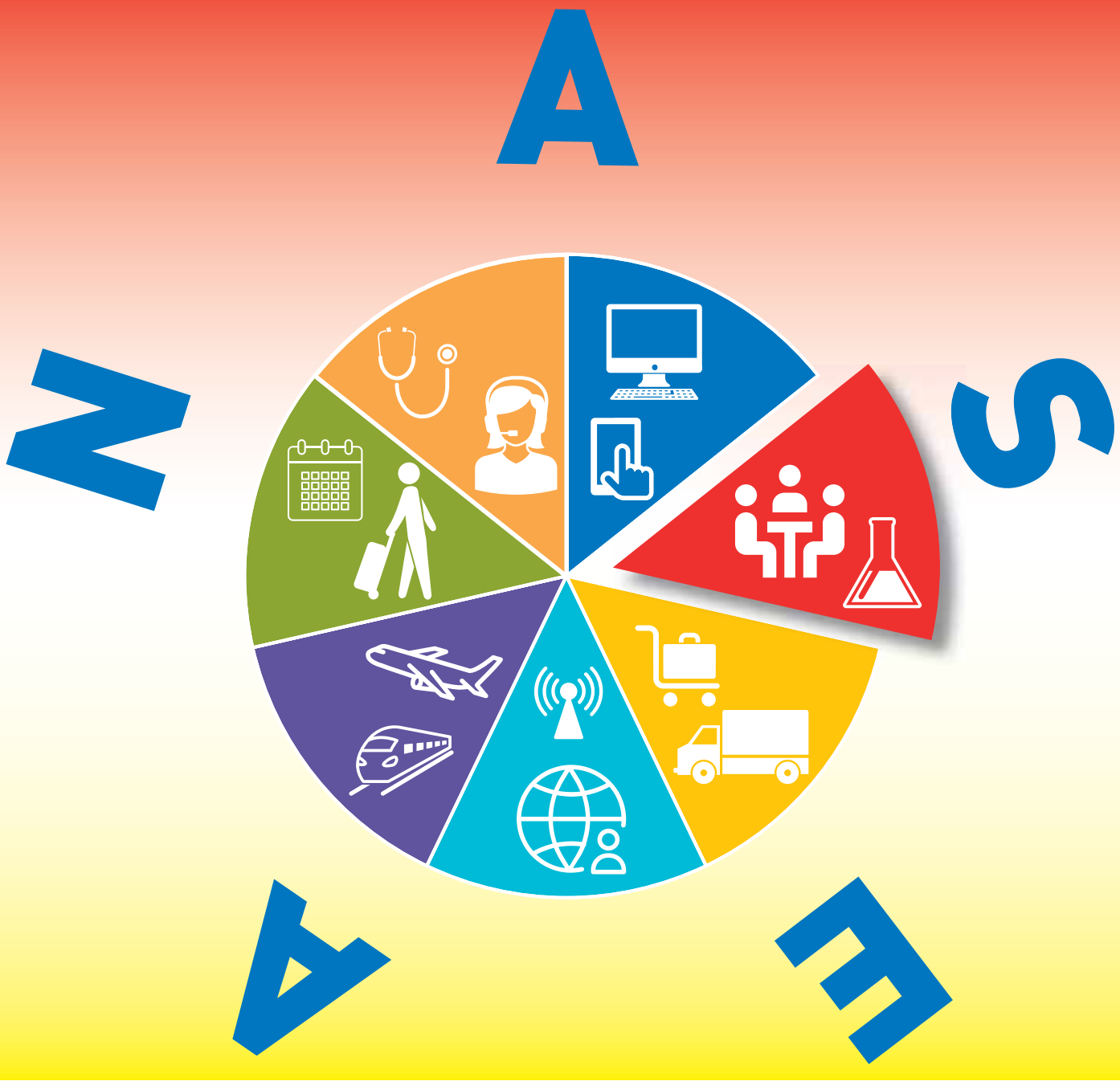
Promoting Services Trade in ASEAN

Trade in Research and Development Services

PAPER 2

FEBRUARY 2017



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NOTES

The terms country and/or economy as used in this study also refer, as appropriate, to territories or areas; the designations employed and the presentation of the material do not imply the expression of any opinion whatsoever on the part of the ASEAN-Japan Centre concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The following symbols have been used in the tables:

- Two dots (..) indicate that data are not available or are not separately reported.
- A dash (-) indicates that the item is equal to zero or its value is negligible.
- Use of a dash (–) between dates representing years, e.g., 2015–2016, signifies the full period involved, including the beginning and end years.
- Reference to "dollars" ($) means United States dollars, unless otherwise indicated.

There are seven papers in total. The other six papers cover professional services; computer and related services; courier services; telecommunication services; air, rail and road transport services; and tourism.

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CONTENTS

I. INTRODUCTION

Research and development (R&D) services are an indispensable input into the economic activities of ASEAN. The World Trade Organization (WTO) lists the following three job categories under "Research and Development Services":

a. R&D services in natural sciences;

b. R&D services in social sciences and humanities; and

c. Interdisciplinary R&D services

R&D services play an important role in value-creating economic activities as depicted by the value chain curve (figure 1). The coverage (the shaded area in the figure) of R&D services are located at the upstream part of the value chain curve. R&D services enable more efficient operation of the country's entire value-creating activities with a large impact on the assembly part of the chains, as the upward arrows in the figure indicate. Like professional services, R&D services are the provision of professional information, and the importance of R&D services tends to rise with economic development. In the ASEAN region, which records rigorous economic progress, the role of R&D services is becoming larger year after year.

As recognized widely, R&D services can promote economic growth in the ASEAN region, as evidenced by quantitative research on developed countries' experiences (e.g., Okabe, 2006). The sector, however, is subject to positive externality: in other words, other companies can also benefit from R&D activities through demonstration effects, technology spillovers and reverse engineering. R&D services might be under-supplied. Table 1 shows R&D expenditure as a percentage of GDP. More developed ASEAN countries (Singapore and Malaysia specifically) show higher percentages; as for the remaining ASEAN Member States, data are either not available or negligible.

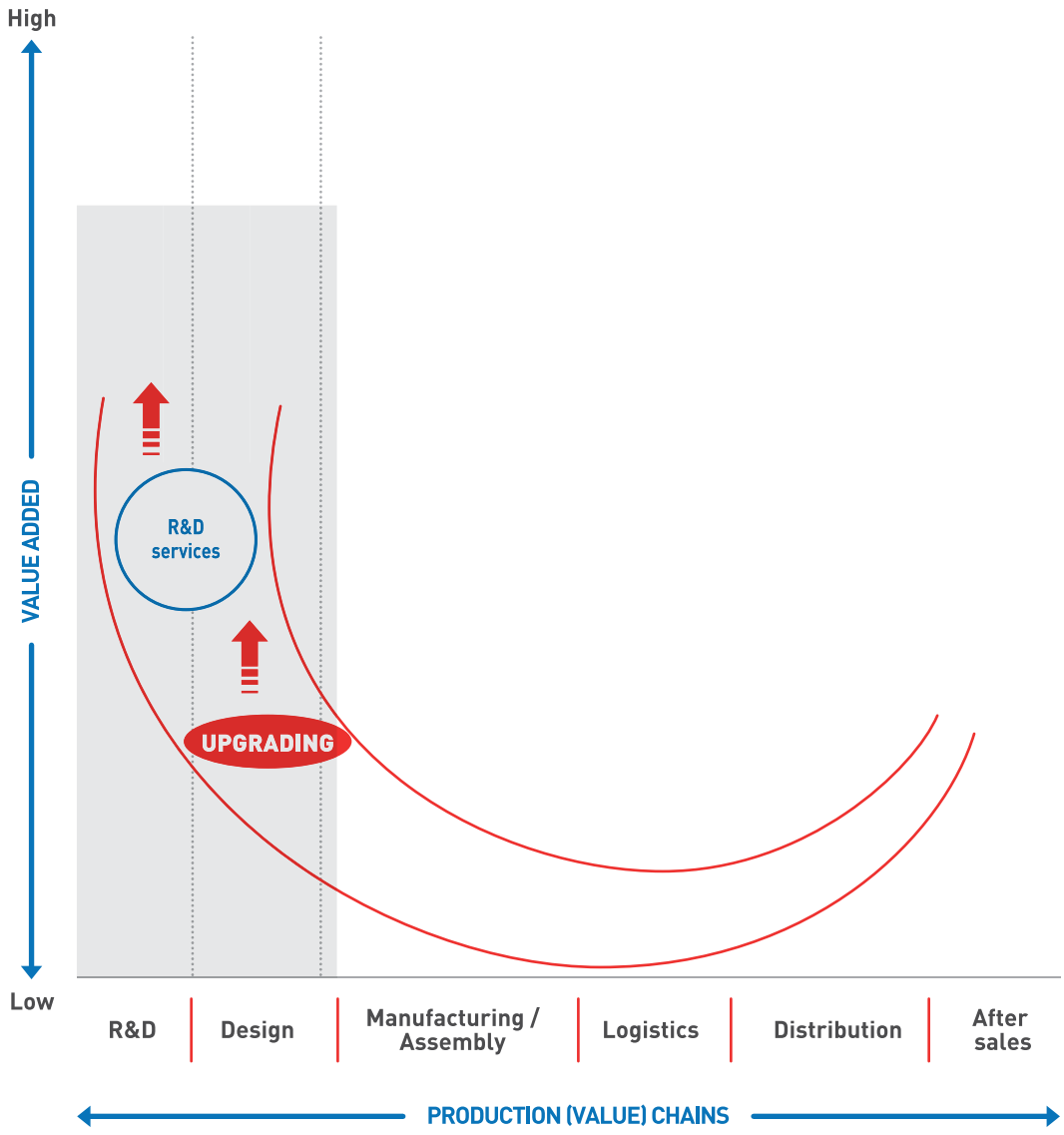
Table 1. **R&D expenditure as a share of GDP** (Per cent)

Country	2006	2007	2008	2009	2010	2011	2012	2013	2014
Brunei Darussalam		..	..	..	..	..	..	..	..
Cambodia	..	..	..	..	..	..	..	..	..
Indonesia	..	..	..	0,08	..	..	..	0,08	..
Lao People's Democratic Republic	..	..	..	..	..	..	..	..	..
Malaysia	0,61	..	0,79	1,01	1,04	1,03	1,09	..	1,26
Myanmar	..	..	..	..	..	..	..	..	..
Philippines	..	0,11	..	0,11	..	0,12	..	0,14	..
Singapore	2,13	2,34	2,62	2,16	2,01	2,15	2	2	2,19
Thailand	0,23	0,2	..	0,23	..	0,36	..	..	0,48
Viet Nam	..	..	..	..	..	0,19	..	..	..
(Memorandum)									
China	1,38	1,38	1,46	1,68	1,73	1,79	1,93	2,01	2,05
Japan	3,41	3,46	3,47	3,36	3,25	3,38	3,34	3,47	3,58
United States	2,55	2,63	2,77	2,82	2,74	2,76	2,7	2,73	..

Source: World Bank, World Development Indicators.

Market regulation needs to be introduced to correct this situation. At the same time, the market for R&D services in ASEAN should embrace further market liberalization. Thus, the main objective of regulatory measures for R&D services is to increase the volume, efficiency and effectiveness of R&D, enhancing the level of value creation, especially at the upstream part of the value chain curves, while avoiding market failure for under-supply of such services.

Figure 1. **Value chains and R&D services**



Source: AJC.

II. TRENDS IN SUPPLY OF R&D AND RELATED SERVICES

Estimates were made to gauge the supply of R&D services through four modes (Mode 1 to Mode 4). Unlike other services, Mode 3 does not occupy an important position in delivering R&D services to foreign markets (table 2). The supply of R&D services through both Mode 2 and Mode 4 is small. Looking at ASEAN Member States as importers of R&D services shows, however, a somewhat different picture: data on the number of patents and trademarks granted or applied for demonstrates that foreigners are predominant in intellectual property rights, accounting for 80–90 per cent of the total cases (annex B). Imports (payments) of R&D services were five times larger than exports (receipts) in 2013–2014 (tables 3 and 4).

Table 2. **Estimated value and share of R&D services supply in ASEAN, by mode of supply, 2014** (Billions of dollars and per cent)

	Receipts from the world				Supply to the world			
	R&D services		Total services		R&D services		Total services	
Mode of supply	Value	Share	Value	Share[a]	Value	Share	Value	Share[a]
Mode 1			330[b]	30	2	50	317[b]	30
Mode 2	3	30	110	10	0,7	18	106	10
Mode 3	5	50	605	55	1	25	581	55
Mode 4	2	20	55	5	0,3	8	53	5
Total	**10**	**100**	**1 100**	**100**	**4**	**100**	**1 057**	**100**

Source: AJC based on own estimates, UNCTAD for total services and WTO for the mode shares of total services.
Note: For R&D services,the AJC calculation is based on data in this study. For total services, each mode share estimated by the WTO for the global supply is applied to ASEAN. The basic data for estimates by different mode are cross-border services (Mode 1) from UNCTAD. Shares in each mode are applied to calculate the value of each mode. Data for 2014 are used, as the 2015 data include an anomaly.
a WTO data.
b UNCTAD.

1. Export performance (Mode 1)

R&D services are part of "other business services" as categorized under the balance-of-payments statistics. Only three countries have data for R&D services separately; they are the Philippines, Singapore and Thailand. Other countries' data are estimated on the basis of the ratio of R&D services to "other business services" from these three countries.

With these data estimation problems in mind, it can be said that the trade volume of R&D services has been on an increasing trend for all the ASEAN Member States, according to their exports/imports of R&D services[1] (tables 3 and 4 and annex A), as well as royalty and license fees and number of patents and trademarks, both of which represent the success and use of R&D (box 1 and annex A).

[1] Although the categorization used here is unique to the international balance of payments and not in line with the services trade categorization under the WTO's General Agreement on Trade in Services (GATS), it is still helpful to make sectoral observations..

Box 1. **Results of R&D activities: "royalty and license fees" and "patents and trademarks"** (Continuded)

Royalty and License fees:

In order to approximate the value of R&D activities that are undertaken in other countries, data on royalty and license fees which are captured in the balance of payments provide an useful indicator, though they are the consequence and use of R&D activities, rather than undertaking R&D itself. Therefore, the larger the amount is, the more the intellectual property rights are supposed to be used. It does not necessarily measure the R&D activities undertaken.

All ASEAN Member States pay more than they receive from the use of intellectual property rights or the results of R&D (annex A). As a group, ASEAN Member States pay eight times more than what they receive. Therefore, ASEAN is the user, rather than the undertaker of R&D. This also supports the view that ASEAN imports R&D services more than exports.

Although small, except in the Philippines and Viet Nam where trend lines are negative (box table 1), receipts or exports of royalty and license fees have been rising over the years. In other words, ASEAN firms are engaged in R&D activities and exporting them under the contract of licensing, franchising or any other intellectual property arrangements that guarantee payments for use by foreign countries.

Box Table 1. **Exports (receipts) and the slope of the trend line of "royalties and license fees"**

Country (latest data)	Amount of receipts (US$ million) in the latest year	Slope of trend line, 2005-2014
Brunei Darussalam	..	..
Cambodia (2013)	2,4	0,4603
Indonesia (2014)	60	0,018
Lao People's Democratic Republic	..	..
Malaysia (2014)	76	0,1445
Myanmar	..	..
Philippines (2014)	10	-0,0451
Singapore (2014)	3 152	0,2173
Thailand (2014)	212	0,2599
Viet Nam (2014)	3,1	-0,2298
ASEAN average	**502**	**0,1179**
(Memorandum)		
China (2014)	676	0,1843
Japan (2014)	36 877	0,0715
Korea, Rep. of (2014)	5 151	0,1245
India (2014)	657	0,1789

Source: AJC, based on balance-of-payments data from individual countries.

