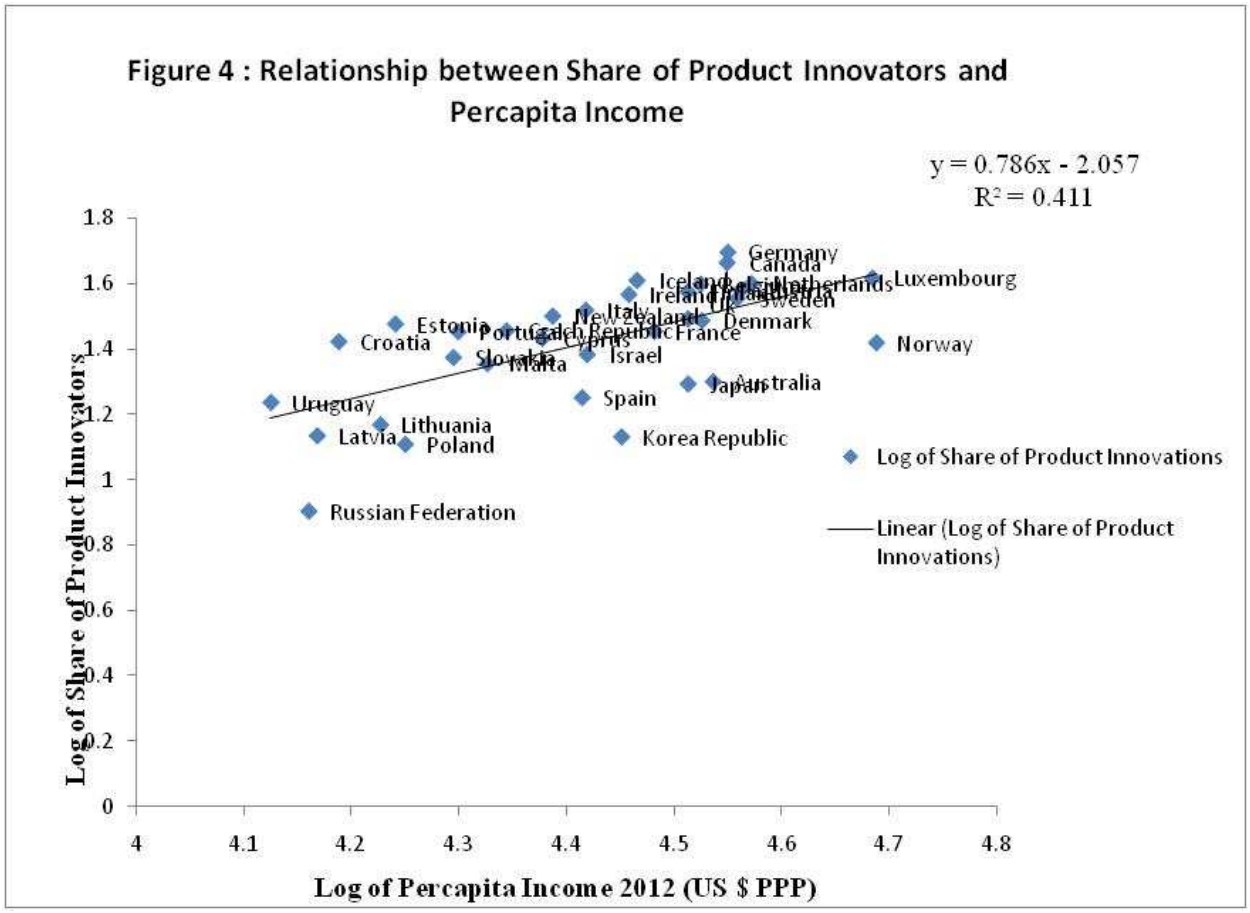
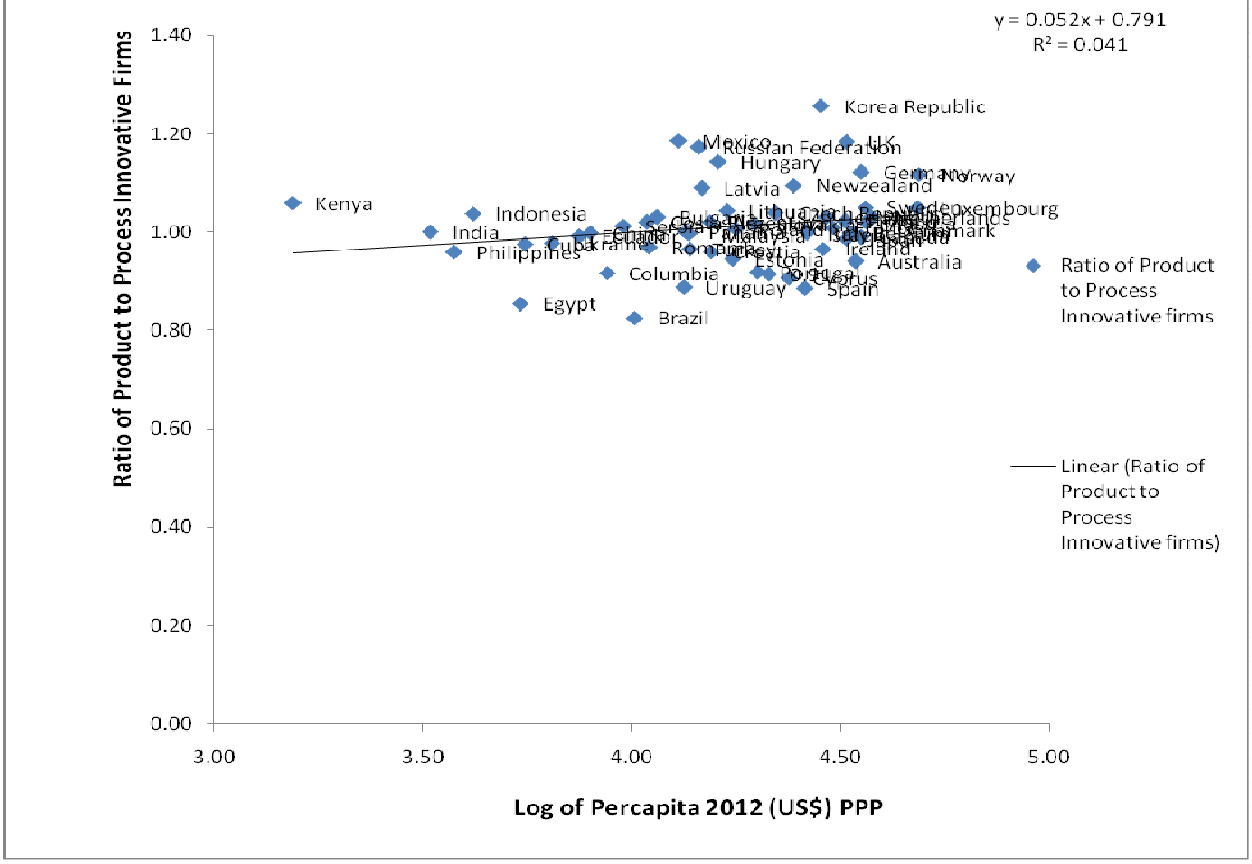