Patents and trademarks:

Statistics on intellectual properties reveals another aspect of liberalization and deregulation in the R&D services, in that increases in patent filings by foreigners may stimulate domestic patent filing. Based on annex B, which lists statistical data concerning intellectual property rights (IPRs), the following observations can be made about patents by country (calculated on an application basis only for Brunei Darussalam; for the other ASEAN Member States, figures on a granting basis are given):

Box 1. **Results of R&D activities: "royalty and license fees" and "patents and trademarks"** (Concluded)

- Brunei Darussalam: the total number of patent application in 2014 is 41; foreign application of patent, trademark and industrial design is dominant;
- Cambodia: the total number of patents granted in 2014 is five, which is a rather low figure;
- Indonesia: the number of patents granted in 2014 is 771, which is much larger than in some ASEAN Member States;
- Lao People's Democratic Republic: the number of patents granted is not given; R&D activities in the country are still at an embryonic stage, as they are in Myanmar.
- Malaysia: the total number of patents granted in 2013 is 7,350 (data on other IPRs are not available), an impressive figure (the largest among the ASEAN Member States); the share of local patents is growing year after year; however, the foreign share is still dominant;
- Myanmar: the number of patents granted is not given; together with the Lao People's Democratic Republic, R&D activities in Myanmar is still at an embryonic stage;
- The Philippines: the total number of patents granted has been increasing, and in 2014 the figure is 608 (although there is no information on the share of local patents);
- Singapore: the total number of patents granted has been increasing drastically, and the figure for 2014 is 5,930, the second largest figure among the ASEAN Member States;
- Thailand: the total number of patents granted is increasing year after year, and the figure for 2014 is 1,405; and
- Viet Nam: the total number of patents granted is on an increasing trend, and the figure for 2014 is 561.

Judging from the number of patents across the ASEAN Member States, there is a wide disparity among ASEAN members in terms of IPR-related activities. Though, like royalty and license fees, there is an increasing trend overall.

Exports to the world. The annual average of ASEAN exports in R&D services were some $2 billion recently (except for 2015, for reasons described below), less than 1 per cent of total services exports from ASEAN (table 3). The relative size of exports of R&D services from Indonesia and Malaysia has been consistently high. In terms of share in total services, Indonesia is the largest exporter. Thailand experienced one-time large exports in 2015, and given that imports to Thailand were also huge in that year, there might be some statistical adjustments to be made. Both Singapore and Thailand exhibit higher exports in R&D services than other countries, reflecting the countries' outward-oriented R&D policy; however, the value of exports is one fifth that of imports. Although ASEAN has been engaged in more and more R&D activities (see Section IV on the impact), the group relies more on foreign R&D. This can be observed in the rise of imports of R&D services: ASEAN firms use foreign technologies.

Imports from the world. ASEAN imported R&D services with a value of more than $10 billion recently, accounting for 3 per cent of ASEAN's services imports (table 4). The data for 2015 were inexplicably high for Thailand; but, generally speaking, Singapore is the largest importer, followed at a far distance by Malaysia and Indonesia.

Small or even negligible amounts and shares of R&D services in ASEAN in both accounts, exports and imports, are due not only to difficulties with and unwillingness to conduct cross-border transactions through normal trade modes but also to the burgeoning state of undertaking and using R&D in ASEAN countries other than Singapore.

Table 3. **Exports of R&D services and their share in total exports of services, goods and services, 2005-2015** (Millions of dollars and per cent)

Country	Annual average 2005-2010	2011	2012	2013	2014	2015
R&D services exports						
Brunei Darussalam	9	11	11	10	10	..
Cambodia	4	7	9	13	13	5
Indonesia	143	298	398	341	310	247
Lao People's Democratic Republic	..	..	..	..	..	..
Malaysia	183	334	394	422	361	292
Myanmar	3	2	9	16	40	
Philippines	15	16	18	15	59	94
Singapore	320	521	333	880	700	664
Thailand	355	561	474	539	528	8 924
Viet Nam	4	3	3	14	15	..
ASEAN total	**1 036**	**1 752**	**1 647**	**2 249**	**2 037**	**10 227**
Share in total exports of services						
Brunei Darussalam	1,2	2,2	2,2	2,0	1,8	..
Cambodia	0,3	0,2	0,3	0,4	0,3	0,1
Indonesia	1,0	1,4	1,7	1,5	1,3	1,1
Lao People's Democratic Republic	..	..	..	..	..	..
Malaysia	0,7	0,9	1,0	1,0	0,9	0,8
Myanmar	1,0	0,2	0,7	0,6	1,0	0,8
Philippines	0,11	0,08	0,08	0,06	0,23	0,33
Singapore	2,91	0,40	0,26	0,62	0,46	0,5
Thailand	0,23	1,34	0,95	0,91	0,95	16,1
Viet Nam	0,06	0,03	0,03	0,13	0,14	..
ASEAN total	**0,6**	**0,7**	**0,6**	**0,7**	**0,6**	**3,4**
Share in total exports of goods and services						
Brunei Darussalam	0,1	0,1	0,1	0,1	0,1	..
Cambodia	0,1	0,1	0,1	0,1	0,1	0,0
Indonesia	0,1	0,1	0,2	0,2	0,2	0,1
Lao People's Democratic Republic	..	..	..	..	..	..
Malaysia	0,002	0,002	0,001	0,001	0,001	0,001
Myanmar	..	..	..	..	..	..
Philippines	0,03	0,02	0,02	0,02	0,08	0,13
Singapore	0,10	0,09	0,50	0,15	0,12	0,13
Thailand	0,20	0,22	0,17	0,19	0,19	3,27
Viet Nam	..	..	..	..	..	..
ASEAN total	**0,1**	**0,1**	**0,1**	**0,1**	**0,1**	**0,7**

Source: AJC, based on data from WGSITS (ASEAN Working Group on Statistics of International Trade in Services), IMF, UNCTAD and individual countries' balance-of-payments data.

Note: Data for R&D services, part of «other business servcices», are available only for the Philippines, Singapore and Thailand. Therefore the average ratio of R&D services to «other business services» for these three countries is applied to other ASEAN countries, except for the Lao People's Democratic Republic, whose «other business services» data are not available.

Table 4. **Imports of R&D services and their share in total exports of services, goods and services, 2005-2015** (Millions of dollars and per cent)

Country	Annual average, 2005-2010	2011	2012	2013	2014	2015
R&D services imports						
Brunei Darussalam	44	50	46	44	45	
Cambodia	8	11	12	13	22	13
Indonesia	844	1 018	1 231	1 203	1 093	1 170
Lao People's Democratic Republic	..	..	..	..	..	..
Malaysia	772	1 181	1 306	1 389	1 316	1 165
Myanmar	30	30	61	57	59	
Philippines	14	20	56	47	45	38
Singapore	2 268	3 712	3 611	9 056	7 792	5 606
Thailand	272	478	515	600	679	10 955
Viet Nam	28	53	55	129	146	..
ASEAN total	4 279	6 552	6 893	12 537	11 197	18 948
Share in total imports of services						
Brunei Darussalam	3,4	2,7	1,7	1,5	2,1	
Cambodia	1,0	0,8	0,8	0,7	1,1	0,7
Indonesia	3,5	3,2	3,6	3,4	3,3	3,9
Lao People's Democratic Republic						
Malaysia	2,8	3,1	3,0	3,1	2,9	2,9
Myanmar	4,9	2,8	4,2	2,6	2,3	
Philippines	0,2	0,2	0,4	0,3	0,2	0,2
Singapore	2,9	3,1	2,8	6,2	5,0	3,9
Thailand	0,7	0,9	1,0	1,1	1,3	21,6
Viet Nam	0,4	0,4	0,4	0,9	1,0	0,0
ASEAN total	2,3	2,4	2,4	3,9	3,4	6,1
Share in total imports of goods and services						
Brunei Darussalam	1,3	0,9	0,7	0,6	0,8	
Cambodia	0,1	0,1	0,1	0,1	0,2	0,1
Indonesia	0,8	0,5	0,6	0,6	0,5	0,7
Lao People's Democratic Republic	..	..	..	..	..	..
Malaysia	0,5	0,6	0,6	0,6	0,6	0,6
Myanmar	0,9	0,4	0,7	0,5	0,4	
Philippines	0,03	0,03	0,07	0,06	0,05	0,04
Singapore	0,7	0,8	0,7	1,8	1,5	1,3
Thailand	0,2	0,2	0,2	0,2	0,3	4,8
Viet Nam	0,04	0,05	0,05	0,09	0,10	0,00
ASEAN total	0,5	0,5	0,5	0,9	0,8	1,5

Source: AJC, based on data from WGSITS (ASEAN Working Group on Statistics of International Trade in Services), IMF, UNCTAD and individual countries' balance-of-payments data.

Note: Data for R&D services, part of «other business servcices», are available only for the Philippines, Singapore and Thailand. Therefore the average ratio of R&D services to «other business services» for these three countries is applied to other ASEAN Member States, except for the Lao People's Democratic Republic, whose «other business services» data are not available.

This is reflected in the export competiveness index,[2] which is generally negative or low because imports overwhelm exports. Among the countries that have actual data on R&D services, not estimated data, the index for the Philippines has been increasing steadily (0.48 in 2000, -0.45 in 2005, -0.29 in 2010 and 0.13 in 2014), while that for Singapore remains low (-0.82 in 2012 and -0.88 in 2013).[3]

Among ASEAN Member States, Myanmar, Thailand and the Philippines are growing faster in their R&D exports according to the trend line (table 5). What is notable is that overall, if the current trend continues, all ASEAN Member States will be increasing their exports of R&D services.

The low level of exports is due to low capacity in undertaking R&D. As discussed in detail later, there is a need for a comprehensive policy framework encompassing both the country in question and its partner countries. Even for those R&D activities undertaken in ASEAN Member States, foreign countries play an important role in contributing to ASEAN's exports of R&D through two channels: contribution by foreign affiliates operating in Member States and contribution of inputs sent directly from foreign partner countries. The former is related to Mode 3 and the latter to cross-border supply or Mode 1. This second channel is through the import of key information and inputs from abroad. In this connection, foreign import content in the R&D exports from ASEAN is another aspect of export competitiveness. Most ASEAN Member States display higher levels of foreign value added contents in their R&D services exports than do the East Asian Memorandum countries (China, Japan and the Republic of Korea) (table 6). Foreign inputs account for one fifth of ASEAN's total R&D exports. In

Table 5. **Slope of the export trend line of R&D services, 2005-2014**

Country	Slope of the trend line (in log)
Brunei Darussalam	0,0228
Cambodia	0,1013
Indonesia	0,0776
Lao People's Democratic Republic	..
Malaysia	0,0756
Myanmar	0,7116
Philippines	0,3686
Singapore	0,4591
Thailand	0,4591
Viet Nam	0,4420
ASEAN average	0,1603
(Memorandum)	
China	..
Japan	0,0526
Korea, Rep. of	0,0079
India	0,0663

Source: For ASEAN Member States, based on the balance-of-payments data from individual countries. For China, Japan, the Republic of Korea and India, based on the United Nations Service Trade Statistics Database.

2 The index is defined as (export value - import value)/(export value + import value).

3 In order to measure a long-term shift in competitiveness, the calculation here is based on the data provided by the United Nations Service Trade Statistics Database (http://unstats.un.org/unsd/servicetrade/default.aspx).

Table 6. **Foreign value added share of gross exports (to the world) for R&D and other business activities, 1995-2011** (Per cent)

Country	1995	2000	2005	2008	2009	2010	2011
Brunei Darussalam	13,0	13,7	12,8	14,4	14,7	13,9	13,2
Cambodia	16,0	24,2	24,1	25,8	22,1	22,3	21,6
Indonesia	9,9	11,4	13,3	12,5	10,6	10,5	10,9
Malaysia	13,0	25,2	21,0	19,3	19,1	19,1	19,6
Philippines	17,3	15,3	16,2	17,8	15,9	17,1	18,9
Singapore	29,1	32,2	31,2	31,6	32,5	32,6	32,1
Thailand	17,3	19,0	22,2	25,6	22,3	23,4	25,3
Viet Nam	20,6	23,5	23,0	31,1	20,2	18,6	20,9
ASEAN Average	**17,0**	**20,6**	**20,5**	**22,3**	**19,7**	**19,7**	**20,3**
(Memorandum)							
China	3,5	6,5	10,2	11,6	10,5	12,3	12,4
Japan	2,3	2,7	3,2	3,9	3,2	3,5	4,0
Korea, Rep. of	7,2	7,8	10,7	13,5	13,1	13,7	13,6

Source: OECD, Measuring Trade in Value Added: An OECD-WTO joint initiative (http://www.oecd.org/sti/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm).

particular, the foreign value added share in Singapore is high, at one third. Another country where the foreign content share is rising is Thailand. Both countries also reveal a high level of foreign R&D presence in the domestic markets (see Mode 3). Cambodia's foreign value added is also high, reflecting its integration into the regional market system.

It should be noted that the export data used covers only Mode 1 (cross-border trade). Since the supply of professional services is predominantly undertaken in Mode 3 (supply of services through establishing commercial presence), this trend may underestimate the role of R&D services in the ASEAN region. However, there is little presence of Mode 3 supply of R&D services in ASEAN (see discussion later). R&D supply through the remaining Modes 2 and 4 is also small.

2. Supply of R&D services in Mode 2

Although official trade statistics are not available in this mode, anecdotal evidence is provided here. Receipts of R&D services in ASEAN in this mode (consumption abroad) are considered as taking place when foreign-based firms' workers move to an ASEAN country to purchase R&D services (exports for ASEAN). However, this channel for supply of R&D services is not common, as the content of information traded could be highly confidential in nature.

Payments for R&D services in ASEAN run in the opposite way: ASEAN firms go abroad to buy R&D services from foreign-based firms (imports for ASEAN). A possible situation in such a case would be for an ASEAN firm to purchase (import) generic information related to R&D activities, e.g., ASEAN engineers getting training on the use of a computer-aided design (CAD) system at the Overseas Human Resources Industry Development Association (HIDA) based in Japan. In this case, however, the supply of R&D-related services would not be recorded as trade in R&D services; the relevant Mode 2 data would therefore not be available publicly. In a nutshell, Mode 2–based supply of R&D services is actually taking place between countries, e.g., the ASEAN Member States and Japan, yet the corresponding statistics are not available.

If the ratio of Mode 2 to Mode 1 for the global supply of services, which is one to three (table 2), were applied, supply through Mode 2 would be $3 billion for imports and $1 billion for exports.

3. Presence of foreign firms: Mode 3

The supply of R&D services in Mode 3 is, as in the case of professional services, estimated using the sales of foreign affiliates undertaking R&D. The process is typically as follows: First, identify R&D-related service companies that are considered as undertaking R&D services in Mode 3. The sales of foreign affiliates of such companies in ASEAN markets correspond to imports of R&D from ASEAN's point of view. The sales of ASEAN affiliates undertaking R&D activities in foreign countries are considered exports or supply from ASEAN. Thus, collecting data on sales of R&D foreign affiliates is the second stage of this estimation procedure. As sales volume, which corresponds to trade in Mode 3, is not available for all affiliates, the ratio of sales to capital or the ratio of sales to investment from available affiliates is applied to the affiliates for which no sales data are available. Affiliates that have no information on capital or investment, or on sales, were not included in the calculation (for detail, see box 2).

Receipts of R&D services. In all ASEAN Member States, 100 percent foreign equity participation is possible, although this upper bound of foreign equity participation is not committed under free trade agreements[4] (as in annex E). Nonetheless, overall, the presence in the ASEAN region of foreign firms in the field of R&D remains limited. An estimated 115 foreign entities undertake R&D in ASEAN,

Box 2. How to estimate services supply of Mode 3

Almost no developing countries compile foreign affiliate statistics (FATS). ASEAN Member States are not exceptions. Therefore, the supply of R&D services as well as other services through commercial presence is estimated from the sales of foreign affiliates engaged in such services, as follows:

(1) Identify foreign affiliates in each country by examining lists of foreign companies compiled from various sources, including Toyo Keizai's database for Japanese affiliates in ASEAN, Orbis and Who Owns Who databases for non-Japanese foreign affiliates in ASEAN, and individual foreign investment cases from Thomson One, Financial Times' fDiMarkets database.

(2) Calculate the ratio of sales to firm size on the basis of the affiliates identified that provide information on both sales and firm size (i.e., in terms of capital, assets value, or investment value).

(3) To estimate sales for affiliates that have only firm size data, apply the ratio

Affiliates for which estimates of sales were not possible are not included in the calculation. They are assumed to be small and thus to not affect the totality.

For sales by ASEAN affiliates abroad, the same estimation procedure is applied. In both estimates (supply of services by foreign affiliates in ASEAN and supply of services by ASEAN affiliates abroad), the AJC's estimates tend to be underestimated because they include only those affiliates that are identified and only those whose main business is R&D services. Companies whose main business is not R&D services may provide such services; however, in the calculation of Mode 3, supply by this type of firm is not covered.

Annexes C and D provide some of those identified R&D foreign firms that were established through FDI.

[4] In other words, and importantly, actual domestic policy (in ASEAN as well as elsewhere) tends to differ from international commitments under free trade agreements.

with an estimated sales value of at least $5 billion in 2015 (table 7). Unlike professional services and, perhaps, many other services as well, supply through Mode 3 is smaller than, perhaps half of, supply through Mode 1 (table 1). This amount is still five times higher than ASEAN's supply to the world. It reflects the unwillingness of transnational corporations (TNCs) to establish or move their R&D facilities in ASEAN because of the still low capabilities to undertake R&D in many ASEAN countries. At this moment, it seems that TNCs are not motivated to establish R&D affiliates in ASEAN.[5]

R&D services supply includes those provided by foreign companies that specialize in R&D and do not include in principle in-house R&D activities by other companies. Nearly 90 per cent of foreign R&D affiliates in ASEAN are established by developed country TNCs with Japanese ones being most engaged, followed by the United States ones (table 8). Mediatek Singapore Pte. Ltd. is a large R&D affiliate established by a Taiwanese TNC, Mediatek (annex C). Samsung Electronics (Korea) has a large R&D facility in Viet Nam.

Sales of R&D services through foreign presence in ASEAN are apparently increasing as foreign investment in R&D in ASEAN continues (figure 2). With promotional efforts by ASEAN countries, including special measures and incentives given only to high-technology firms that include R&D components,[6] such foreign investment amounted to more than $1 billion in 2015. While inward foreign investment fluctuates overall, R&D FDI in Singapore and Thailand retains an upward trend.

Table 7. **Mode 3: Estimates sales of R&D services through foreign presence, 2015**
(Millions of dollars)

Country	Receipts from abroad		Supply to the world	
	Number of foreign entities	Estimated sales	Number of ASEAN entities abroad	Estimated sales
Brunei Darussalam	1	9	0	0
Cambodia	3	0	0	0
Indonesia	4	1	2	259
Lao People's Democratic Republic	0	0	0	0
Malaysia	29	52	7	29
Myanmar	0	0	0	0
Philippines	14	184	1	0
Singapore	33	2 788	21	949
Thailand	24	269	2	27
Viet Nam	7	1 659	0	0
ASEAN total	**115**	**4 962**	**33**	**1 264**

Source: AJC, based on data from Toyo Keizai Shimposha, UNCTAD, Thomson Reuters, Orbis and fDiMarkets.
Note: For estimated sales, see the estimation procedure in the main text.

[5] There is also a possibility that the Mode 3 figures are underestimated: only the companies that undertake R&D activities exclusively were counted.

[6] In Singapore, on 14 March 2016, the Parliament passed an amendment to the Economic Expansion Incentives Act. According to the revised Act, firms that are awarded the "pioneer certificate" by the government will be entitled to the maximum tax relief period of 15 years for each incentivized activity, instead of for the company as a whole. Previously, a firm enjoyed tax relief only for a maximum of 15 years, regardless of the number of pioneer certificates it had. The updated Act clarifies that a firm can be awarded multiple pioneer certificates when it anchors different qualifying economic activities in Singapore over time. In 2010, the Indonesian Government issued regulation No. 94/2010, providing incentives for new investments in pioneer industries, including reduction of corporate income tax. The term "pioneer" refers to activities involving high-value technologies that hold strategic importance for the national economy.

Table 8. **Foreign affiliates in ASEAN and ASEAN affiliates abroad in R&D services, by source and destination country**

		Foreign affiliates in ASEAN		ASEAN to affiliates	
	Country	**Number of affiliates**	**Estimated sales**	**Number of affiliates**	**Estimated sales**
Developed countries	United States	20	540	6	551
	Europe	11	344	3	45
	Japan	62	1 959	1	346
	Others	3	24	2	41
	Sub total	**96**	**2 867**	**12**	**982**
Developing countries	ASEAN	10	54	10	196
	China	0	0	6	51
	Korea, Rep. of	1	466	0	0
	India	4	79	3	19
	Taiwan Province of China	1	1 117	1	0
	Asia	**16**	**1 716**	**20**	**266**
	Other (Kenya)	0	0	1	17
	Sub total	**16**	**1 716**	**21**	**283**
World		**112**	**4 583**	**33**	**1 264**

Source: AJC, based on data from Toyo Keizai Shimposha, UNCTAD, Thomson Reuters, Orbis and fDiMarkets.
Note: For estimated sales, see the estimation procedure in the main text.

Interestingly, ASEAN firms also invest abroad to establish R&D facilities (figure 2). As in the case of inward R&D investment, the amount varies year to year. Singapore has long been the main investor from ASEAN; for example, Kositech Scientific invested $300 million in the United States in 2007 to do research and produce biological products, and GfK Custom Research Pte Ltd acquired MarketWise Ltd, a Bangkok-based provider of market research services with a value of $120 million in 2011.

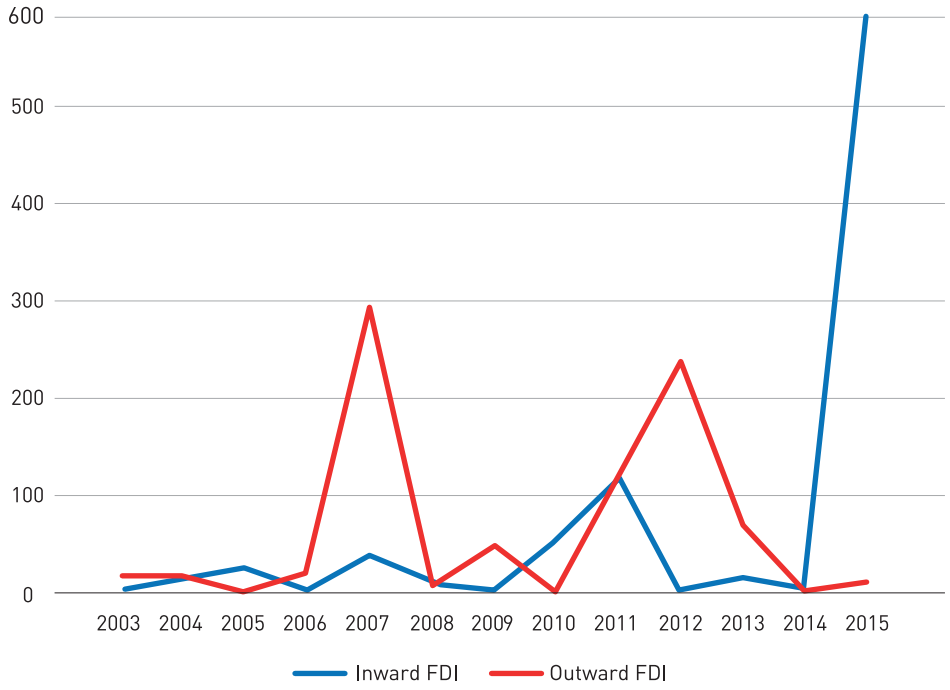
More than 60 Japanese affiliates specialize in R&D in ASEAN. Those in Singapore and Malaysia focus on R&D in the electric sector; those in the Philippines and Viet Nam, on the information sector; and those in Thailand, on the automotive sector. In Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, R&D remains a peripheral activity; there is no listing of R&D-focused firms in those countries.

According to a survey of Japanese TNCs by Japan's Ministry of Economy, Trade and Industry, at least 339 Japanese firms operating in ASEAN spent $580 million in R&D expenditures in FY2014, for an average of $1.7 million (Japan METI, 2016).[7]

Supply of R&D services. Among ASEAN Member States, only Singapore and Malaysian firms go abroad to offer R&D services through affiliates that are principally engaged in R&D. The AJC could identify only 30 such affiliates and estimated their sales value at only $1.3 billion. Two thirds of such R&D affiliates were established in developing countries, half of them in ASEAN (table 8). They include Trina Solar (Singapore) Pte. Ltd. and Kositech Scientific from Singapore, and Ajmaks Sdn Bhd and Sengenics from Malaysia (annex D).

[7] These R&D activities are for themselves and generally not for others.

Figure 2. **R&D foreign investment in and from ASEAN, 2003-2015**



Source: AJC. Based on individual investment cases.
Note: Data for 2015 R&D investment from abroad includes one by Samsung (Republic of Korea) in Viet Nam to expand production facilities, including R&D function with a value of more than $500 million.

4. Supply of R&D services in Mode 4

In the absence of trade data on this mode, as for Mode 2, anecdotal evidence is considered. Along the supply chains or between affiliated firms (parent firms and their affiliates, for example), this kind of supply of services takes place often. In the automotive industry, provision of R&D services is undertaken mainly through intrafirm arrangements: Nissan Motor Asia Pacific Co., Ltd in Thailand (Nissan's R&D arm for automobiles for sale in ASEAN Member States), for instance, employs 250 mostly local workers.[8] It collaborates with engineers affiliated with Nissan's headquarters in Japan. Conceptually, this can be seen as Mode 4 supply of R&D services from Japan to Thailand; however, because this supply is an intrafirm transaction, it does not constitute part of the service trade statistics. In actuality, firms are importing R&D services in Mode 4; however, this service is not necessarily captured as such in the official statistics.

Again, if the ratio of Mode 1 to Mode 4 for global supply of services is applied, value for Mode 4 would amount to $2 billion for visits by foreign researchers and developers and $0.3 billion for ASEAN researchers and developers' visits abroad (table 2).

[8] Based on Nikkei BP (http://business.nikkeibp.co.jp/article/interview/20140905/270849/?rt=nocnt).

III. TRADE AGREEMENTS AND REGULATIONS AMONG AND IN ASEAN MEMBER STATES

In order to consider the relationships between the growth of the services sector and FDI (Mode 3) and other modes (Mode 1, Mode 2 and Mode 4), this section focuses on ASEAN's existing policy frameworks.

1. AEC Blueprint 2025 on R&D services

The results of and the use of R&D services entail proprietary knowledge and assets, which should not be easy to transfer to a third party and should be protected from intellectual property infringement and piratical acts. Mode 3 guarantees this protection more than other modes. Therefore, even though R&D services take place through all four modes, the focus here is on Mode 3, i.e., through commercial presence. In the AEC Blueprint 2025, ASEAN envisions an enhanced level of supply chain connectivity and positioning in the broader global value chain (GVC). The Blueprint 2025 mentions policy targets related to R&D activities to create "(a) competitive, innovative and dynamic ASEAN". A key element is to strengthen IPR cooperation.[9] As intellectual property plays an important role in contributing to the achievement of national and regional socioeconomic development goals, protecting IPRs is critical if ASEAN Member States are to move higher up the technology ladder, encourage transfer of technology, and stimulate innovation and creativity.

R&D activities in Mode 3 are indispensable in the ASEAN region for productivity-driven growth. What policymakers could do is to facilitate the process of technological upgrading. In order to see the linkage between Mode 3 and other modes, they should consider the ASEAN Framework Agreement on Services (AFAS).

2. ASEAN Framework Agreement on Services (AFAS)

The main objective of trade in services in ASEAN is to broaden and deepen the integration of services within the region and facilitate their integration into the GVCs of various industries, thereby enhancing the ASEAN Member States' competitiveness in services as well as other industries. The AFAS is the main ASEAN-wide service liberalization agreement. Under the AFAS as an internal agreement, ASEAN made deeper and broader commitments than in other free trade agreements involving ASEAN and its six dialogue partners (i.e., Australia, China, India, Japan, the Republic of Korea and New Zealand). The AFAS has the modality of progressive liberalization by successive "packages". This study focuses on the ninth package,[10] which was agreed upon and signed in November 2015. The AFAS is in line with the GATS in terms of sectoral classification and the "positive list" style (i.e., listing those service sectors to which the Agreement applies). In each package, the ASEAN

[9] Rasiah (2014) points out that ASEAN Member States consider IPR governance as a vehicle to stimulate national as well as regional participation in innovative activities, and as an instrument to attract value adding FDI. It is also important, however, to promote fair use of the protected intellectual property (otherwise, the outcomes of R&D activities would not be shared owing to the prohibitively high cost of using them). In this connection, the ASEAN Working Group on Intellectual Property Cooperation (AWGIPC) was set up in 1995 to develop, coordinate and implement all ASEAN-wide programs related to intellectual property

[10] The tenth package of the AFAS is being negotiated but was not yet ratified as of this writing.

Member States submit several types of restrictions in their AFAS schedules of specific commitments. Analyzing the restrictive measures listed in their commitments for market openings is helpful for assessing the status of their market liberalization in services trade.

GATS Article 16 (para. 2) defines t six types of limitations which a WTO member shall not maintain or adopt unless otherwise specified in its schedule of commitments (and this categorization is applicable to the AFAS packages; see annex E for details):

A: limitations on the number of service suppliers, whether in the form of numerical quotas, monopolies, exclusive service suppliers or the requirements of an economic needs test;

B: limitations on the total value of service transactions or assets in the form of numerical quotas or the requirement of an economic needs test;

C: limitations on the total number of service operations or on the total quantity of service output expressed in terms of designated numerical units in the form of quotas or the requirement for an economic needs test;[11]

D: limitations on the total number of natural persons that may be employed in a particular service sector or that a service supplier may employ and who are necessary for, and directly related to, the supply of a specific service in the form of numerical quotas or the requirement of an economic needs test;

E: measures which restrict or require specific types of legal entity or joint venture through which a service supplier may supply a service; and

F: limitations on the participation of foreign capital in terms of maximum percentage limits on foreign shareholding or the total value of individual or aggregate foreign investment.

Under the AFAS, types A, B and C are not used by the ASEAN Member States in the R&D services sector. In addition to these six types of market-access restrictions, the following two restrictions are observed:

G: Government approval requirement; and

H: Tax or fee payment requirement.

Counting of each type of restrictions (A-H) by country reveals the following observations (table 9 and annex E).

The total number of entries for R&D services is 18; i.e., 3 (subsectors) times 3 (modes) times 2 (market access and national treatment). However, due to subgroupings at some ASEAN Member States' initiatives, the number with no limitation (N) can exceed that total. The upper limit of foreign capital participation under "R&D Services" is also counted in the parentheses following the symbol F (limitations on the participation of foreign capital).

Table 9 shows that for R&D services, N is dominant. Where there are limitations, E (measures that restrict or require specific types of legal entity or joint venture), F (limitations on the participation of foreign capital) and G (government approval) are the measures most used. This is rather promising, especially considering the fact that F is the most transparent and easy-to-follow restriction.

[11] This does not cover measures of a Member State that limit inputs for the supply of services (GATS Article 16, para. 2).