Figure 3: Relationship between Share of Product Innnovators and Percapita Income
Log of Share of Product Innovators
y = -0.033x + 1.484
R² = 0.001
Costa Rica
Kenya
Cuba
Ecuador
Malaysia
Philippines
Serbia
Panama
Argentina
China
Turkey
Indonesia
Brazil
Columbia
Bulgaria
Hungary
India
Ukraine
Romania
Mexico
Egypt
Log of Share of Product Innnovators
Linear (Log of Share of Product Innnovators)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
3
3.2
3.4
3.6
3.8
4
4.2
4.4
Log of Percapita 2012 (US$ PPP)



It is imperative to examine the relationship between ratio of product to process innovation firms and level of economic development represented by the per capita income. This relationship is theoretically intuitive because it shows the tendency of the firms to make transition from process innovations to product innovations as the level of economic development rises. To test this relationship and identify the emerging pattern if any, we have developed data set of 54 countries for product and process innovation firms and made comparison with per capita income. This relationship is presented through figure 5. The analysis of the data and of the figure clearly brings out broad pattern of transition of firms from product to process innovations with the rise of per capita income. The sign of the regression coefficient is on expected lines, which is positive (0.052). Since the regression coefficient is significant at 15 per cent level, it shows clearly the tendency of firms moving towards product innovations with the higher level of economic development. This relationship is also put to test by dividing the whole sample of 54 countries into developed and developing countries and found higher coefficient for group of developed countries (0.114). The regression coefficient for the group of developing countries is 0.04. Both the groups of countries separately shows the positive direction of the relationship but there is a strong tendency of direction of firms of advanced countries moving towards product innovations compared with the developing countries. As a matter of fact, the relationship is positive in both the cases allow us to conclude that level of economic development determines the ratio of product to process innovative firms. An important point needs to noted here is that five countries, that is, South Korea, United Kingdom, Russian Federation, Mexico and Hungary, emerged as the most important in terms of product to process innovation firms ratio showing higher level of product innovative firms in their manufacturing sector.

Figure 5: Relationship between Ratio of Product to Process Innovative firms and Percapita Income 2012 (US$) PPP



It is imperative to examine the distribution of manufacturing firms actively engaged in innovations (product and process) and also social organizational innovations according to size classes. The distribution of innovative firms according to micro, small, medium and large size is presented in Table 2a. The analysis of Table 2a reveals that the size of the firm and its engagement in introducing innovations is positively correlated. The proportion of manufacturing firms implementing innovations across size classes and countries shows a clear pattern, that is, as the size of the firm increases, its engagement with implementing innovations also increases. However, in general, it is observed from the analysis that there is a high degree of concentration of innovative firms in the large sized category. Malaysia emerged as the leading country in terms of high concentration of innovative firms in the large sized category followed by Philippines, Japan and South Korea. Contrary to this, Indian innovative firms form the inverted-u-shape relationship. In India, the highest concentration of innovative firms is in the medium sized class. Somewhat similar trends can be observed from the analysis of the distribution of firms who have engaged in organizational innovations across Asian countries (Table 2b). So far as marketing innovative firms distribution is concerned, three countries, that is, Japan, Malaysia and South Korea confirmed the regular pattern of movement towards concentration of innovative firms in the large sized category of firms, but the other three countries, that is, India, Indonesia and Philippines recorded higher concentration of firms in the category of medium sized firms (Table 2c).

Table 2(a) Percentage of product and process innovators in manufacturing by size classes

Country	Micro	Small	Medium	Large	Total
China	-	-	-	-	21.27
India	5.219	8.408	11.7	12.28	5.68
Indonesia	-	-	6.2	7.1	6.4
Japan	-	9.086	15.022	30.06	11.27
Malaysia	-	27	32.93	42.23	34.2
Philippines	17	25.2	33.8	42	31.2
Republic of Korea	3.57	5.08	6.97	16.44	4.0219

Source: UNESCO (2015).

Table 2(b) Percentage of organizational innovators in manufacturing by size classes

Country	Micro	Small	Medium	Large	Total
China	-	-	-	-	-
India	36.6	46.52	62.76	47.37	38.02
Indonesia	-	-	38	42.6	39
Japan	-	25.61	35.81	49.87	28.83
Malaysia	-	33.333	33.33	46.21	37.72
Philippines	38.7	52.3	70	66.9	57.8
Republic of Korea	13.29	18.64	24.47	43.47	14.68

Source: UNESCO (2015).

Table 2 (c) Percentage of marketing innovators in manufacturing by size classes

Country	Micro	Small	Medium	Large	Total
China	-	-	-	-	-
India	34.068	44.62	57.45	43.86	35.53
Indonesia	-	-	58.5	42.6	55.2
Japan	-	21.4	24.94	37.93	22.85
Malaysia	-	38.4	47.39	64.14	50.2
Philippines	43.4	50.5	53.8	53	50.4
Republic of Korea	9	8.92	9.83	21.62	9.16

Source: UNESCO (2015).

Are Asian manufacturing firms engaged in innovations in similar or different product lines? It is possible to answer this question while examining the distribution of innovative firms across the sub-category of industries. At this level of disaggregation, the information is available only across 20 industries for three Asian countries, that is, Japan, India and South Korea, and is presented in Table 3. It is significant to note that both in Japan and South Korea, the active innovative firms are almost implementing innovations in the similar line of industrial products. For example, first three industries where both the countries' firms highly concentrate as active innovative firms are pharmaceutical, chemical products and electronic equipment. In Japan and South Korea, the fifth ranked industry according to active innovative firms is computer electronics. However, there is only one industry where two countries accorded different priority to innovations, that is, Japan's priority in innovations is textile industry where as South Korean active innovative firms are engaged in beverages. Therefore, the race for innovation between Japan and South Korea is in similar lines of industrial categories. An important fact that needs to be noted here is that active innovative firms in India are engaged in implementing innovations in different industrial products compared with Japan and South Korea, except one industry, that is, computer electronics. Whereas this industry is the fifth level priority of Japan and South Korea, Indian active innovative firms accorded it the highest priority. The other industries where Indian active innovative firms

accorded higher priority are motor vehicles, rubber, printing and recorded media and leather products.