Table 9. **Status of restrictions in R&D services by subsector**

Country	N = none/no limitation	D = limitations on the total number of natural persons	E = measures that restrict or require specific types of legal entities	F = limitations on the participation of foreign capital	G = Government approval requirement	H = Tax or fee payment requirement
Brunei Darussalam	25	0	0	5 (51%: 5)	0	0
Cambodia	Unbound					
Indonesia	6	0	1	2 (51%: 2)	2	0
Lao People's Democratic Republic	18	0	0	0	0	0
Malaysia	26	0	4	4 (51%: 2 70%: 2)	0	0
Myanmar	4	0	0	0	0	0
Philippines	15	0	0	3 (70%: 3)	0	0
Singapore	24	0	0	0	0	0
Thailand	25	0	5	5 (49%: 2 70%: 3)	0	0
Viet Nam	11	0	0	1 (70%: 1)	0	0

Source: AJC based on the AFAS (ninth package) and Appendix D of this study.
Note: A-C are not used by ASEAN; thus they are not listed.

Measuring the degree of liberalization for R&D services for each mode by the Hoekman Index[12] shows that in Mode 1 and Mode 2, most ASEAN Member States are fully committed; in Mode 3, some ASEAN Member States have limitations; and in Mode 4, which is mainly administered by the ASEAN Agreement on the Movement of Natural Persons (AMNP) signed in 2012, there is the least liberalization (table 10). As shown in the table, most ASEAN Member States have a Hoekman Index value in Mode 4 of between 0.17 and 0.50, reflecting the rather sensitive status of this mode.

[12] Hoekman (1995) proposes an indexation method for measuring the GATS-style degree of commitment in the services sector. This method assigns values to each of eight cells (four modes and two aspects – market access (MA) or national treatment (NT)), as follows: assign the value 1 when the sector at issue is "fully liberalized"; 0.5 when "limited (but bound)"; 0 when unbound" (government has not committed to liberalize) by subsector, by mode and by aspect (market access of national treatment), and take the simple average for aggregation; then calculate the average value by services sector and by country. The higher the figure, the more liberal the country's service trade commitments are to the FTA members. Using the database prepared for this study, the Hoekman Index was derived for each of the 155 subsectors. Then the simple average at the level of the 11 sectors was calculated. The Hoekman Index takes a value between 0 and 1, with 0 referring to the most restricted status and 1 being the most open situation.

Table 10. **Hoekman Index of AFAS (9th package, signed in November 2015) and AMNP commitments for R&D services** (Per cent)

Country	Mode 1 under AFAS (9th package)	Mode 2 under AFAS (9th package)	Mode 3 under AFAS (9th package)	Mode 4 underAMNP	AMNP Total (reference)
Brunei Darussalam	1	1	0,75	0,5	0,5
Cambodia	0	0	0	0,5	0,49
Indonesia	0,33	0,67	0,33	0,17	0,39
Lao People's Democratic Republic	1	1	1	0,5	0,32
Malaysia	1	1	0,8	0,5	0,39
Myanmar	1	1	1	0,0	0,18
Philippines	1	1	0,75	0,5	0,34
Singapore	1	1	1	1	0,5
Thailand	1	1	0,75	0,33	0,3
Viet Nam	1	1	0,83	0,17	0,4
Average	**0,83**	**0,87**	**0,72**	**0,37**	**0,38**

Source: OECD, Measuring Trade in Value Added: An OECD-WTO joint initiative (http://www.oecd.org/sti/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm).

The upper limit of foreign equity participation (F) ranges from 49 to 70 percent. Considering that the AEC's eventual goal is to make the upper limit close to 70 percent, some more policy efforts might be needed.

Overall, it seems imperative that Mode 1 and Mode 4 be liberalized along with Mode 3, especially because Mode 3 liberalization would entail network-based transactions (Mode 1) as well as movement of businesspersons (Mode 4).

IV. AN ASSESSMENT OF IMPACTS OF LIBERALIZATION AND DEREGULATION

1. General economic impacts

The input-output tables for ASEAN Member States available from the Organization for Economic Co-operation and Development (OECD) provide some basic economic information on R&D services ("R&D and other business activities" in the tables) as well. For example, outputs (sum of total intermediary inputs and value added) indicate the size of economic activities (table 11). According to these tables, Singapore has the largest R&D sector among ASEAN Member States, accounting for more than one third of the ASEAN total (though Myanmar and the Lao People's Democratic Republic are not covered) in 2011 (the most recent year for which data are available), followed by Indonesia and Thailand. The share of this sector's output in the whole economy for ASEAN Member States is 2 per cent on average with Singapore again being the largest and accounting for 5 per cent. The ASEAN Member States Global Innovation Index Ranking released by INSEAD, Cornell University and the World Intellectual Property Association in 2015 ranks the ASEAN Member States as follows: Singapore is 7th; Malaysia, 32nd; Viet Nam, 52nd; Thailand, 55th, the Philippines, 83rd, Brunei

Table11. **Value added and output of R&D services, 2011** (Millions of dollars and ratio)

Country	R&D and other business activities			All industries		
	Value added	Output	Ratio of value added to output	Value added	Output	Ratio of value added to output
Brunei Darussalam	448	646	0,69	16 697	23 709	0,70
Cambodia	133	199	0,67	12 042	25 145	0,48
Indonesia	7 858	14 339	0,55	815 181	1 606 973	0,51
Malaysia	6 370	11 674	0,55	280 687	829 419	0,34
Philippines	6 030	12 445	0,48	209 529	429 792	0,49
Singapore	17 139	36 910	0,46	254 808	711 535	0,36
Thailand	4 475	14 310	0,31	343 407	893 396	0,38
Viet Nam	1 068	2 098	0,51	126 630	332 716	0,38
ASEAN total	**43 520**	**92 620**	**0,47**	**2 058 981**	**4 852 685**	**0,42**

Source: OECD Input-Output table database.
Note: Myanmar and the Lao People's Democratic Republic are not covered in the OECD database.

Darussalam, 88th (in 2014), Cambodia, 91st, Indonesia, 97th, and Myanmar, 138th (the Lao People's Democratic Republic is not included).

The role of R&D services in the input-output structure of ASEAN Member States is an important consideration. When a Member States is well connected to the global market, its domestic industry structure will create a "multiplier effect": additional demand such as increases in investment, including FDI, will bring about indirect impacts upon the host country in addition to the direct impacts.

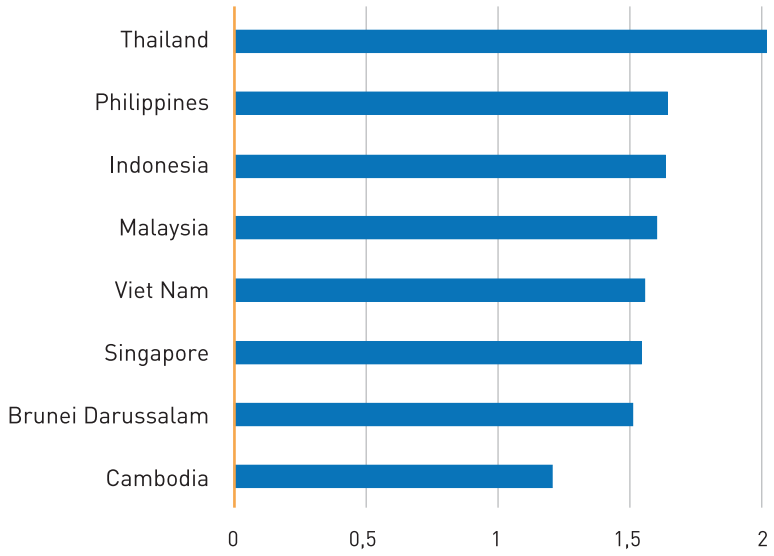
In R&D services, the indirect impact is some 1.5 to 2.0 times larger than the direct impact (figure 3). In some ASEAN Member States, the production multiplier for R&D services has been increasing over time. The value added rate (ratio of value added to output) in the sector is in the range of 0.3 to 0.7 (as shown in table 11), indicating that the sector is above the country average for five out of eight ASEAN Member States for which data are available. Among ASEAN Member States, Thailand seems to have the largest impact at two times indirect impact, but the lowest ratio of value added to output or lowest profitability.[13] This implies that the mechanism for creating value added from R&D outputs is relatively weak, even though R&D activity generates a larger amount of outputs.

2. Socioeconomic impacts of introducing foreign R&D services

Availability and affordability of R&D services. The availability of R&D services is a serious concern, especially for late-starter ASEAN Member States. As the presence of R&D activities is small, there is no or little investment made in R&D-related services. The gap in economic size of this sector was 185 times in 2011 between the smallest (Cambodia) and the largest (Singapore) (table 11). The vicious cycle of low quality, high price, and low level of employment (owing to job market mismatch) should be addressed through governmental supports.

[13] Thailand's main R&D activities concern its automotive sector; yet the sector is dominated by foreign (including Japanese) automakers. This fact might explain why it has the largest multiplier impact but the lowest ratio of value added to output.

Figure 3. **Multiplier effects of R&D and other business activities in ASEAN, 2011**



Source: AJC, based on OECD Input-Output table database.
Note: Refers to R&D and other business activities. Myanmar and the Lao People's Democratic Republic are not covered in the OECD database.

Skills and technology transfer. There is a need to fortify the processes of technological upgrading in the less developed ASEAN Member States (Rasiah, 2014). Technology transfer takes place when the absorptive capacity is well nurtured in the receiving ASEAN Member State(s). Intentional ASEAN-wide efforts focused on technology transfer (e.g., this AJC project on promoting trade in R&D services) are important policy considerations (discussed in section V).

Restructuring of acquired firms, crowding out of domestic companies. In R&D services, the shrinking domestic sector might not be a serious concern in ASEAN, since the potential market is immeasurably large. As research companies undertaking R&D focus on specific areas, market differentiation would arise, thereby securing the market positioning of each of those companies in various research fields. Market competition (in the form of mergers and acquisitions and market exit by "losing companies") would of course entail restructuring, yet researchers can still move across R&D companies. Indeed, foreign investment in ASEAN's R&D market would stimulate ASEAN's domestic R&D market, with synergy being nurtured: after all, innovations through R&D activities come from "new combination" (Schumpeter, 1961). The introduction of foreign R&D services can maximize the domestic benefits, while avoiding adverse effects from such foreign provision.

3. Interaction between FDI and movement of natural persons

The interplay between Mode 3 (commercial presence) and Mode 4 (movement of natural persons) contributes to the upward shift of the value chain curve. Singapore provides a success story. Singapore has become a value chain location for more knowledge-intensive industries in the GVCs, such as in pharmaceutical R&D, highlighting the potential of services to provide an entry point for competitive GVC participation, even for smaller economies (ASEAN and the World Bank,

2015). This development has led to more foreign pharmaceutical companies establishing their factories (i.e., supplying services in Mode 3) and offices in Singapore to undertake more production of pharmaceutical ingredients. This whole process moved Singapore's value chain curve upward and opened new markets for other GVC activities, especially in drug testing and high-end medical tourism. Singapore at present has R&D centers for large-scale TNCs including Proctor & Gamble and GlaxoSmithKline.

To create this virtuous cycle, investment in human capital has been made significantly. Take, for instance, the case of the National University of Singapore (NUS): it attracts foreign researchers undertaking R&D in natural as well as social and interdisciplinary fields. Graduates of the NUS go into the R&D sector in Singapore as well as in other countries (while retaining their network of connections with the NUS and Singapore at large). Although there are no official Mode 4 statistics on R&D services, the input of foreign researchers in Singapore has been indispensable for the country's technological upgrading.

Currently, efforts to upgrade R&D activities are limited in most ASEAN Member States; however, they could emulate the experience of the leader, Singapore: enabling technological upgrading by promoting inward FDI and greater education of the workforce through consistent government supports.

Take another case, this one from Thailand: the country has been developing its automotive sector over the last couple of decades, and now inward R&D investment is also taking place. Japanese auto maker Nissan has announced the establishment of an R&D test centre in Thailand.[14] As an FDI project, once established, this centre would surely promote the movement of natural persons (engineers) not just to and from Japan, but also among all the other ASEAN Member States (as that is precisely the aim of an R&D test centre).

4. Different levels of R&D activities

The varied scale, intensity and type of R&D undertaken by each Member State result in different policies calling for maximizing benefits and minimizing the negative impacts of continuing to intensify and liberalize R&D services supply. One researcher positions the ASEAN Member States in five phases of R&D (Rasiah, 2014). Cambodia, the Lao People's Democratic Republic and Myanmar all fall in phase 1 (initial phase); Indonesia, the Philippines, Thailand and Viet Nam are categorized in phase 2 (learning phase); Malaysia is seen to be in phase 3 (catch-up phase); there are no ASEAN Member States in phase 4 (advanced phase); and Singapore is in phase 5 (frontier phase) (table 12). Policy efforts would therefore be needed, keeping these phases in view.

[14] Nissan press release, 28 April 2016 (https://newsroom.nissan-global.com/releases/160428-02-j?lang=ja-JP).

Table 12. **Five phases of R&D activities and ASEAN members**

Phase and corresponding ASEAN member state	Basic target	Additional target	Target on networking	Target on global integration
(1) Initial phase: Brunei Darussalam, Cambodia, Lao People's Democratic Republic and Myanmar	Political stability and efficient basic infrastructure	Emergence of demand for technology	Social bonds driven by the spirit to compete and achieve	Linking with regional and global markets
(2) Learning phase: Indonesia, the Philippines, Thailand and Viet Nam	Strengthening of basic infrastructure with better customs and bureaucratic coordination	Learning by doing and imitation	Expansion of tacitly occurring social institutions to formal intermediary organizations to stimulate connections and coordination between economic agents	Access to foreign sources of knowledge, imports of material and capital goods, and FDI inflows
(3) Catch-up phase: Malaysia	Smooth links between economic agents	Creative destruction activities start here through imports of machinery and equipment, licensing and creative duplication	Participation of intermediary and government organizations in coordinating technology inflows, initiation of commercially viable R&D	Licensing and acquisition of foreign capabilities, upgrading synergies through technology imports and emergence of strong technology-based exports
(4) Advanced phase: no match	Advanced infrastructure to meet demands of economic agents	Developmental research to accelerate creative destruction activities	Strong participation of intermediary and government organizations in coordinating technology inflows, initiation of commercially viable R&D	Access to foreign human capital, knowledge linkages and competitiveness in high-tech products
(5) Frontier phase: Singapore	Novel infrastructure developed to save resource costs	Basic research undertaken, R&D labs to support creative accumulation activities	Participation of intermediary organizations in two-way flow of knowledge between producers and users	Connecting to frontier nodes of knowledge, and competitive export of high-tech products

Source: Adapted from Rasiah (2014), Table 2.

V. POLICY RECOMMENDATIONS AND PROMOTIONAL MEASURES

Emphasis is more on promotion and facilitation of undertaking R&D, rather than liberalization, because this sector is de facto liberalized in Modes 1–3. Mode 4, as in other professional services, has some way to go. Thus, the policy recommendations made here are to create an environment conducive to undertaking R&D for both domestic and foreign firms. Table 1 shows the small scale of activities by foreign firms. It implies that there is a large potential for Mode 3. FDI in R&D is still small (figure 2). If ASEAN wishes to enlarge the R&D sector to improve the productivity of the whole economy, ASEAN as a group and its individual Member States need to consider specific policies for R&D.

As the AEC Blueprint 2025 states, "ASEAN's long-term competitiveness rests on significantly improving ASEAN Member States' labour productivity and total factor productivity performance if ASEAN is going to move up the GVCs". Indeed, the Blueprint continues, "labour productivity and total factor productivity, in turn, are determined by efficiency in the use of inputs, and advancement of knowledge, innovation and technological progress".