III. Sources of Innovative Activities of Manufacturing Firms across Asian Countries

Innovations are fundamental source for growth of the firm in the fiercely competitive environment both in the domestic and global market places. The firms are also provided incentives by the policy makers to encourage innovative intensity among the firms so that national objective of higher growth and international competitiveness of the national economy can be realized.

Table 3: Distribution of innovative and active innovative firms across industrial products

Country	India		Japan		Republic of Korea	
	Innovative Firms	Active Innovative firms	Innovative Firms	Active Innovative firms	Innovative Firms	Active Innovative firms
Food product	13.3	31.52	31.46	35.43	16.73	20.89
Beverages	21.8	38.18	29.64	33.79	26.21	32.31
Tobacco products	8.3	15.27	-	-	-	-
Textiles	21.3	35.77	41.65	42.54	11.7	16.91
Wearing apparel	21.6	36.73	22.46	30.13	7.5	8.18
Leather and related products	22.7	46.1	24.92	27.07	10.56	15.72
Wood and products of wood and cork, except furniture : manufacture of articles of straw and plaiting materials	11.5	21.42	18.65	23.24	2.51	6.47
Paper and paper products	14.5	38.51	21.41	23.14	11.86	16.65
Printing and reproduction of recorded media	23.29	46.6	27.12	27.99	5.49	9.3
Coke and refined petroleum products	19.1	32.58	35.35	38.38	21.1	32.11
Chemicals and chemical products	19.5	35.7	45.62	53.41	37.26	53.64
Basic pharmaceutical products and pharmaceutical preparations	29.7	40.45	55.68	60	30.2	71.81
Rubber and plastic products	20.19	46.7	30.21	35	11.26	15.96
Other non-metallic mineral products	9.7	25.02	14.48	16.54	13.5	17.15
Basic metals	14.3	30.49	20.41	25.21	12.45	15.72
Fabricated metal products, except machinery and equipment	20.38	34.82	28.61	33.38	16.16	22.51
Computer, electronics and optical products	30.37	52.59	33.91	39.82	20.43	31.36
Electronic-equipment	23.39	38.56	36.4	43.86	27.2	37.61
Machinery and equipment n.e.c.	25.23	41.42	28.91	35.26	23.43	30.73
Motor vehicles, trailers and semi-trailers	31.5	51.333	28.22	33.16	14.32	19.68
Other transport equipment	16.1	27.4	9.5	13.4	14.4	18.9
Furniture	25.4	47.5	24	25.2	18.6	19.3
Other manufacturing	25.5	37.3	34.0	47.8	11.9	11.9
Repair and installation of machinery and equipment	22.2	34.4	12.7	15.9		
Innovative firms in manufacturing	18.5	35.6	28.5	33.0	17.5	24.3

Source: UNESCO (2015).

Therefore, it is imperative to examine the sources that innovative firms employ to increase their intensity of innovation. The distribution of innovative firms according to type of sources employed to do innovations across Asian countries are presented in Table 4 and Figure 6. The innovative manufacturing firms from South Korea had the highest proportion of firms (86.37 per cent) depending on in-house R&D as a source of innovations. In this context, Lee and Mathews (2012) have argued that the public policy of South Korea in fact generated high rents for product innovations but international competitive environment forced the Chaebol firms to increase the intensity of R&D expenditure. They have further emphasized that government reshaped incentive system in a manner that remained complementary to the firms which were engaged in in-house R&D.

Internal research and development performers in East Asian countries are ranging between 86.37 per cent in South Korea and 55.95 per cent in Japan. Malaysia, China and Indonesia recorded 69.28, 63.27 and 58.41 per cent respectively R&D performer firms. It is amazing to note that a very high proportion of innovative firms were engaged in in-house R&D across East Asian countries. The proportion of firms engaged in internal R&D in India is 35.5 per cent. This is very low level compared with East Asian standards. The proportion of firms that contracted out R&D is also higher in East Asian countries compared with Indian firms, except Indonesian firms. But it is quite a small proportion compared with the engagement of innovative firms in internal R&D.

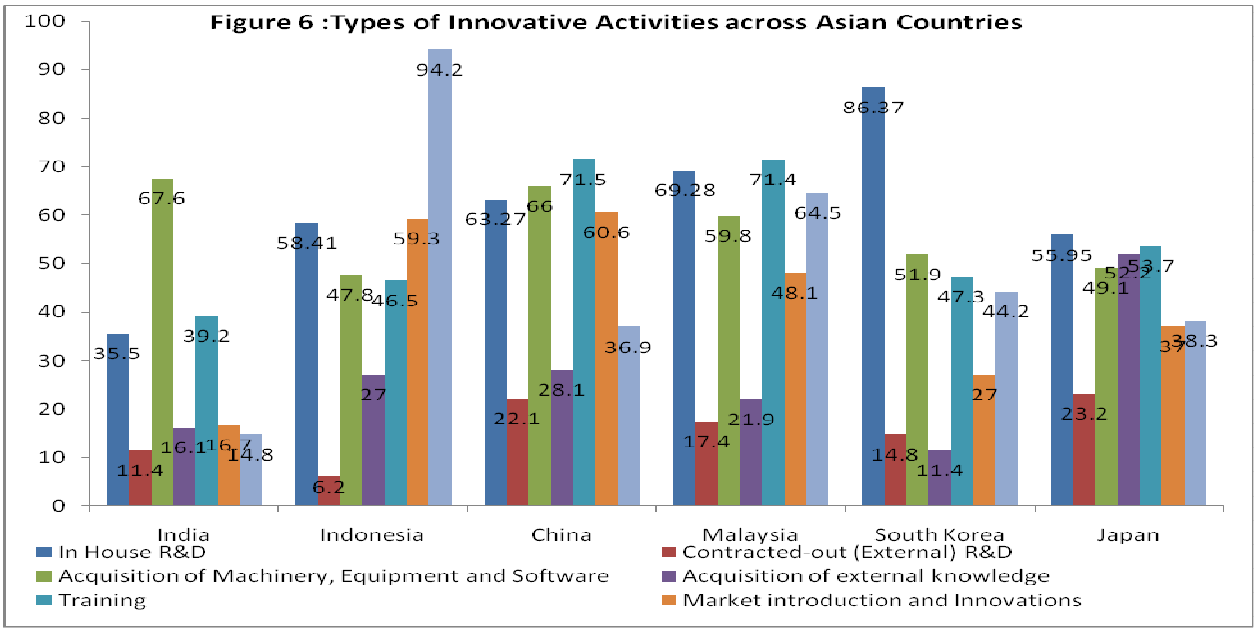
Table 4: Types of innovative activities of manufacturing firms across Asian countries (figures in percentages)

Country	In House R&D	Contracted-out (External) R&D	Acquisition of Machinery, Equipment and Software	Acquisition of external knowledge	Training	Market introduction and Innovations	Other Preparations
India	35.5	11.4	67.6	16.1	39.2	16.7	14.8
Indonesia	58.41	6.2	47.8	27	46.5	59.3	94.2
China	63.27	22.1	66	28.1	71.5	60.6	36.9
Malaysia	69.28	17.4	59.8	21.9	71.4	48.1	64.5
South Korea	86.37	14.8	51.9	11.4	47.3	27	44.2
Japan	55.95	23.2	49.1	52.2	53.7	37	38.3
Average	61.46	15.85	57.03	26.12	54.93	41.45	48.82
Standard Deviation	15.27	5.91	7.90	13.04	12.41	16.18	24.96
Coefficient of Variation	24.84	37.28	13.85	49.92	22.59	39.03	51.12

Source: UNESCO (2015).

Among the sources of innovative firms, across the board all the countries under consideration accorded highest priority to acquisition of machinery, equipment and software. Indian firms had shown highest proportion (67.6 per cent) but lowest value is 47.8 per cent for Indonesia. The acquisition of machinery, equipment and software turned out to be the predominant activity compared with other sources. The imbalance in the technology balance

of payment of these countries confirmed that their dependence for technology on other developed countries is very high except Japan where technology balance of payments is surplus. It is important to note that Japan has shown a high proportion (52.2 per cent) of firms acquiring external knowledge. Skill base through which imparting training to employees is very high in China (71.5 per cent) followed by Malaysia (71.4 per cent), Japan (53.7 per cent), South Korea (47.3 per cent), Indonesia (46.5 per cent) and lowest (39.2 per cent) in India (Table 4). When we look at the coefficient of variation across various sources of innovations, the lowest value (13.85 per cent) for the source-acquisition of machinery, equipment and software provides evidence of high priority to this source followed by training (22.59 per cent) and in-house R&D (24.84 per cent).



Firms are social organizations and have substantial linkages across numerous other social organizations. Inter-firm network of relationship entails learning from each others, sharing information and resources, and transfer of knowledge (Gilbert, Ahrweiler and Pyka 2007). The strategic uses of network of relationship by the firms help them in internationalization and also substantially contribute to their international performance (Lin, Chang, Ou and Tseng 2014). The innovation survey identified 10 common social organizations where firms can interact to draw crucial knowledge for using it for further becoming innovative. These forms of knowledge acquisitions are reported in Table 5 and Figure 7. As observed in the networks relationship literature, the most important source of relationship recorded by the firms is inter-firm networking. Except Indonesian firms, in all other Asian countries firms have highly valued enterprise group relationship to acquire technological knowledge and learning that enhances the firm's innovative performance. However, there are wide variations observed across countries where the proportion of Malaysian firms (72 per cent) was highest followed by Philippines (70.7 per cent), India (58.54 per cent) and China (49.5 per cent). In the inter-enterprise network of relationships, 47.35 per cent and 33.65 per cent of the firms from South Korea and Japan respectively rated it very highly. The firms usually obtain information from the equipment and components/software suppliers regarding knowledge transfer. Therefore, all the countries innovative firms included in the sample rated this source as important. But two countries, Philippines and India, recorded a high proportion of firms (49.5 per cent and 43.3 per cent respectively) that used this channel of network.

Table 5: Sources of inputs (information) rated highly important by innovative firms across Asian countries

Country	Enterprise or enterprise group	suppliers of equipment, materials and components or software	Clients or customers	Competitors or other enterprises in their sector	Consultants, commercial laboratories or private R&D institutes	Universities or other higher education institutions	Government or public research institutes	Conferences, trade fairs, exhibitions	Scientific journals and trade/technical publications	Professional and industry associations
China	49.49	21.63	59.7	29.64	17.11	8.93	24.7	26.68	11.97	14.77
India	58.54	43.3	58.95	32.63	16.82	7.94	11.03	29.74	15.14	24.46
Indonesia	0.4	1.3	1.8	1.3	0.9	0.4	0.4	0.9	0.9	0.9
Japan	33.65	20.7	30.46	7.48	6.15	5.09	4.78	4.57	2	2.88
Malaysia	72	39	39.6	33.9	39.6	17.1	17.3	25.1	22.9	23.2
Philippines	70.7	49.5	66.2	37.9	21.2	10.1	7.1	21.7	16.7	15.7
South Korea	47.35	16.1	27.72	11.28	3.39	3.93	6.06	6.66	5.16	4.92
Average	47.45	27.36	40.63	22.02	15.02	7.64	10.20	16.48	10.68	12.40
Standard Deviation	24.75	17.14	22.85	14.83	13.31	5.32	8.30	11.99	8.25	9.64
Coefficient of Variation	52.16	62.65	56.23	67.36	88.60	69.65	81.42	72.76	77.26	77.70

Source: UNESCO (2015).

The interaction with the client customers in the era of information technology have been considered most significant. Therefore all the country firms rated it very highly except Indonesian firms. Two network channels, that is, competitors and commercial consultants and private R&D institutions, were accorded low priority by firms across the board. Among all the preferred channels of information, the lowest preference firms were institutions/universities of higher learning. Firms from China, Malaysia, and India had shown higher preference to obtain input from the public research institutes as compared with Japan, South Korea and Philippines. However, Indonesia showed exceptionally lower preference. Trade fairs, scientific journals' publications and interaction with professional industry associations are other important channels firms used to enhance their innovativeness across Asian countries.