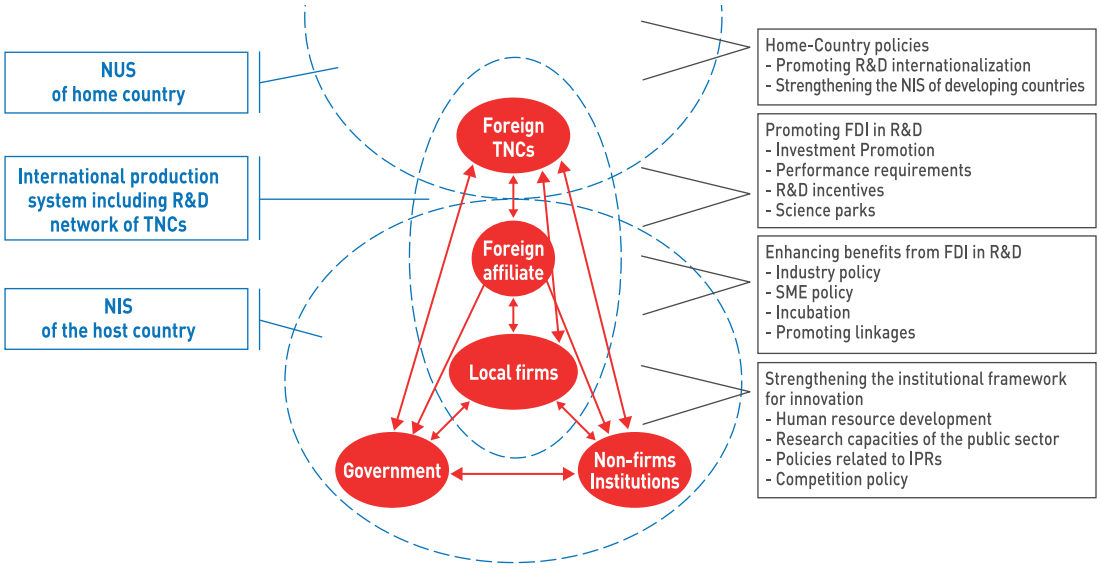
Given the critical role of technology adaptation and diffusion, as well as innovation in ASEAN's productivity growth and long-term competitiveness, ASEAN Member States need to make a concerted effort to improve their innovation and technological capability. The challenges in moving towards a more innovative ASEAN lie in investment in R&D and human capital development, and strengthening of the policy and institutional environment (e.g., IPR regime) for quality assurance, technology diffusion and innovation. Concrete policy efforts and promotional measures should be formulated with these in mind, in order to enhance ASEAN's competitiveness.

1. Policies to create and promote trade in R&D services

Concrete policy suggestions should go beyond what is stipulated in free trade agreements and lead to the undertaking of concrete R&D service activities. Liberalization and deregulation alone do not promote trade in R&D services. Suppose member states wish to promote R&D services supply through Mode 3. There is a need for a comprehensive policy framework encompassing all stakeholders (figure 4). The existence of a national innovation system (NIS) framework is a precondition for any R&D policies to be workable. As the policy framework for trade in R&D services is already liberalized to a certain degree, it is concrete research topics that determine the actual trajectory and level of R&D activities in the ASEAN region. With this in mind, concrete industry- and country-specific promotional measures are as follows.

Initial phase: Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar
In this phase, basic conditions for R&D activities should be established, rather than focusing on specific research areas. The role of the governmental sector is therefore larger than in more advanced phases. The promotion of partnerships among academia, research institutions and the private sector to build capacity is effective for technology transfer and commercialization. To this end, first and foremost, the establishment and/or expansion of government-led physical R&D facilities will be needed. In Mode 1, information technology (e.g., internet) physically connects local R&D facilities and foreign partner facilities; therefore, priority should be given to securing this physical connectivity. As for Mode 2, skills transfer can take place through potential researchers visiting other countries (including Japan) for R&D internships, which can be facilitated by international and regional organizations including the AJC for work in Japan.

Figure 4. **Supply of R&D services through Mode 3; the policy dimension**



Source: UNCTAD, 2005.

Concerning Mode 3, government-led business matching in R&D-related services could be scheduled in both the host and investing countries. A feasible and illustrative topic for R&D (in natural science) would be the development of tropical medicine, given that Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar are all located in the tropics. In more concrete terms, a candidate focus could be a tropical plant called star anise, which is used as a spice but also as an ingredient for oseltamivir (marketed under the trade name Tamiflu), an antiviral medication used to treat influenza A and influenza B. This sort of research topic could be designated as a flagship R&D project to showcase and promote Mode 3 investment.[15] In terms of Mode 4, the AMNP can be further liberalized to enable foreign researchers (as natural persons) to work on government-led R&D projects.

Learning phase: Indonesia, the Philippines, Thailand and Viet Nam

The government and private sectors should collaboratively work on promoting trade in R&D services, as those ASEAN Member States in this phase already have some private sector-based R&D facilities. As Mode 1 and Mode 2 are already fully liberalized among the ASEAN Member States, concrete R&D projects should be formulated. Following are the current focus areas[16] of R&D services set by each of the governments in this phase.

- Indonesia: (1) R&D utilizing the country's diversity in biological resources, (2) research contributions using the country's geographical characteristics, and (3) hazard reduction studies.
- The Philippines: (1) industry (electronics, semiconductor, food processing, metals, engineering,

[15] In this connection, there is a Myanmar-based non-governmental organization (activity) called the Star Anise Peace Project (https://ar-ar.facebook.com/star.anise.peace.project/), which promotes the conversion of former military zones into the local hub of star anise cultivation for research purposes. The organization is also considering international R&D networking involving other ASEAN countries as well as Japan (Okinawa, for instance) and China (Yunnan Province).

[16] Based on Center for Research and Development Strategy, Japan Science and Technology Agency (2015).

mining and minerals), (2) energy (alternative energy, efficiency of energy, efficient transport), (3) emerging technology (biotechnology, genomics, information and communication technology, material science, nanotechnology, photonics, space technology), and (4) special issues (adaptation to climate changes and mitigation of their impacts, reduction and management of disaster risks, environmental issues).

- Thailand: (1) biotechnology, (2) technical development for high value added products from natural resources, (3) manufacturing design and product development, (4) renewable energy, (5) medical applications, (6) agricultural promotion, and (7) nanotechnology.
- Viet Nam: (1) agriculture, forestry and livestock industry (especially biotechnology), (2) source and other materials, (3) water quality preservation and development of the water supply and sewage systems, (4) information and communication, (5) building construction and transportation, (6) renewable energy, and (7) medicine and drug development.

A common denominator of these research priorities is their focus on agro-based R&D activities. From a cross-border and future-oriented research perspective, the use of information technology in Mode 1 would be indispensable. As an example, satellite-based remote-sensing technologies for land mapping and meteorological purposes could be launched in the form of public-private partnerships, while employing foreign researchers. The reason for this focus lies in the fact that those ASEAN Member States in this phase (i.e., Indonesia, the Philippines, Thailand and Viet Nam) all possess agrarian areas of significant size, necessitating land-mapping and meteorological investigations across borders. Mode 2–based R&D services could also be promoted in this sort of project, in the form of researchers ("consumers") moving to one of the ASEAN Member States to receive R&D-related knowledge (with payment, which means trade in Mode 2).

Concerning promotion of trade in R&D services in Mode 3, business matching for launching concrete joint-venture projects should be facilitated. In terms of Mode 4, the host ASEAN governments should launch flagship R&D projects, possibly in the above-mentioned research areas (remote sensing) so that Mode 4 (face-to-face oriented) R&D projects can be launched by host ASEAN governments in collaboration with relevant organizations such as the AJC.

Catch-up phase: Malaysia

The private sector's role becomes larger in this catch-up phase than in phases 1 and 2. "Creative duplication" (table 12) should be further pursued as it forms the basis for more advanced activities in the next phases (as evidenced by Japan's experience in the early stages of its industrial development). Among the ASEAN Member States, Malaysia falls in this phase. Catch-up requires nurturing local absorptive capacity while embracing trade in R&D services. According to the OECD (2013), Malaysia seems to have its comparative R&D advantage in such fields as agriculture, fishery and forestry, biology, chemistry and engineering, at least in terms of the number and quality of scientific journal papers published in the country. These correspond to the country's natural factor endowments (i.e., agrarian areas as well as natural resources, most importantly crude oil and natural gas).[17]

Judging from these observations, R&D activities in agro-based and petrochemical products could be promoted. A concrete project proposal would then be to develop research and technology parks; for example, the country can utilize the Iskandar Malaysia (i.e., the large-scale development area adjacent to Singapore) in inviting foreign companies that undertake R&D in these areas, in collaboration with neighboring academic institutions.

[17] Research priority areas set by Malaysia for public subsidy are life sciences; computer sciences and information and communication technology (ICT); agriculture sciences/agricultural engineering; environmental sciences; advanced materials science; chemical sciences; physical and mathematical sciences; engineering; medical and health sciences; and social sciences and humanities. This listing corresponds to Malaysia's areas of comparative advantage.

In terms of the AFAS (9th package), Mode 1 and Mode 2 are already fully liberalized. As for Mode 3, a joint venture requirement with majority foreign capital participation is observed for Brunei Darussalam, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam.[18] This could gradually be further liberalized, and in the process, Malaysia could place greater focus on entrepreneurship through promoting joint-venture businesses (as stipulated in the AFAS text), and developing R&D business incubator programs for commercialization in these research areas. In terms of Mode 4, Malaysia should also go beyond the AMNP, restricting the free entry of R&D-related foreign workers with a view to capturing the dynamic gains from embracing foreign researchers (i.e., R&D market expansion as a result of market opening). Malaysia is on the way to becoming a successful country in this, like Taiwan (box 3).

Advanced phase: no match among the ASEAN Member States

Climbing up the technological ladder to reach this advanced phase requires "creative destruction", rather than duplicating what are being produced elsewhere. When this phase is reached by some ASEAN Member States, they should "scrap and rebuild" their R&D activities while of course going beyond free trade agreements.

The Republic of Korea can be considered as belonging to this phase. The country started its industrialization through exporting less R&D-intensive, light industry products (including footwear). It then launched an R&D-driven industrialization and now has a large-scale, successful electronics industry, especially in the field of advanced televisions (so-called "4K" and "8K"). Although the basic concept of television is already established, creative destruction is needed constantly for the country to stay in the front line of the advanced television industry. Under the Korean government's "Creative Economy" policy, the country has been undergoing this process of creative destruction.[19]

Frontier phase: Singapore

In this phase, where Singapore falls, "creative accumulation" becomes crucial: unprecedented R&D activities should be created and accumulated. Information sharing through networking stimulates business-level R&D activities. "Market-disruptive technology" (new technology that could change

Box 3. Case of Taiwan Province of China for a R&D economy

Taiwan Province of China can be considered as a successful R&D-driven country more or less comparable to Malaysia (or somewhat ahead of the country). The country has been experiencing economic development driven by the catch-up strategy of the government. The role of market opening up and technology transfer from abroad (especially Japan) to small and medium-sized enterprises has been large. This is what Malaysia is also emulating.

The result is that Taiwan Province of China recorded 28,451 patent applications (6,830 by locals and 21,621 by foreigners) in 2000, and that number rose to 46,378 (19,054 by locals and 27,324 by foreigners) in 2014 (annex B lists Malaysia's patent application figures). These figures demonstrate the catch-up scenario: i.e., the locals' share in patent applications rose sharply. Malaysia is expected to follow the path of Taiwan Province of China.

[18] The Lao People's Democratic Republic and Singapore allow 100 per cent foreign ownership.

[19] In her 2013 inauguration address, President Park Geun-hye defined the creative economy: "A creative economy is defined by the convergence of science and technology with industry, the fusion of culture with industry, and the blossoming of creativity in the very borders that were once permeated by barriers. It is about going beyond the rudimentary expansion of existing markets, and creating new markets and new jobs by building on the bedrock of convergence. At the very heart of a creative economy lie science technology and the [information technology] industry, areas that I have earmarked as key priorities."

the architecture of the current industrial structure) can emerge out of such R&D activities, beyond (somewhat outdated) trade agreements. Concrete future research projects for Singapore could include the "internet of things", artificial intelligence, self-driving cars, big data analysis, drug repositioning and development of biosimilar drugs, all of which are considered state-of-the-art areas of R&D activities.[20]

This kind of categorization which divides the R&D evolution into several phases is important, as different policies for trade in R&D services are required at different levels of economic development. For moving to the next phase, current regulation could be modified. In this context, Ohkawa (2007) shows a useful conceptual framework for firms' decisions to undertake R&D investment abroad. Figure 5 presents the conditions for international R&D investment. Firms considering R&D have incentives to maximize their profits, and there are two choices to make: accumulate new knowledge through undertaking R&D activities in the home country or create new knowledge through undertaking R&D activities in a foreign country.

In order for the latter choice (creating new knowledge through R&D activities in a foreign country) to be meaningful, the foreign country must possess either (1) a sufficiently large market as compared with the home market; or (2) a sufficiently large "public knowledge base" (local free learning opportunities, including information spillover on the technological potential of particular topics for R&D projects[21]), as compared with the home market's public knowledge base. Item (1) is measured by the vertical axis in figure 5, and item (2) by the horizontal axis.

Considering the fact that creating new knowledge (technology) entails unintended spillover and/or intended technology transfer, investment in R&D services bears the cost of losing some part of that new knowledge. At the same time, the investment captures the benefit of the locally and freely available "public knowledge capital". And importantly, this is because the establishment of an R&D firm carries an "opportunity cost" of reducing the related human and capital resources from the headquarters to the foreign location (hence the profit level at the headquarters): this opportunity cost becomes higher for advanced firms than for emerging firms, since the profit reduction at the headquarters is bigger for advanced firms than for emerging firms. This is depicted in figure 5, which shows that the boundary curve of R&D investment by "advanced firms" (firms undertaking cutting-edge knowledge creation) is located to the right of the boundary curve of R&D investment by "emerging firms" (presumably most ASEAN firms). This framework is used below to make policy recommendations for the ASEAN Member States.

In figure 5, area A corresponds to "no R&D investment" (since the market size and public knowledge capital are not large enough); area B corresponds to the situation of "R&D investment by emerging firms only (since R&D investment would be profitable for emerging firms but would not be profitable for advanced firms); and area C corresponds to the situation of "R&D investment by both developed and emerging firms", since R&D investment is profitable for both emerging firms and advanced firms. For areas B and C, the part closer to the vertical axis is suitable for "home-base-exploiting" R&D; and the part closer to the horizontal axis is suitable for "home-base-augmenting" R&D.

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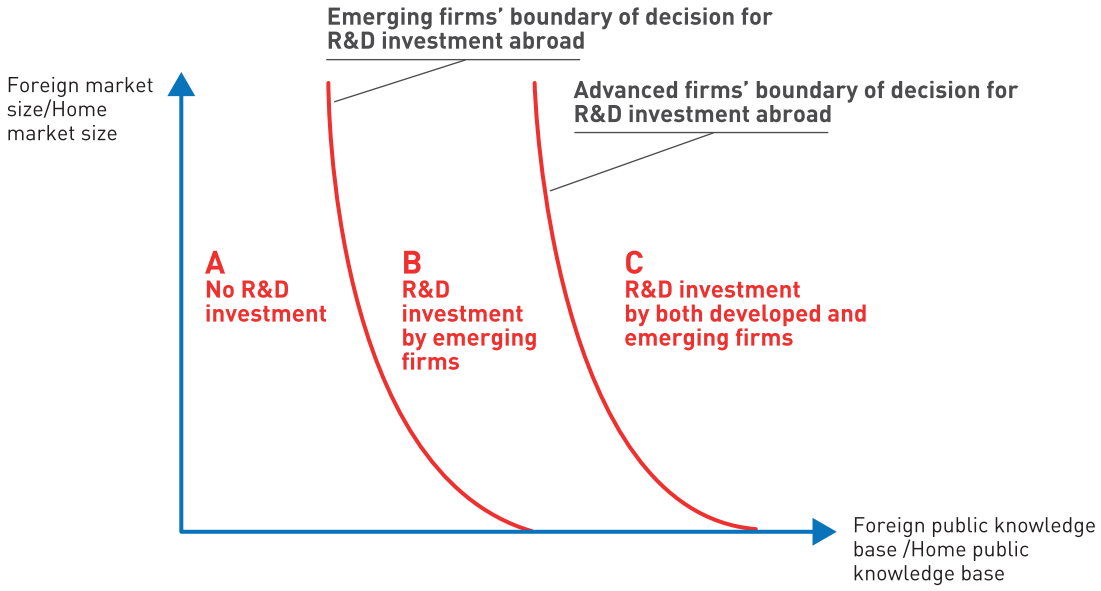
20 Browsing the internet with these keywords produces a long list of relevant R&D activities undertaken by global-scale firms.