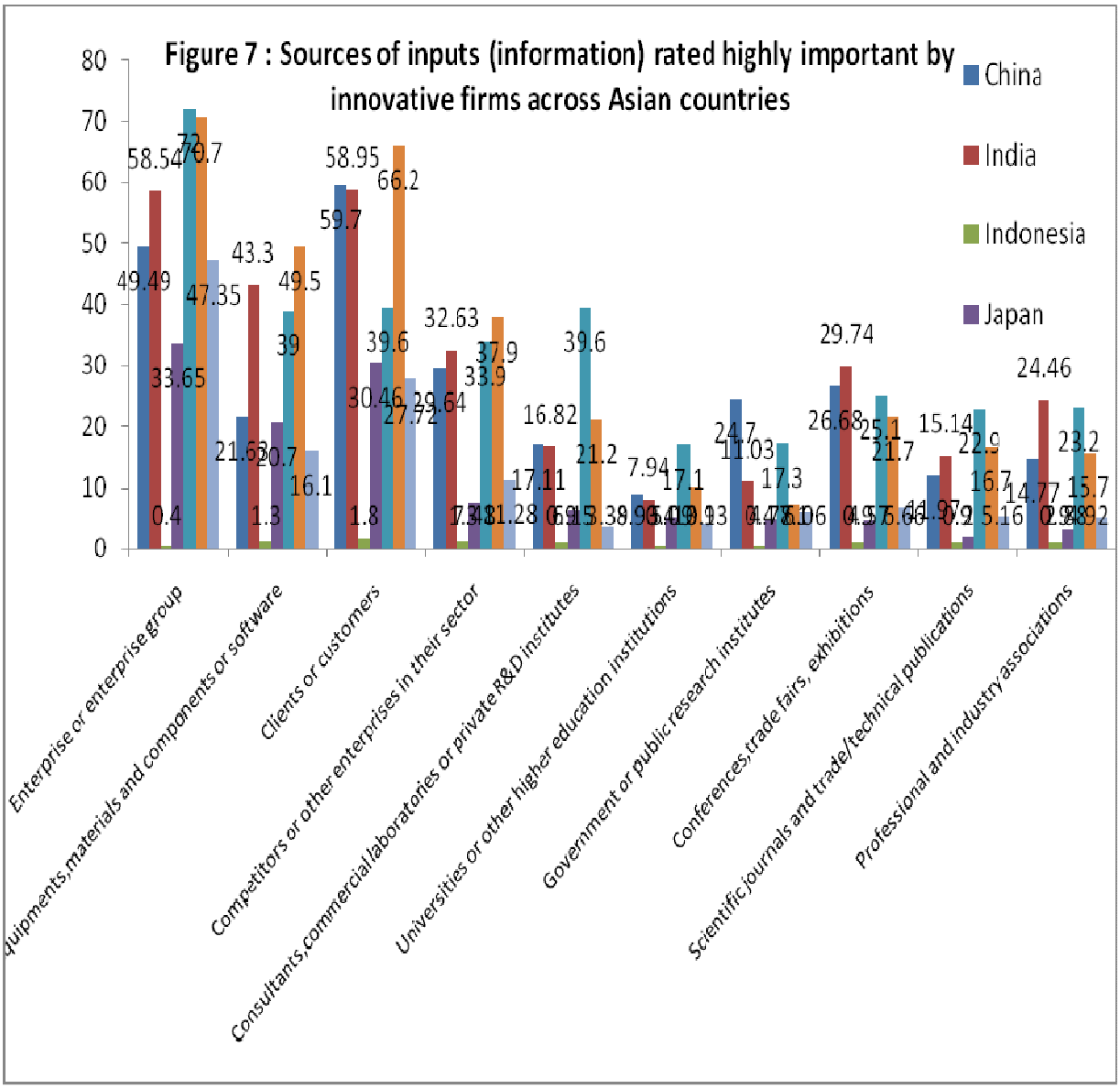
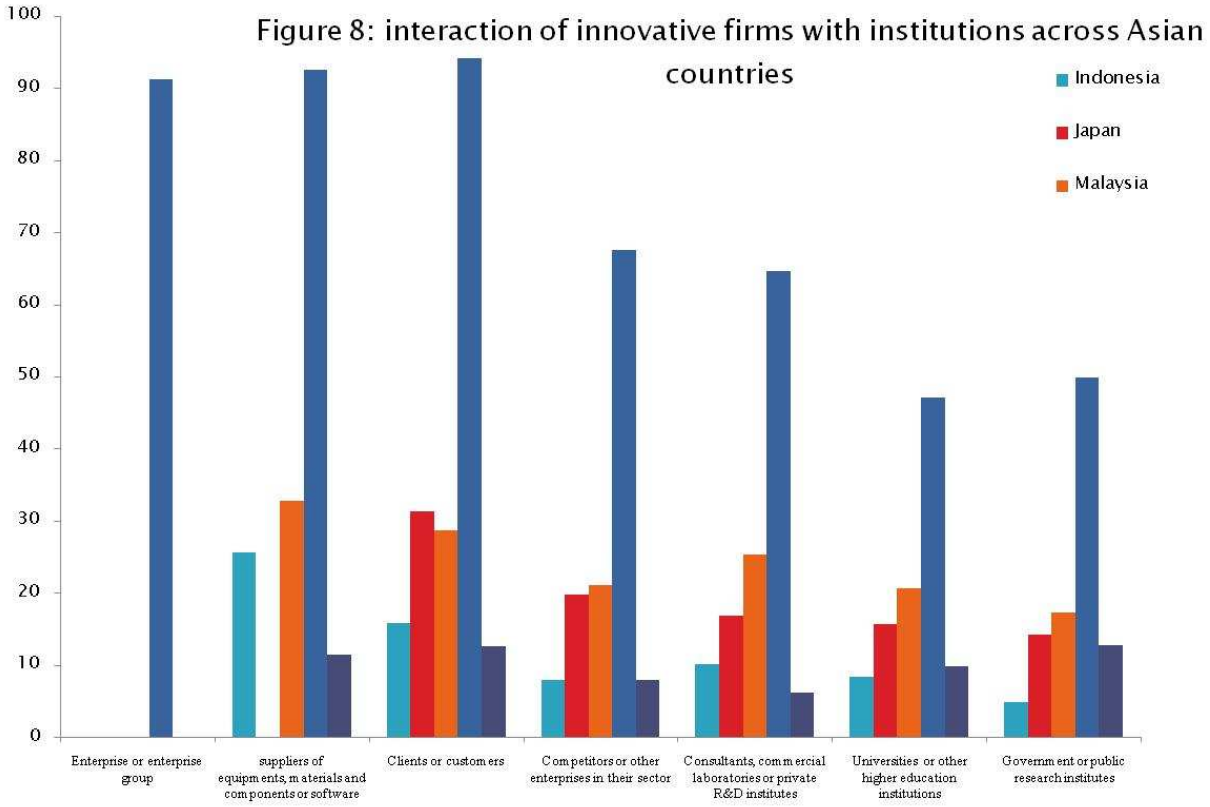


Table 6: Interaction of innovative firms with institutions across Asian countries

Country	Enterprise or enterprise group	suppliers of equipment, materials and components or software	Clients or customers	Competitors or other enterprises in their sector	Consultants, commercial laboratories or private R&D institutes	Universities or other higher education institutions	Government or public research institutes
Indonesia	-	25.7	15.9	8	10.2	8.4	4.9
Japan	-	-	31.45	19.88	16.9	15.7	14.37
Malaysia	-	32.85	28.8	21.19	25.47	20.71	17.38
Philippines	91.2	92.6	94.1	67.6	64.7	47.1	50
Republic of Korea	-	11.51	12.75	8.08	6.27	9.99	12.8
Average	-	40.67	36.60	24.95	24.71	20.38	19.89
Standard Deviation	-	35.74	33.13	24.65	23.51	15.71	17.45
Coefficient of Variation	-	87.89	90.52	98.80	95.16	77.09	87.74

Source: UNESCO (2015).