21 For example, if the firm captures local information such as "ASEAN-grown star anise might possess a better medicinal potential", it can benefit from that information by investigating how to utilize the ASEAN-grown star anise for its future drug creation.

Figure 5. **Conditions required for international R&D investment to be undertaken**



Source: Adapted from Ohkawa (2007), Figure 4.

2. Policy recommendations for ASEAN Member States

Launching a pilot R&D project would benefit the process of learning how to achieve an enhanced level of trade in R&D services. To this end, a virtual R&D services firm involving the ASEAN Member States could be established in Mode 3 in one of the Member States. The main research topic could be in agro-based tropical medicine as the comparative advantage of the ASEAN Member States lies in this field for geographical reasons. Recommendations for such a project are as follows, by phase of development:

(1) Initial phase (for Brunei Darussalam, Cambodia, Lao People's Democratic Republic and Myanmar)

This phase corresponds to area A in figure 5. Market expansion should be the dominant thrust of government policy for moving to the next phase. Thus, workable recommendations are as follows:

1-1. ASEAN Member States select government-affiliated local engineers.
1-2. The engineers observe the process of trading R&D-related information in Mode 1 (as conducted below).
1-3. The engineers observe the process of trading R&D-related information in Mode 2 (as conducted below).
1-4. The engineers observe the process of trading R&D-related information in Mode 4 (as conducted below).
1-5. The ASEAN Member States concerned, in collaboration with an international or regional organization such as the AJC, collect information on any barriers to undertaking the activities above.

(2) Learning phase (Indonesia, the Philippines, Thailand and Viet Nam)
This phase corresponds to area B. The creation of a public knowledge base and market expansion should be the dominant thrust of government policy for moving to the next phase. Thus, workable recommendations are as follows:

2-1. ASEAN Member States select government-affiliated local engineers.
2-2. The engineers "import" information from other ASEAN Member States' selected engineers (as below) through Mode 1.
2-3. As a Mode 2 activity, the engineers visit another ASEAN Member State's R&D firm to receive (import) information in Mode 2.
2-4. As a Mode 4 activity, the engineers invite the other ASEAN Member States' engineers (as mentioned below) to receive (import) R&D-related information.
2-5. The ASEAN Member States concerned, in collaboration with an international or regional organization such as the AJC, measure any barriers restricting the activities above.

(3) Catch-up phase (Malaysia)
This phase corresponds to the borderline between area B and area C in figure 5. Further expansion of the public knowledge base should be the dominant thrust of government policy for nurturing and attracting inbound foreign R&D investment and moving to the next phase. Thus, workable recommendations are as follows:

3-1. ASEAN Member States select government-affiliated local engineers in this phase.
3-2. The engineers import R&D-related information in Mode 1 for catching-up purposes.
3-3. As a Mode 2 activity, the engineers host visits of other engineers who provide R&D-related information.
3-4. As a Mode 4 importation of R&D services, the engineers host other ASEAN Member States' engineers (mentioned below).
3-5. The ASEAN Member States concerned, in collaboration with an international or regional organization such as the AJC, measure any barriers restricting the activities above.

(4) Advanced phase (no match among the ASEAN Member States)
This phase corresponds to area C (but closer to the borderline) in figure 4. Accumulation of intrafirm knowledge capital for R&D becomes the main policy thrust in this phase. Activities in this phase (for future reference) are as follows:

4-1. ASEAN Member States could select government-affiliated local engineers and engineers from advanced states outside ASEAN in this phase.
4-2. The engineers "trade" (import and export) information with engineers from advanced states outside ASEAN in Mode 1.
4-3. As a Mode 2 activity, the engineers host visits of engineers from non-ASEAN states who provide R&D-related information.
4-4. Conduct Mode 4 trade (export as well as import) of R&D services by sending local engineers to other ASEAN Member States and also by hosting engineers from non-ASEAN advanced states.
4-5. The ASEAN Member States concerned, in collaboration with an international or regional organization such as the AJC, measure any barriers restricting the activities above.

(5) Frontier phase (Singapore)
This phase corresponds to area C (away from the borderline) in figure 5. Disruptive knowledge creation inside R&D firms is the dominant thrust in this phase. Recommendations for international or regional organizations such as the AJC are as follows:

5-1. ASEAN Member States select government-affiliated local engineers could in this phase.
5-2. Promote home-base-exploiting R&D as well as home-base-augmenting R&D at this stage, by making concrete business proposals in connection to the agro-based research topic (tropical medicine).

5-3. Promote outbound R&D services from the ASEAN Member States (possibly Singapore) to non-ASEAN countries.
5-4. Conduct Mode 4 trade (export as well as import) of R&D services can be conducted by sending local engineers to non-ASEAN advance states.
5-5. The ASEAN Member States concerned, in collaboration with an international or regional organization such as the AJC, measure any barriers restricting the activities above.

Implementing this sort of project not only promotes an ASEAN-wide platform for trade in R&D services, but also creates an environment of providing practical policies towards the formation of the Regional Comprehensive Economic Partnership (RCEP) involving the ASEAN Member States and their dialogue partners (Australia, China, India, Japan, Korea and New Zealand).

Conclusion: The way forward

R&D services can boost a country's position in GVCs. The value added is created through R&D services at the upstream part of economic activities, which include design and licensing. In the downstream part, activities related to distribution, repairs and maintenance as well as manufacturing and processing can be value adding activities, and their productivity can be enhanced (figure 1). Thus, ASEAN Member States should "internalize" R&D services. In this connection, the AEC Blueprint 2025 mentions the importance of R&D services, as follows (para. 34):

"To promote innovation, more attention needs to be given to the development of national and cross-border mechanisms that promote the following strategic measures:

i. Information sharing and networking to stimulate ideas and creativity at the universities and business level;
ii. Place a greater focus on entrepreneurship, and development of business incubator programs for commercialization;
iii. Foster a hospitable intra-ASEAN policy environment for technology transfer, adaptation and innovation, including increased level of as well as supportive fiscal and non-fiscal policies for R&D in both local and foreign-owned firms in the region;
iv. Focus support on the development of research and technology parks; joint corporate, government and/or university research laboratories; R&D centres; and similar science and technology institutions and centres;
v. Develop and strengthen ASEAN linkages to global and regional R&D networks;
vi. Promote strong IPR protection in the region; and
vii. Promote programs that enhance ASEAN participation in global and regional value chains and production networks, including programs and joint promotions that attract leading technology firms to set up shop in region, develop industrial clusters and support industries, and improved physical and institutional connectivity within the region and with the rest of the world".

The supporting function provided by R&D services in the long run should be taken account of in public policy making; private firms naturally pursue short-term profits, yet when it comes to long-term benefits for the host country at large, private firms alone cannot create the socially optimum level of R&D activities from a longer-run perspective, and under-supply of R&D services would be the social consequence (due to their public good nature). Innovation through R&D activities is, by its very nature, a haphazard event (which takes place somewhat by chance). In order to internalize it in business organizations, some degree of insensitivity to a short-term business fluctuation is needed; otherwise, large-scale R&D breakthroughs would not take place. R&D, again, has the property of a public good: the outcome of R&D services can be utilized by outsiders to some degree. In other words, there can be a situation of market failure (or sub-optimality, from a traditional microeconomic perspective) in R&D activities, necessitating government policy interventions as suggested above. Deregulating the AFAS-based restrictions, together with the IPR protection, would expand the scope for R&D investment in the ASEAN region at large. Considering the abundant tropical and/or mineral

resources in the region, information on these resources can be the core part of the public knowledge base; then profit-seeking R&D investment may happen. Protecting incumbent suppliers is important from a short-run, job-protection perspective. In the long run, however, market opening will expand the market, thereby enabling incumbent as well as new investors to prosper.

R&D services are by nature predominantly implemented by private firms. In the ASEAN region, where such services exist, they are led by multinational firms in the form of FDI. The involvement of private sector firms should therefore be promoted strategically. However, in-house R&D activities by private firms, when not disclosed, would have only limited economic impacts. This would signify a coordination failure.

Through the course of launching and implementing concrete R&D projects, therefore, it is expected that hidden restrictions (such as lack of coordination between the public and private sectors) will be disclosed.

Meanwhile, policy options for promoting trade in R&D services were discussed and identified by the ASEAN Member States at the seminar organized by the AJC on 29–30 November 2016 (box 4). Policy needs in the field of promoting trade in R&D services differ, depending on the stage of R&D capacity and economic advancement.

Box 4. **Policy options by the ASEAN Member States for promoting trade in R&D services** (Continued)

ASEAN Member States proposed and discussed various policy options to promote professional services trade at the first Seminar on Promoting Services Trade, Professional Services Trade and R&D Services Trade in ASEAN Member States on November 29–December 1, 2016, organized by the AJC.

Reflecting a big gap in R&D capacity among ASEAN Member States, these options cover a wide range of policies for two efforts:

(1) Development of the R&D services sector, required for all Member States, in particular least developed ASEAN countries; and

(2) Promotion of R&D services trade in both directions.

The following is the list of options:

(1) Development of R&D services

- Market expansion – Inviting experts from ASEAN Member States (Singapore) to advise the process of trading R&D-related information. Governments should support scientific and technical research through tax incentives.
- Strengthening the IPR regime is important to protect the results of R&D for mutual economic benefit.
- To improve the quality of products of micros, small and medium enterprises, we need to collaborate through opening investment among ASEAN Member States and Japan for technology transfer.
- The policy on temporary entry (visas) for experts must be reviewed, to enable extending stays to take into account the time needed for particular projects.
- A centralized competent authority is needed to oversee promotion and coordination of R&D services.
- Reference is needed to best practices and regulatory frameworks.
- To expand markets requires strengthening policies in order to facilitate R&D services.
- To promote R&D services, collaboration among ASEAN is required.
- Create a coordinating body (private-public sector) to establish a framework for the R&D development agenda and its implementation.
- Prepare and establish an incentive system (not necessarily fiscal) to encourage the establishment of R&D centres and companies (not in house).

Box 4. **Policy options by the ASEAN Member States for promoting trade in R&D services** (Concluded)

- Identify target markets for exports.
- Establish networking groups for R&D within ASEAN Member States to connect with other regional networks.
- Conducting meetings between public sector and private sector representatives is required in order to know the needs of the private sector so as to make sure that committed sectors to be liberalized under the R&D sector match with the private sector's need to eliminate the conflict between the private and public sector.
- After identifying restricted barriers, some policy recommendations from international and regional organizations would be useful to countries that are in the learning phase.
- Because many companies are small and medium enterprises, R&D promotion policy should be more supportive for them. Private companies' opinions should be considered in the policy-making process.
- Participation in a pipeline project launched by an international organization could help in sharing R&D technology by applying results of the experience to make more advances in innovation.

(2) Promotion of R&D services trade

- Enhancing the institutional capacity and engagement of the private sector is a must.
- Capacity building and technical assistance are needed.
- The participation of the private sector is very important.

Exchanges of R&D professionals in the region can enable them to learn from each other.

- Developing countries still need assistance from outside to strengthen or support their R&D service sectors.
- Funding for R&D activities is needed.
- Capacity building to promote R&D services resources is needed for practical implementation.
- Establish a data collecting system in R&D services that is available to and rendered by both the private and government sectors.
- Identify a sectoral champion and agency to oversee and manage trade in R&D services.
- Continue to build and ensure a strong innovation environment that supports trade in R&D services.
- To gather information on R&D in ASEAN Member States as a database for promoting R&D services.
- To strengthen the capabilities and capacities of ASEAN Member States in some specific fields of research based on particular needs of each Member State.
- Each Member State has different capacity and capability, therefore it is vital for each to conduct research and surveys in order to identify which research fields are required and which are needed for investment from foreign investors that will lead to the transfer of technology.
- The national policy should focus on R&D development since the development of R&D will increase the capacity for producing and will be the vital factor to more toward higher value-added service-oriented activities.
- Include private sector's ASEAN local engineers into the project to receive more "realistic" perspectives/ opinions.
- As financial resources are still limited, domestic and international banks (government banks or the Asian Development Bank, for example) should have supportive program for R&D projects. In reality, many companies need to invest in R&D – for example, biotechnology or agriculture – but still has difficulty.
- A data collecting system is required.

Source: Discussion at the Seminar on Promoting Services Trade, Professional Services Trade and R&D Services Trade in ASEAN Member States, November 29–December 1, 2016, at the ASEAN-Japan Centre, Tokyo.

The diversity (in terms of economic stages, industrial strengths and sociopolitical differences) possessed by ASEAN Member States on the whole can be a source of comparative advantage, since the nut of R&D services is "new combination (of different factors)", as put forward by Schumpeter (1961). And the possibility of new combinations would expand if ASEAN further promotes trade in R&D services. In the process, ASEAN could also envision nurturing endogenous seeds for R&D. Cross-border utilization of agro-based resource endowments[22] involving all the service modes by an ASEAN-wide R&D consortium (and possibly in collaboration with an international or regional organization such as the AJC) would be an important research undertaking for showcasing ASEAN's trade in R&D services.

[22] The "Star Anise Peace Project" mentioned above is an example in this context.

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ANNEX A.

Annex A. **Charges for the use of intellectual property (royalty and licensing fees), 2005-2015** (Millions of dollars)

Country		2005	2006	2007	2008
Brunei Darussalam	Balance	..	-3,7	-5,5	-6,6
	Export	..	0,0	0,0	0,0
	Import	..	3,7	5,5	6,6
Cambodia	Balance	-6,9	-6,8	-10,1	-5,9
	Export	0,4	0,1	0,1	0,5
	Import	7,3	7,0	10,2	6,4
Indonesia	Balance	-697,5	-858,8	-1 054,8	-1 300,5
	Export	263,3	13,4	30,7	27,2
	Import	960,9	872,2	1 085,5	1 327,7
Lao People's Democratic Republic	Balance	..	..	..	..
	Export	..	..	..	..
	Import	..	..	..	..
Malaysia	Balance	-1 342,6	-927,8	-1 148,2	-1 068,5
	Export	27,0	26,2	37,0	199,3
	Import	1 369,7	954,0	1 185,2	1 267,8
Myanmar	Balance	..	..	..	..
	Export	..	..	..	..
	Import	..	..	..	..
Philippines	Balance	..	-342,7	-380,0	-384,7
	Export	..	6,2	5,4	2,6
	Import	..	348,9	385,4	387,3
Singapore	Balance	-8 800,7	-9 064,4	-8 929,1	-12 698,5
	Export	516,1	529,8	697,8	784,2
	Import	9 316,8	9 594,2	9 626,9	13 482,7
Thailand	Balance	-1 659,4	-2 000,4	-2 234,5	-2 466,3
	Export	16,8	46,4	54,1	100,8
	Import	1 676,2	2 046,8	2 288,6	2 567,1
Viet Nam	Balance	..	..	..	..
	Export	..	..	..	..
	Import	..	..	..	..
Total	Balance	-12 507,1	-13 204,6	-13 762,2	-17 931,0
	Export	823,7	622,1	825,1	1 114,6
	Import	13 330,8	13 826,7	14 587,4	19 045,6

Source: AJC, based on national balance of payments data Indonesia), IMF (Philippines and Thailand), and UNCTAD (Brunei Darussalam, Cambodia, Malaysia and Singapore).

2009	2010	2011	2012	2013	2014	2015
-7,3	-7,6	..	..	..	..	..
0,0	0,0	..	..	..	..	..
7,3	7,6	10,6	11,4	10,5	10,8	..
-8,4	-5,9	-9,1	-7,3	-9,5	-17,8	-11,5
0,0	0,3	1,0	3,8	2,4	2,7	0,5
8,4	6,3	10,1	11,1	11,9	20,5	12,0
-1 492,0	-1 556,9	-1 709,2	-1 742,0	-1 684,4	-1 802,3	-1 516,0
38,1	59,6	78,8	58,0	52,0	59,6	54,3
1 530,1	1 616,5	1 788,0	1 800,1	1 736,4	1 861,9	1 570,3
..	..	..	..	..	..	..
..	..	..	..	..	..	..
..	..	..	..	..	..	..
-867,4	-1 217,4	-1 485,2	-1 407,7	-1 285,6	-1 391,9	-1 172,5
265,7	100,7	149,0	135,6	109,8	75,8	81,1
1 133,1	1 318,0	1 634,2	1 543,3	1 395,3	1 467,7	1 253,6
..	..	..	..	..	..	..
..	..	..	..	..	..	..
..	..	..	..	..	..	..
-410,6	-442,3	-436,6	-463,7	-526,4	-537,3	-601,4
1,5	4,1	4,9	7,6	3,0	9,8	11,2
412,2	446,5	441,5	471,3	529,4	547,0	612,6
-12 384,8	-15 634,2	-17 892,7	-19 830,5	-18 907,3	-16 002,2	-13 982,7
842,3	975,6	1 661,7	1 856,9	3 185,1	3 778,9	3 302,0
13 227,1	16 609,8	19 554,4	21 687,4	22 092,4	19 781,1	17 284,7
-2 102,4	-2 927,4	-2 943,9	-3 369,1	-4 371,4	-3 758,7	-3 940,2
145,2	153,2	177,3	240,6	222,0	212,2	181,3
2 247,5	3 080,5	3 121,3	3 609,7	4 593,4	3 970,8	4 121,5
..	..	..	..	..	..	..
..	..	..	..	..	..	..
..	..	..	..	..	..	..
-17 272,8	-21 791,6	-24 476,8	-26 820,3	-26 784,5	-23 510,1	-21 224,4
1 292,9	1 293,5	2 072,7	2 302,6	3 574,2	4 138,9	3 630,4
18 565,7	23 085,1	26 560,0	29 134,3	30 369,2	27 659,8	24 854,8

ANNEX B.

STATISTICS RELATED TO INTELLECTUAL PROPERTY RIGHTS

Table B1. **Summary comparison of patent statistics for ASEAN Member States**

Country	Total number of patents in 2011	Total number of patents in 2012	Total number of patents in 2013	Total number of patents in 2014
Brunei Darussalam (application basis)	53	31	35	41
Cambodia	..	..	1	5
Indonesia	600	..	755	771
Lao People's Democratic Republic	..	..	..	..
Malaysia	2 392	2 501	2 691	1,380 (first half of 2014)
Myanmar	..	..	..	..
Philippines	301	290	350	608
Singapore	4 572	4 884	5 474	5 930
Thailand	1 140	1 279	1 911	1 405
Viet Nam	322	426	497	561

Source: Made from Tables B2.. B11.
Note: Number of patent grants is shown (except for Brunei Darussalam, for which the number of patent applications is shown).

Table B2. **Brunei Darussalam: statistics related to intellectual property rights**

(Unit: number)

Year	Patent		Trademark		Industrial Design	
	Local applications	Foreign applications	Local applications	Foreign applications	Local applications	Foreign applications
2009	..	43	35	614	5	26
2010	..	40	33	692	..	12
2011	..	53	19	838	4	16
2012	20	11	51	1 075	1	19
2013	20	15	38	1 094	..	11
2014	10	31	46	392	..	2

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).

Table B3. **Cambodia: statistics related to intellectual property rights**

(Unit: number)

Year	Patent (Resident + Abroad)	Trademark (Resident + Abroad)	Industrial Design (Resident + Abroad)
2000	..	282	..
2001	..	246	..
2002	..	318	..
2003	..	279	..
2004	..	389	..
2005	..	363	..
2006	..	869	3
2007	..	553	6
2008	..	582	5
2009	..	866	4
2010	..	883	7
2011	..	938	..
2012	..	974	8
2013	1	1 008	3
2014	5	1 291	51

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).

Table B4. **Indonesia: statistics related to intellectual property rights**

(Unit: number)

Year	Patent (Resident + Abroad)	Trademark (Resident + Abroad)	Industrial Design (Resident + Abroad)
2000	168	..	..
2001	215	26 480	..
2002	268	20 660	..
2003	227	28 957	..
2004	252	36 049	..
2005	256	31 025	..
2006	311	37 225	..
2007	324	33 660	..
2008	409	34 861	2 934
2009	450	39 405	3 707
2010	572	44 493	..
2011	600	52 229	..
2012	..	..	..
2013	755	46 925	2 828
2014	771	37 330	2 588

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).

Table B10. **Thailand: statistics related to intellectual property rights**

(Unit: number)

Year	Patent (Resident + Abroad)	Trademark (Resident + Abroad)	Industrial Design (Resident + Abroad)
2000	580	15 622	1 944
2001	547	17 260	2 076
2002	633	23 109	2 456
2003	910	25 485	2 843
2004	921	27 087	2 791
2005	1 000	25 206	3 698
2006	1 149	23 006	2 669
2007	1 130	24 579	2 776
2008	1 108	25 598	3 158
2009	1 186	27 870	3 575
2010	1 389	27 958	3 430
2011	1 140	28 125	3 178
2012	1 279	32 233	2 777
2013	1 911	34 928	3 336
2014	1 405	33 986	3 325

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).

Table B11. **Viet Nam: statistics related to intellectual property rights**

(Unit: number)

Year	Patent (Resident + Abroad)	Trademark (Resident + Abroad)	Industrial Design (Resident + Abroad)
2000	34	3 487	1 084
2001	53	3 161	813
2002	69	6 931	595
2003	81	9 124	449
2004	109	11 000	686
2005	183	13 382	990
2006	202	16 627	1 156
2007	232	20 195	1 392
2008	218	21 832	1 172
2009	264	23 262	1 566
2010	325	22 162	1 271
2011	322	24 061	1 273
2012	426	24 731	1 731
2013	497	26 252	1 398
2014	561	28 321	1 592

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).

Table B5. **Lao People's Democratic Republic: statistics related to intellectual property rights**

(Unit: number)

Year	Patent (Resident + Abroad)	Trademark (Resident + Abroad)	Industrial Design (Resident + Abroad)
2000	..	25	..
2001	..	14	..
2002	..	25	..
2003	..	54	..
2004	..	..	..
2005	..	..	..
2006	..	..	..
2007	..	..	..
2008	..	..	..
2009	..	..	..
2010	..	..	..
2011	..	..	..
2012	..	..	..
2013	..	..	..
2014	..	..	..

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).

Table B6. **Malaysia: statistics related to intellectual property rights**

(Unit: number)

Year	Patents applied			Patents granted		
	Local	Foreign	Total	Local	Foreign	Total
2003	376	4 686	5 062	31	1 547	1 578
2004	522	4 920	5 442	24	2 323	2 347
2005	522	5 764	6 286	37	2 471	2 508
2006	531	4 269	4 800	187	6 562	6 749
2007	670	1 702	2 372	338	6 645	6 983
2008	864	4 539	5 403	198	2 044	2 242
2009	1 234	4 503	5 737	270	3 198	3 468
2010	1 275	5 189	6 464	204	1 973	2 177
2011	1 136	5 423	6 559	335	2 057	2 392
2012	1 160	5 867	7 027	308	2 193	2 501
2013	1 269	6 081	7 350	305	2 386	2 691
2014	631	3 158	3 789	210	1 170	1 380

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).
Notes: The "Applied" side shows the number of patents submitted (or "applied") to the patent authority for approval; the "Granted" side shows the number of approved patents as a result.

Table B7. **Myanmar: statistics related to intellectual property rights**

(Unit: number)

Year	Patent (Resident + Abroad)	Trademark (Resident + Abroad)	Industrial Design (Resident + Abroad)
2010	..	3 872	..
2011	..	4 041	..
2012	..	4 456	..
2013	..	NA	..
2014	..	NA	..

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).

Table B8. **Philippines: statistics related to intellectual property rights**

(Unit: number)

Year	Patent (Resident + Abroad)	Trademark (Resident + Abroad)	Industrial Design (Resident + Abroad)
2000	158	5 006	479
2001	138	5 172	389
2002	151	6 832	449
2003	194	6 994	674
2004	250	7 034	538
2005	280	7 262	647
2006	302	8 679	480
2007	330	9 617	472
2008	313	10 306	677
2009	253	9 338	469
2010	275	9 221	451
2011	301	11 499	548
2012	290	12 863	802
2013	350	13 409	1 000
2014	608	15 812	937

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).

Table B9. **Singapore: statistics related to intellectual property rights**

(Unit: number)

Year	Patent (Resident + Abroad)	Trademark (Resident + Abroad)	Industrial Design (Resident + Abroad)
2000	705	6 126	..
2001	858	4 308	366
2002	948	5 582	302
2003	1 829	8 750	821
2004	1 967	7 289	1 238
2005	1 899	9 023	1 153
2006	2 397	11 911	1 281
2007	3 728	13 796	1 754
2008	3 786	14 465	1 559
2009	3 325	13 704	1 303
2010	4 229	16 111	1 841
2011	4 572	19 204	2 136
2012	4 884	18 258	1 819
2013	5 474	21 763	2 824
2014	5 930	23 690	3 334

Source: ASEAN Intellectual Property Portal (https://www.aseanip.org/).

Annex C. **Fifty largest foreign affiliates engaged in R&D services in ASEAN, 2015** (continued)

	Name of foreign affiliates	Host country	Estimated sales ($ million)	Name of parent firms	Home country
1	Mediatek Singapore Pte. Ltd.	Singapore	1 117	MEDIATEK INC.	Taiwan Province of China
2	Dream Incubator (Vietnam) Joint Stock Co.	Viet Nam	823	Dream Incubator Co., Ltd.	Japan
3	Research and development	Viet Nam	466	Samsung Electronics	The Republic of Korea
4	NLI International Asia Pte. Ltd.	Singapore	337	NLI International	Japan
5	Lattice SG Pte. Ltd.	Singapore	329	LATTICE SEMICONDUCTOR CORP	United States
6	Mitsuba Vietnam Technical Center	Viet Nam	323	Mitsuba Corporation	Japan
7	PPD Development (S) Pte. Ltd.	Singapore	195	PPD LUXEMBOURG II SARL	Luxembourg
8	PARCO (Singapore)Pte. Ltd.	Singapore	179	PARCO Co., Ltd.	Japan
9	Rohto Asia Herb (Thailand) Co., Ltd.	Thailand	80	Photo Asia Herb	Japan
10	Quintiles East Asia PTE Ltd	Singapore	63	QUINTILES TRANSNATIONAL HOLDINGS INC	United States
11	Lexmark Research & Development Corporation	Philippines	49	LEXMARK INTERNATIONAL INC	United States
12	Honda R&D Southeast Asia CO Ltd	Thailand	46	HONDA MOTOR CO LTD	Japan
13	Sinomem Technology Ltd	Singapore	44	Clean Water Investment Ltd	Singapore
14	Pacific Seeds (Thai) Ltd	Thailand	43	UPL LTD	India
15	Nomura Research Institute Singapore Pte. Lte.	Singapore	41	Nomura Research Institute	Japan
16	Servicer Philippines, Inc.	Philippines	36	AMPLEX	France
17	Sankyo Tateyama (Thailand) Co., Ltd.	Thailand	32	Sankyo Tateyama Inc.	Japan
18	Financial Services	Philippines	28	Citigroup	United States
19	Professional Services	Viet Nam	28	HSBC Life International	United Kingdom
20	Scigen Limited	Singapore	24	BIOTON S.A.	Poland
21	AJ Research & Pharma	Malaysia	23	AJ Research & Pharma	Saudi Arabia
22	Bioseed Research Philippines Inc	Philippines	18	DCM SHRIRAM LIMITED	India
23	IMS Health Philippines, Inc.	Philippines	18	QUINTILES TRANSNATIONAL HOLDINGS INC	United States
24	Michelin Research Asia (Thailand) CO Ltd	Thailand	16	COMPAGNIE GENERALE DES ETABLISSEMENTS MICHELIN (C.G.E.M.) SCA	France
25	Nissan Motor Asia Pacific Co., Ltd.	Thailand	15	Nissan Motor Co., Ltd.	Japan
26	Biomin	Viet Nam	15	Biomin	Austria
27	ABN Amro Group	Singapore	13	ABN Amro Group	Netherlands
28	3i Infotech	Malaysia	13	3i Infotech	India
29	PriceWaterhouseCoopers (PwC)	Singapore	11	PriceWaterhouseCoopers (PwC)	United States

Annex C. **Fifty largest foreign affiliates engaged in R&D services in ASEAN, 2015** (concluded)

	Name of foreign affiliates	Host country	Estimated sales ($ million)	Name of parent firms	Home country
30	Bureau Veritas	Singapore	11	Bureau Veritas	France
31	Nvidia	Singapore	11	Nvidia	United States
32	Canon Information Technologies Philippines, Inc.	Philippines	11	CANON INC	Japan
33	Shonan Design (S) Pte. Ltd.	Singapore	10	Shonan Design Co., Ltd.	Japan
34	Sengenics	Brunei Darus-salam	9	Sengenics	Malaysia
35	Quintiles Philippines, Inc.	Philippines	9	QUINTILES TRANSNATIONAL HOLDINGS INC	United States
36	Isuzu Technical Center of Asia Co., Ltd.	Thailand	8	Isuzu Technical Center Co., Ltd.	Japan
37	Hay Group	Singapore	8	Hay Group	United States
38	PrivaSys	Singapore	6	PrivaSys	United States
39	Eppendorf Asia Pacific SDN BHD	Malaysia	6	ACEG BETEILIGUNGSGE-SELLSCHAFT MBH	Denmark
40	Novartis Crop Protection (Thailand) CO Ltd	Thailand	5	SYNGENTA PARTICITATION AG	India
41	TT Techo-Park Co., Ltd.	Thailand	4	Toyota Tsusho Co., Ltd	Japan
42	Renesas Design Vietnam Co., Ltd.	Viet Nam	4	Renesas System Design Co., Ltd.	Japan
43	Mitsubishi Electric Asia (Thailand) Co., Ltd.	Thailand	4	Mitsubishi Electric Corpo-ration	Japan
44	Solekia Singapore Pte. Lte.	Singapore	3	Solekia Co., Ltd.	Japan
45	Pilipinas Kaneko Seeds Corporation	Philippines	3	KANEKO SEEDS CO LTD	Japan
46	Sumidenso Automotive Technologies Asia Corp.	Philippines	3	Sumidenso Automotive	Japan
47	T. E. Tech (M) Sdn. Bhd.	Malaysia	3	T.E . Sdn. Bhd.	Japan
48	Parexel Clinical Research (Philip-pines) Ltd. Corp.	Philippines	3	PAREXEL INTERNATIONAL CORP	United States
49	PPD Development (Thailand) CO Ltd	Thailand	2	HELLMAN & FRIEDMAN LLC	United States
50	INA Research Philippines (INARP), Inc.	Philippines	2	INA RESEARCH INC	Japan

Source: AJC, based on data from Toyo Keizai Shimposha, UNCTAD, Thomson Reuters, Orbis and fDiMarkets. Sauce: AJC, DiMarkets.

Note: These 50 firms are not necessarily the largest. They are provided for illustrative purposes. Sales are estimated in the following manner: first the ratio of sales to size of foreign affiliates (investment value, capital size, employment size etc.) is calculated for available foreign affiliates in each ASEAN host economy; second, this ratio is applied to the affiliates whose size is available from the sources given; and third, some adjustment was made to eliminate unreasonable estimates by searching information of the affiliates in question. Nevertheless there are likely to have some, sometimes large, errors, and readers should use these data with utmost caution.