An important way through which active innovative firms seek cooperation, collaborations and joint projects that determine the capabilities of the firms to innovate is active participation in joint projects with other organizations and public institutions. The university/public research institutions-industry interaction has drawn the attention of several scholars across developed and developing countries (Kruss et al 2015; Schiller and Lee 2015). When firms establish in house R&D laboratories and encounter problems in realizing specific objectives, they seek support from external sources such as public research institutions/universities and partners. At that stage the form of interaction turns out to be joint projects/cooperation and contract research (Schiller and Lee 2015:64). There are seven institutions that have been identified among the Asian countries which use this channel of cooperation/joint projects by the firms for enhancing innovative capabilities. Firms from China and India have not reported participation in such activities (Table 6 and Figure 8). It is important to note here that among the East Asian countries, Philippines firms have highly shown their participation in all the channels for developing joint projects. Joint research and innovative activity in which largest proportion of firms cooperated was with client/customers (94.1 per cent) and lowest proportion was with university/institutions of higher learning. Firms from Japan and Malaysia also have established cooperation/joint project with the client/customers. This source was accorded highest priority by these country firms. There are wide variations observed from the very high value of coefficients of variations across all the channels of joint R&D projects. Except enterprise group, the South Korean firms established cooperation/joint R&D projects, but the proportion of innovative firms involved in this channel has remained quite small. However, the public research institutions attracted largest proportion of South Korean firms. This is quite understandable since the government of South Korea, as a matter of policy, has encouraged firms to establish cooperation and draw benefits out of the public funded research (Singh and Bhangoo 2014).

IV. Barriers to Innovations across Active Innovative and Non-innovative Asian Firms

It is a matter of great concern for policy makers that to ensure competitiveness of firms both in the domestic and international markets, the roadblocks faced by firms be gradually reduced or eliminated. Firms and their associations are usually working with the government and exert significant influence in introducing suitable changes in public policy. The economic theory of lobbying is a testimony to this. However, this process of seeking more and more favorable facilities for enhancing capabilities of the firms is an unending process because the environment in which firms interact is dynamic. Another factor that keeps firms at tenterhooks is the contestability of their competitive advantage (Baumol 1982). Therefore, it is imperative to examine the problems encountered by the active innovative firms and also non-innovative firms that constitute majority of sampled firms. The active innovative firms across Asian countries reported mainly 11 barriers faced by the firms which can be classified in four broad categories as cost factors, knowledge factors, market factors and factors prohibiting innovations and are reported in Table 7 and through Figure 9.

There are wide variations across countries regarding factors that determine the height of the barriers faced by the active innovative firms as observed from the values of the coefficients of variation. An important factor that emerged from the analysis is the availability of financial resources for incurring expenditure on innovation projects. 58.71 per cent and 50.47 per cent firms of India and Malaysia respectively reported lack of funds. In fact, it is a very high

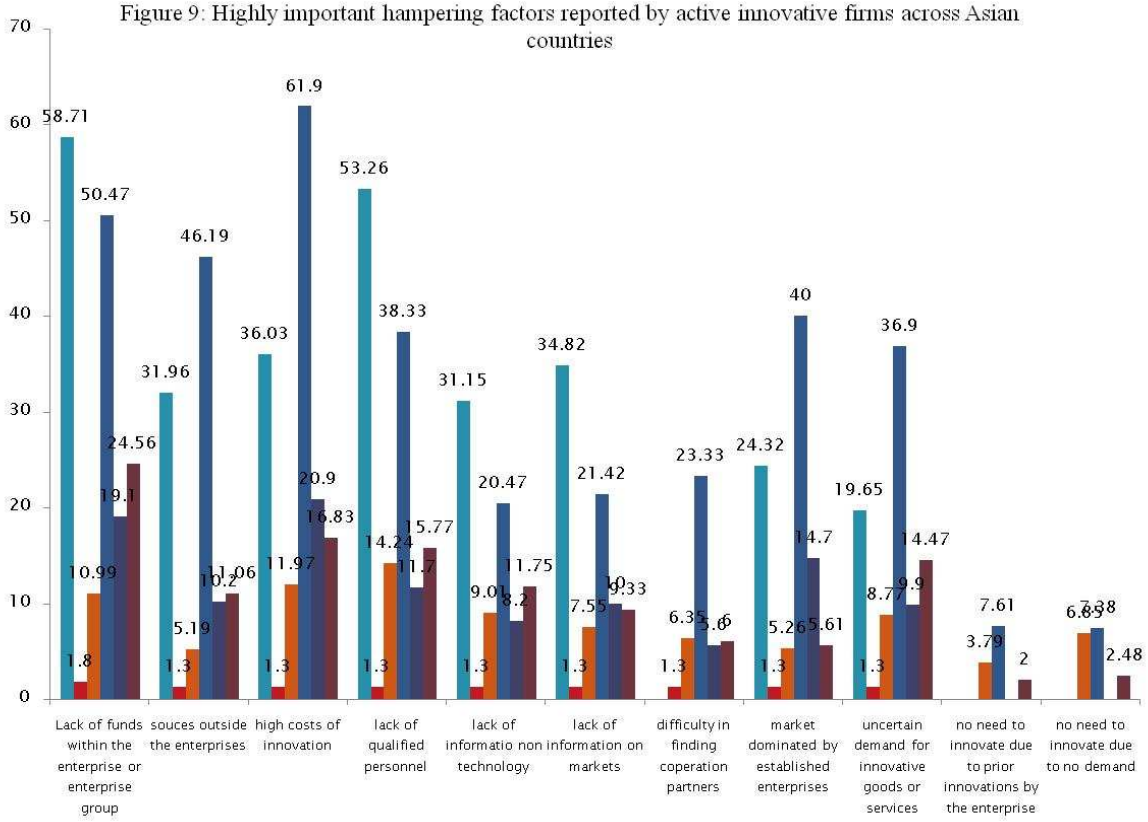
proportion of firms suffering from fund crunch. However, only 24.56 per cent firms from South Korea reported shortages of funds to finance innovations. It is important to note that in Japan active innovative firms that are facing lack of funds within the firm are very low (10.99 per cent). The lack of access to outside sources of finance is quite high among the active innovative firms in the countries of Malaysia and India. However, in other countries of Asia, the lack of access to finance is reported, but it is very low. As low as 5.19 per cent of the active innovative firms from Japan reported lack of external sources of finance. So far as the cost involved in innovations is concerned, a very high proportion of Malaysian firms (61.9 per cent) reported that innovations are highly costly. This proportion for Indian firms is 36.03 per cent. The other East Asian countries reported low proportion of firms but this problem is very much in existence in highly developed countries such as Japan and South Korea as well.

Table 7: Highly important hampering factors reported by active innovative firms across Asian countries

Country	India	Indonesia	Japan	Malaysia	Philippines	Republic of Korea	Average	Standard Deviation	Coefficient of Variation
Lack of funds within the enterprise or enterprise group	58.71	1.8	10.99	50.47	19.1	24.56	27.61	22.42	81.23
Sources outside the enterprises	31.96	1.3	5.19	46.19	10.2	11.06	17.65	17.55	99.46
High costs of innovation	36.03	1.3	11.97	61.9	20.9	16.83	24.82	21.44	86.37
Lack of qualified personnel	53.26	1.3	14.24	38.33	11.7	15.77	22.43	19.37	86.35
Lack of information non technology	31.15	1.3	9.01	20.47	8.2	11.75	13.65	10.58	77.56
Lack of information on markets	34.82	1.3	7.55	21.42	10	9.33	14.07	12.08	85.83
Difficulty in finding co-operation partners		1.3	6.35	23.33	5.6	6	8.52	8.53	100.17
Market dominated by established enterprises	24.32	1.3	5.26	40	14.7	5.61	15.2	14.71	96.81
Uncertain demand for innovative goods or services	19.65	1.3	8.77	36.9	9.9	14.47	15.17	12.28	80.97
No need to innovate due to prior innovations by the enterprise			3.79	7.61		2	4.47	2.87	64.15
No need to innovate due to no demand			6.85	7.38		2.48	5.57	2.69	48.28

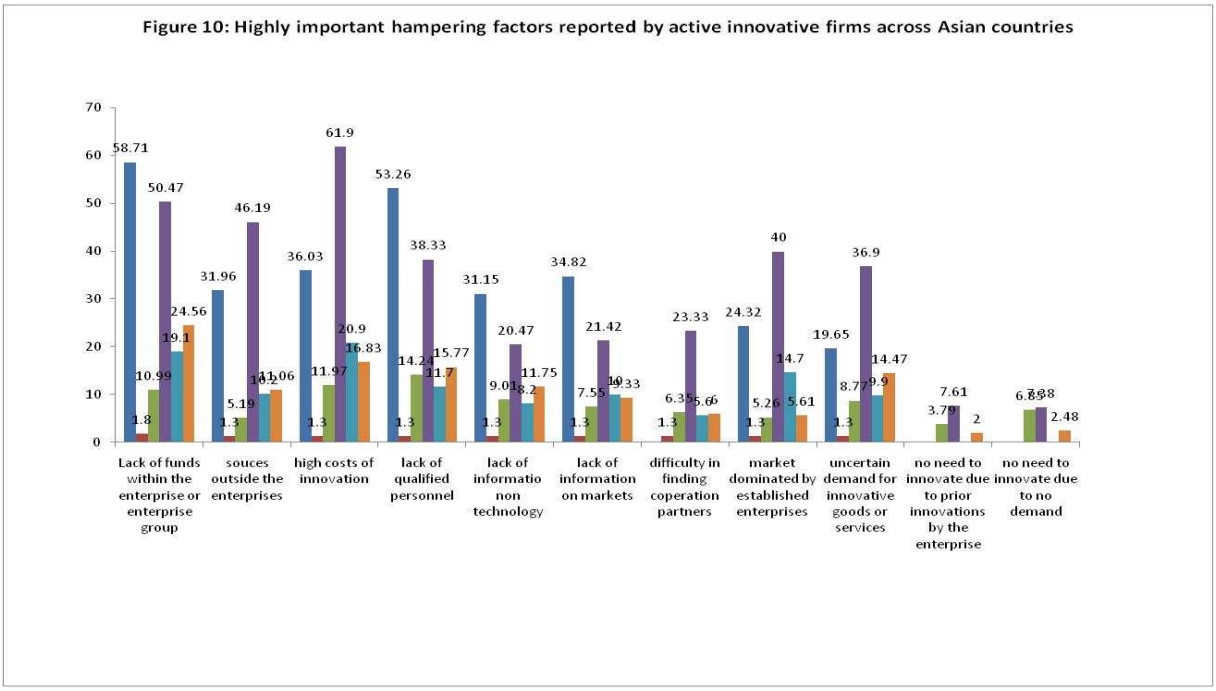
Source: UNESCO (2015).

Figure 9: Highly important hampering factors reported by active innovative firms across Asian countries



The second set of barriers reported by the active innovative firms across Asian countries is related to access to knowledge. Skilled manpower shortages were reported as high as 53.26 per cent of active innovative firms of India, followed by Malaysia (38.33 per cent). Firms from South Korea and Japan also reported lack of qualified personnel that can be employed in R&D projects, but it is a very low proportion of firms (15.77 per cent and 14.24 per cent respectively) compared with India and Malaysia who rated this problem highly. It is important to note that the Asian countries are at different stages of technological maturity. Japan and Korea are at the frontiers of knowledge in most important industrial products and therefore the barriers faced by the firms in the area of knowledge factors are very low. In the case of early stage of technological development like India and Malaysia, high proportion of their active innovative firms is facing higher degree of barriers. This is obvious because the national innovation system has not developed to the extent that it can provide the firms access to knowledge sources with ease. It is interesting to note that the marketing factors that hamper innovations are very low in the case of highly developed Asian countries. It is well known that majority of the innovative firms belongs to the large sized category of firms in Japan and South Korea, therefore, a low proportion of firms reported market dominance of large firms in these countries. However, a very high proportion of firms from Malaysia and India reported this problem (Table 7). The uncertainty of demand is relatively very high in medium stage of innovative firms compared with the early and mature stage of innovative country firms. The two factors come under the category of reasons to not to be innovative show that a very low proportion of firms from Malaysia, Japan

and South Korea reported problems in this category. However, the other three countries' firms have not reported about these factors at all.



The non-innovative firms from Asian countries also reported barriers that inhibit them from participation in the process of innovations. The most important factor that is highly ranked is lack of internal funds with the enterprises (Table 8 and Figure 10). The proportion of Indian firms (67.15 per cent) is very high which have been affected due to lack of funds within firms, followed by Malaysian firms (38.17 per cent) and Philippines firms (23.9 per cent). In case of non-innovative firms in South Korea and Japan, the incidence of lack of internal funds is relatively low. The other cost factors which are external (lack of funds outside enterprise and cost of innovations) to the firms also present somewhat similar picture across Asian countries. The other set of factors that increases the barrier to the non-innovative firms to enter in the process of innovations are shortage of qualified personnel, non-availability of information regarding technology and markets, and also lack of R&D project partners. These factors are related to knowledge acquisition by the firms. The dominance of large sized firms in the market and high degree of uncertainty regarding demand for innovative goods and services are the other barriers valued very highly by the Asian firms. However, the wide variations regarding these characteristics that inhibit non-innovative firms to participate in innovations were reported across Asian countries. The availability of information regarding existence of prior innovations and expected lack of demand for new innovations are the other two factors reported by the firms from Japan, South Korea and Philippines. It is significant to note that incidence of firms who have reported on these factors as well as the coefficient of variation across East Asian countries is very low.