Annex D. **Twenty-one largest ASEAN affiliates abroad engaged in R&D services, 2015**

	Name of ASEAN affiliates abroad	Host country	Estimated sales ($ million)	Name of ASEAN investing company	ASEAN home country
1	Trina Solar (Japan) Ltd.	Japan	345,6	Trina Solar (Singapore) Pte. Ltd.	Singapore
2	Kositech Scientific	United States	303,0	Kositech Scientific	Singapore
3	Heliae Development LLC	United States	229,1	Agri Investments Pte Ltd	Indonesia
4	Market□Wise Ltd	Thailand	123,1	GfK Custom Research Pte Ltd	Singapore
5	KNOWLES GMBH IN LIQUIDATION	Switzerland	44,4	Knowles Electronics Singapore PTE Ltd	Singapore
6	ICT & Electronics	Israel	40,5	SingTel (Singapore Telecommunications)	Singapore
7	Sri Karya Utama Graha PT	Indonesia	30,3	Nielsen Co Indonesia	Indonesia
8	Chia Thai Seed	China	18,7	Chia Thai Seed	Thailand
9	Field Fresh Foods	India	18,7	Field Fresh Foods	Singapore
10	Aurigin Technology	United States	18,4	Aurigin Technology	Singapore
11	GES International	China	17,0	GES International	Singapore
12	Asia Plantation Capital	Kenya	17,0	Asia Plantation Capital	Singapore
13	MPath Sdn Bhd	Malaysia	15,2	Ajmaks Sdn Bhd	Malaysia
14	Creative Industries	China	14,4	National University of Singapore (NUS)	Singapore
15	Sengenics	Brunei Darussalam	11,1	Sengenics	Malaysia
16	INTAGE	Thailand	8,1	INTAGE (Thailand) Co Ltd	Thailand
17	Chakra Biotech Bhd	Malaysia	6,2	Chakra Biotech Bhd	Singapore
18	Nextnation Qahaar Venture Pte Ltd	Singapore	2,4	Nextnation Collections Sdn Bhd	Malaysia
19	VolitionRx	Belgium	0,7	VolitionRx	Singapore
20	Changchun Armstrong Odenwald Technology Co Ltd	China	0,4	Armstrong-Odenwald(Asia) Pte Ltd	Singapore
21	Hamba Research & Development Co Ltd	Taiwan Province of China	0,3	Lion Diversified Holdings Bhd	Malaysia

Source: AJC, based on data from Toyo Keizai Shimposha, UNCTAD, Thomson Reuters, Orbis and fDiMarkets.

Note: Sales are estimated in the following manner: first the ratio of sales to size of ASEAN affiliates abroad (investment value, capital size, employment size etc.) is calculated for available ASEAN affiliates in each host economy; second, this ratio is applied to the affiliates whose size is available from the sources given; and third, some adjustment was made to eliminate unreasonable estimates by searching information of the affiliates in question. Nevertheless there are likely to have some, sometimes large, errors, and readers should use these data with utmost caution.

ANNEX E.

SPECIFIC SCHEDULE OF AFAS (9TH PACKAGE) COMMITMENTS FOR "RESEARCH AND DEVELOPMENT SERVICES" BY ASEAN MEMBER STATES

Legend for this Annex:

(1) means Mode 1 (cross-border supply of services); (2) means Mode 2 (consumption abroad); (3) means Mode 3 (commercial presence); (4) means Mode 4 (movement of natural persons).

The meaning of the alphabetical classification in the right hand column of each specific commitment table is as follows.

N: none (no restriction)

U: unbound (no mention or no promise of liberalization)

A: limitations on the number of service suppliers whether in the form of numerical quotas, monopolies, exclusive service suppliers or the requirements of an economic needs test;

B: limitations on the total value of service transactions or assets in the form of numerical quotas or the requirement of an economic needs test;

C: limitations on the total number of service operations or on the total quantity of service output expressed in terms of designated numerical units in the form of quotas or the requirement of an economic needs test;[23]

D: limitations on the total number of natural persons that may be employed in a particular service sector or that a service supplier may employ and who are necessary for, and directly related to, the supply of a specific service in the form of numerical quotas or the requirement of an economic needs test;

E: measures which restrict or require specific types of legal entity or joint venture through which a service supplier may supply a service; and

F: limitations on the participation of foreign capital in terms of maximum percentage limit on foreign shareholding or the total value of individual or aggregate foreign investment" (Part III: Specific Commitments, Article XVI: Market Access, subparagraph 2).

Under AFAS, the restriction types A, B and C are actually not used by the ASEAN Member States in the sector "Professional Services". In addition to these six types of market-access restrictions, the following two restrictions are observed.

G: Government approval requirement; and

H: Tax or fee payment requirement.

[23] Subparagraph 2(c) does not cover measures of a Member which limit inputs for the supply of services.

Brunei Darussalam

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
R&D services on natural sciences and engineering (CPC 851/8510)	(1) None (2) None (3) Foreign equity participation should not exceed 51%	(1) N (2) N (3) F51	(1) None (2) None (3) None	(1) N (2) N (3) N
R&D services on social sciences and humanities (CPC 852/8520)	(1) None (2) None (3) Foreign equity participation should not exceed 51%	(1) N (2) N (3) F51	(1) None (2) None (3) None	(1) N (2) N (3) N
Interdisciplinary R&D services (CPC 853/8530)	(1) None (2) None (3) Foreign equity participation should not exceed 51 %	(1) N (2) N (3) F51	(1) None (2) None (3) None	(1) N (2) N (3) N

Cambodia

No commitment for this sector

Indonesia

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
Interdisciplinary R&D (CPC853, limited to Industrial Activities)	(1) None (2) None (3) Joint venture with foreign equity participation up to 51%	(1) N (2) N (3) F51	(1) None (2) None (3) Subject to Qualification and Licensing requirement and procedure including registration	(1) N (2) N (3) G
Research and experimental development services on linguistic and languages (CPC 85204), limited to foreign language only	(1) Unbound (2) None (3) Joint venture with foreign equity participation up to 51%	(1)U (2) N (3) EF51	(1) Unbound (2) None (3) Subject to Qualification and Licensing requirement and procedure including registration	(1) U (2) N (3) G

Lao People's Democratic Republic

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
R&D Services on Natural sciences and Engineering (CPC 851)	(1) None (2) None (3) None	(1) N (2) N (3) N	(1) None (2) None (3) None	(1) N (2) N (3) N
Research and experimental development services (CPC 852)	(1) None (2) None (3) None	(1) N (2) N (3) N	(1) None (2) None (3) None	(1) N (2) N (3) N
Interdisciplinary R&D Services (CPC 853)	(1) None (2) None (3) None	(1) N (2) N (3) N	(1) None (2) None (3) None	(1) N (2) N (3) N

Malaysia

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
Research and development services on natural sciences and engineering (CPC 851** except CPC 85105 medical sciences and pharmacy and does not include research and development on Malaysia's natural resources, biodiversity and genetic materials) Limited to industrial activities covering all science and engineering disciplines, including biotechnology and information communication technology; and defined as any systematic or intensive study carried out in the field of science or technology with the object of using the results of the study for the production or improvement of materials, devices, products, produce or processes but does not include: (i) Quality control of products or routine testing of materials, devices, products or produce; (ii) Research in the social sciences or humanities; (iii) Routine data collection; (iv) Efficiency surveys or management studies; and (v) Market research or sales promotion.	(1) None (2) None (3) Only for contract research and development company and research and development company locally incorporated as a joint venture corporation with Malaysian individuals or Malaysian-controlled corporations or both and aggregate foreign equity shall not exceed 70 per cent.	(1) N (2) N (3) EF70	(1) None (2) None (3) None	(1) N (2) N (3) N
Research and development services on medical sciences and pharmacy (CPC 85105**) Research and experimental development on medical sciences and pharmacy limited to clinical trials and study which evolves any investigation in human subjects intended to discover or verify the clinical, pharmacological and/or other pharmaco-dynamic effects of an investigational product(s), and/or to identify any adverse reactions to an investigational products(s), and/or to study absorption, distribution, metabolism, and excretion of an investigational product(s) with the object of ascertaining its safety and/or efficacy. (This will also include pre-clinical contract research organization and contract manufacturing organization)	(1) None (2) None (3) None	(1)N (2)N (3) N	(1) None (2) None (3) None	(1)N (2)N (3) N

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
Research and experimental development services on social sciences and humanities (CPC 8520 except 85203 and 85204)	(1) None (2) None (3) Only through a locally incorporated joint-venture corporation with Malaysian individuals or Malaysian controlled corporations or both and the aggregate foreign shareholding in the joint-venture corporation shall not exceed 51 per cent	(1) N (2) N (3) EF51	(1) None (2) None (3) None	(1) N (2) N (3) N
Research and experimental development services on economics (CPC 85202)	(1) None (2) None (3) Only through a locally incorporated joint venture corporation with Malaysian individuals or Malaysian controlled corporations or both and the aggregate foreign shareholding in the joint venture corporation shall not exceed 51 per cent	(1) N (2) N (3) EF51	(1) None (2) None (3) None	(1) N (2) N (3) N
Interdisciplinary research and development services (CPC 8530**) Covering industrial activities covering all science and engineering disciplines, including biotechnology and information communication technology; and defined as any systematic or intensive study carried out in the field of science or technology with the object of using the results of the study for the production or improvement of materials, devices, products, produce or processes but does not include: (i) Quality control of products or routine testing of materials, devices, products or produce; (ii) Research in the social sciences or humanities; (iii) Routine data collection; (iv) Efficiency surveys or management studies; and (v) Market research or sales promotion.	(1) None (2) None (3) Only for contract research and development company and research and development company locally incorporated as a joint venture corporation with Malaysian individuals or Malaysian-controlled corporations or both and aggregate foreign equity shall not exceed 70 per cent For interdisciplinary research and development services involving Malaysia's natural resources, biodiversity and genetic materials the aggregate foreign equity shall not exceed 49 per cent.	(1) N (2) N (3)EF49&70	(1) None (2) None (3) None	(1) N (2) N (3) N

Myanmar

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
R&D Services on natural sciences [CPC 851] - R&D and experimental development services on physical sciences (CPC 85101) - Research and experimental development services on Chemistry and Biology (CPC 85102) - Research and experimental development services on Engineering and technology (CPC 85103) - Research and experimental development services on Agricultural Sciences (CPC 85104)	(1) None (2) None (3) Unbound	(1) N (2) N (3) U	(1) None (2) None (3) Unbound	(1) N (2) N (3) U

The Philippines

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
a. R&D services on agricultural sciences (CPC 85104)	(1) None (2) None (3) None, except that up to 70% foreign equity participation is allowed	(1) N (2) N (3) F70	(1) None (2) None (3) None	(1) N (2) N (3) N
b. R&D services on economics (CPC 85202)	(1) None (2) None (3) None, except that up to 70% foreign equity participation is allowed	(1) N (2) N (3) F70	(1) None (2) None (3) None	(1) N (2) N (3) N
c. Interdisciplinary research and experimental development services on information and communications technology (CPC 853**)	(1) None (2) None (3) None, except that up to 70% foreign equity participation is allowed	(1) N (2) N (3) F70	(1) None (2) None (3) None	(1) N (2) N (3) N

Singapore

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
R&D services on natural sciences, specifically biotechnology services and industrial research (CPC 85102-85103)	(1) None (2) None (3) None	(1) N (2) N (3) N	(1) None (2) None (3) None	(1) N (2) N (3) N
Research and experimental development services on economics (CPC 85202)	(1) None (2) None (3) None	(1) N (2) N (3) N	(1) None (2) None (3) None	(1) N (2) N (3) N
R&D services on social sciences and humanities, specifically economic and behavioral research (CPC 852**)	(1) None (2) None (3) None	(1) N (2) N (3) N	(1) None (2) None (3) None	(1) N (2) N (3) N
Interdisciplinary R&D services for projects undertaken by education institutions (CPC 853**)	(1) None (2) None (3) None	(1) N (2) N (3) N	(1) None (2) None (3) None	(1) N (2) N (3) N

Thailand

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
(a) Research and development on natural sciences: research and experimental development on: - physical sciences (CPC 85101) - chemistry & biology (CPC 85102) - engineering & technology (CPC 85103)	(1) None (2) None (3) As indicated in 3.3 of the horizontal section	(1) N (2) N (3) EF49	(1) None (2) None (3) None	(1) N (2) N (3) N
Research and experimental development on physical sciences (CPC Version 1.1: 81110)	(1) None (2) None (3) As indicated in 3.1 of the horizontal section	(1) N (2) N (3) EF70	(1) None (2) None (3) None	(1) N (2) N (3) N
(b) Research and experimental development services on: - economics (CPC 85202) - law (CPC 85203) - linguistics and languages (CPC 85204)	(1) None (2) None (3) As indicated in 3.3 of the horizontal section	(1) N (2) N (3) EF49	(1) None (2) None (3) None	(1) N (2) N (3) N
Research and experimental development services in linguistics and languages (CPC Version 1.1: 81240)	(1) None (2) None (3) As indicated in 3.1 of the horizontal section	(1) N (2) N (3) EF70	(1) None (2) None (3) None	(1) N (2) N (3) N
(c) interdisciplinary research and experimental development services (CPC Version 1.1: 81300)	(1) None (2) None (3) As indicated in 3.1 of the horizontal section	(1) N (2) N (3) EF70	(1) None (2) None (3) None	(1) N (2) N (3) N

Notes: 3.1 of the horizontal section states: "Foreign equity participation must not exceed 70 per cent of the registered capital and shall only operate through joint-venture with a juridical person of Thai national".
3.3 of the horizontal section states: "a. Foreign equity participation must not exceed 49 per cent of the registered capital; and b. the number of foreign shareholders must be less than half of the total number of shareholders of the company concerned."

Viet Nam

Subsector	Limitation on Market Access (MA)	A-H classification of MA	Limitation on National Treatment (NT)	A-H classification of NT
R&D services on natural sciences (CPC 851)	(1) None (2) None (3) None	(1) N (2) N (3) N	(1) None (2) None (3) None	(1) N (2) N (3) N
R&D services on social sciences and humanities (CPC 852) Interdisciplinary R&D services (CPC 853)	(1) None (2) None (3) None, except that joint ventures with foreign capital contribution not exceeding 70% can be established	(1) N (2) N (3) F70	(1) None (2) None (3) None	(1) N (2) N (3) N

Sources: http://myservices.miti.gov.my/widget/web/guest/protocol/-/56_INSTANCE_cxTW8VKZiDDD
For Brunei Darussalam, http://www.miti.gov.my/miti/resources/AFAS_9_Consolidated_Schedule_-_BD_SOC_(CCS_78).pdf
For Indonesia, http://www.miti.gov.my/miti/resources/AFAS_9_Consolidated_Schedule_-_ID_SOC_(CCS_78).pdf
For Lao People's Democratic Republic, http://www.miti.gov.my/miti/resources/AFAS_9_Consolidated_Schedule_-_LA_SOC_(CCS_78).pdf
For Malaysia, http://www.miti.gov.my/miti/resources/AFAS_9_Consolidated_Schedule_-_MY_SOC_(CCS_78).pdf
For Myanmar, http://www.miti.gov.my/miti/resources/AFAS_9_Consolidated_Schedule_-_MM_SOC_(20140312).pdf
For the Philippines, http://www.miti.gov.my/miti/resources/AFAS_9_Consolidated_Schedule_-_PH_SOC_(21Aug2015).pdf
For Thailand http://myservices.miti.gov.my/documents/10180/f0c1be7c-124f-47bf-b4f9-2fd6300ab7d1
For Singapore, http://www.miti.gov.my/miti/resources/AFAS_9_Consolidated_Schedule_-_SG_SOC_(20130509).pdf
For Viet Nam, http://www.miti.gov.my/miti/resources/AFAS_9_Consolidated_Schedule_-_VN_SOC_(20150911).pdf

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