Table 8: Highly important hampering factors reported by non- innovative manufacturing firms across Asian countries

Country	India	Indonesia	Japan	Malaysia	Philippines	Republic of Korea	Average	Standard Deviation	Coefficient of Variation
Lack of funds within the enterprise or enterprise group	67.15	0.8	10.79	38.17	23.9	10.81	25.27	24.24774	95.95465
Sources outside the enterprises	43.75	0.6	4.12	32.2	14.5	3.94	16.51833	17.64584	106.8258
High costs of innovation	28.5	0.8	8.98	45.11	26	5.81	19.2	16.88999	87.96869
Lack of qualified personnel	44.21	0.6	11.1	35.33	9.5	5.99	17.78833	17.62886	99.10352
Lack of information non technology	32.09	0.6	7.8	12.61	13.3	3.45	11.64167	11.18573	96.08354
Lack of information on markets	35.02	0.6	6.45	13.24	8.2	3.51	11.17	12.44674	111.4301
Difficulty in finding cooperation partners	-	0.6	5.69	12.61	8.6	2.61	6.022	4.774879	79.29059
Market dominated by established enterprises	23.7	0.6	5.25	34.4	16	2.43	13.73	13.4447	97.92208
Uncertain demand for innovative goods or services	20.3	0.6	7.09	32.49	12.1	6.41	13.165	11.54048	87.66028
No need to innovate due to prior innovations by the enterprise	-	-	4	6.62	7.4	3.42	5.36	1.946141	36.30861
No need to innovate due to no demand	-	-	7.62	5.99	13	12.42	9.7575	3.481651	35.68179

Source: UNESCO (2015).

VI. Conclusions

This paper has examined the rise of Asian firms in the global context and their increasing innovation capabilities. The theory of growth of the firm has also been reviewed to identify the theoretical basis of the rise of firms. The theory has underlined multiple factors that contribute to the expansion and growth of firms. The evolutionary-capability-learning approach supplemented by the national innovation framework seems to explain better the recent rise of Asian firms in the global markets. It is further complemented by the OLI theory that brings out unique competitive advantage encourages firms to internationalize. Empirical studies following evolutionary technology capability approach examined Asian firms and the evolution of innovation capabilities in the process of catching up. These studies have been based on thin sample as well as successful firms and suffer from usual sample selection bias. This paper based on Oslo manual approach based survey conducted across Asian countries and data compiled by UNESCO (2013) examined the extent of manufacturing firms' innovation capabilities, sources of innovations and barriers to innovations of seven Asian countries.

The analysis of technological innovations and social innovations across Asian countries shows that on an average the participation of manufacturing firms in social innovations is higher than the technological innovations. The low variations across active innovative firms in the Asian countries imply that the innovation activities to develop product and process innovations are stable and rising. The relationship between level of economic development approximated by per capita income and active innovative firms of Asian countries is negative and elasticity coefficient is -0.11. This finding clearly brings out the tendency toward catch up in innovation intensity among the Asian countries. Furthermore, the finding is further confirmed when we have enlarged the scope of the sample to 21 developing countries. Contrary to this, the relationship between innovation intensity and per capita income of developed countries is positive and significant. Thus the incidence of innovation intensity is rises more or less in line with per capita income. An important finding that depicts the relationship between the ratio of product to process innovation firms and level of economic development reflected through per capita income based on sample of 54 developed and developing countries shows tendency towards product innovations. This implies that the transition of firms from process innovation to product innovation occurs with the level of economic development.

The analysis of the innovation intensity across firm size classes among the East Asian countries shows the tendency toward concentration of active innovative firms in the large size classes. India’s innovative firms, however, form the inverted-u-shaped relationship and high degree of innovations are concentrated in the medium sized category of firms. Social innovations in Japan, South Korea and Malaysia confirmed the regular trend across the size classes where as medium sized firms across India, Indonesia and Philippines dominates in social innovations. Across industrial categories innovation intensity analysis shows that the firms from Japan and South Korea are competing in almost in the same product lines. However, Indian firms are active in innovations in different line of manufacturing products compared with Japan and South Korea.

Among the sources of innovations, the most important source of innovation turns out to be in-house R&D expenditure. In Asian countries, South Korean firms were the leading lights in terms of developing in-house R&D projects. On the whole, East Asian firms are highly in-house R&D intensive whereas Indian firms have low in-house R&D intensities. There are wide

variations observed across Asian countries using inter-enterprise network of relationship in enhancing knowledge for innovation performance. Firms from China, Malaysia and India had shown high preference to obtain inputs from public research institutes as compared with Japan, South Korea and Philippines. The major finding that emerges from the analysis of the barrier to innovative and non innovative firms is the deficiency of internal and external finances, except firms of Japan and South Korea. The environmental constraints are more important in the case of firms from Asian countries where the national innovation system is at nascent phase. Therefore, it suggested that public policy should accord higher priority to invest higher proportion of resources in innovations to relieve the firms from such constraints.

Notes:

1. The data set developed by UNESCO Institute for Statistics (UIS) published in the year 2015 is used for analysis in the paper. The UIS innovation data was collected in 2013 and country experts were involved while collecting data. The countries were asked to report data only for manufacturing firms. As stated in the UNESCO (2015) "this was a deliberate choice that aimed to foster comparability, as customarily manufacturing industries are fully – or at least almost fully – covered in innovation surveys". The collection of data was based on the concept of innovation developed in the Oslo manual. It defines innovations as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. A common feature of an innovation is that it must have been implemented. An innovation does not need to be commercially successful. The four concepts of innovations used to collect data are defined as follows:
   - **(i)** **Product innovation** is the implementation of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness, or other functional characteristics. Firms that implemented at least one product innovation are product innovators.
   - **(ii)** **Process innovation** is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. Firms that implemented at least one process innovation are process innovators. These two innovations are described as technological innovations.
   - **(iii)** **Organizational innovation** is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations. Firms that implemented at least one organizational innovation are organizational innovators.
   - **(iv)** **Marketing innovation** is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion, or pricing. Firms that implemented at least one marketing innovation are marketing innovators. Organization and marketing innovations are described as social innovations.

2. **Innovation-active firms** are those that implemented product or process innovations or had abandoned or ongoing innovation activities to develop product or process innovations. **Innovative firms**, in turn, only include those firms that really implemented product or process innovations or both.

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