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A Review of R&D and Sectoral Incentives in Manufacturing in Industrialised and Emerging Economies: Lessons for 'Make in India'

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RIS
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A Review of R&D and Sectoral Incentives in Manufacturing in Industrialised and Emerging Economies: Lessons for 'Make in India'

Sabyasachi Saha[*]

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Abstract: This paper explores fiscal instruments for promoting firm level R&D across the BICS (BRICS minus Russia) and six selected countries as well as the European Union (EU). The selected countries (apart from the BICS and EU) are Germany, Japan, Malaysia, Republic of Korea, Thailand, and the United State of America (USA). The selected countries represent a mix of early industrialised and newly industrialised economies. Technological capabilities in industrialised nations are driven by firm level innovations, often encouraged through government policies and fiscal incentives. In this paper, contributions of such policies for sectoral competitiveness in manufacturing in the countries have been reviewed. The focus is on the Medium and High Tech (MHT) industries. This paper proposes to draw lessons in policy making on the sectoral R&D incentives for Indian manufacturing to facilitate innovation driven competitiveness akin to the early industrialised countries of the West and the newly industrialised nations of Asia; besides strengthening MHT manufacturing in India, like the emerging economy peers, notably China.

Keywords: R&D, innovations, fiscal incentives, high technology industry, manufacturing, competitiveness

Introduction

Research and Development (R&D) plays an essential role in supporting innovation, leading to firm-level competitiveness and long-term productivity growth. R&D generates new information and knowledge which drives technological change. Economists generally agree that knowledge has public good characteristics (i.e. non-rivalry and non-

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excludability), leading to potential market failure in knowledge creation. This prompts governments to support basic scientific research in most countries. Due to externalities the private returns on R&D are typically much lower than their social returns. Given that scientific enterprise requires mammoth foundation of resources, capacity and skills, and the development and commercial prospects of innovations are uncertain, the private sector often demonstrates low inclination towards R&D. Hence, often governments seek to incentivise private sector firm-level R&D to achieve country level capabilities, competitiveness and for ensuring availability of technologies.

Public intervention in R&D is justified by three paradigms—the market failure paradigm, the mission-oriented paradigm and the cooperation paradigm (Bozeman and Dietz (2001)). Governments can adopt long term agenda and launch scientific missions in the areas like health-care and defence. To achieve mission targets, innovation in products and processes would be essential. In cooperation paradigm, entire range of R&D inputs may not necessarily be available locally and hence the need for government support is to fill the gaps. This can be through cooperation between public and private agencies.

To support firm-level R&D, governments may adopt direct funding/financing approach based on the merit of scientific projects in the private sector. Alternatively, the popular approach is to let firms choose their own R&D projects and the government allows certain tax incentives based on the quantum of scientific expenditure by the firm. This saves administrative costs, but may be inefficient if the government is good at spotting which projects would generate big knowledge ‘spillovers’ (Nguyen and Reenen, 2016).

For developing countries, R&D capabilities are important to reduce import dependence on high technology products. With greater integration with world trade innovation assumes higher significance for competitiveness and value creation (through improvements in quality of products). This view has largely influenced developing countries to adopt policies for inducing firms to invest in technological changes (Bloom, Draca and Van Reenen, 2015) and in product quality upgradation (Khandelwal, 2013), and governments allocate larger amount of taxpayers' money to subsidize R&D (EU, 2010).

The primary purpose of the paper is to understand the spectrum of firm level/sectoral R&D incentives currently in practice in pre-selected countries to draw lessons for policy-making in India. India seeks to broaden its manufacturing base similar to newly industrialised countries of Asia and for achieving high tech manufacturing capabilities, like emerging economy peers, China, etc. This is also important to expand job opportunities in India at a faster pace when demographic situation has tilted towards large young work-force. The new comprehensive policy focus on the manufacturing sector by the present government in India has been popularly called 'Make in India' programme.

In the following section, statistical information on the current share of manufacturing, R&D expenditure and competitiveness in Medium and High Tech (MHT) industries in the BICS (Brazil, India, China, and South Africa) and the other six economies including European Union (EU), Germany, Japan, Malaysia, Republic of Korea, Thailand, and the USA has been presented. In the third section, based on literature, the rationale, design, evolution and effectiveness of the R&D tax incentives have been discussed, which are predominantly used to incentivise firm-level R&D. In the fourth section, country level tax policies and other mechanisms like financial support for medium-high tech industry have been explored. Finally, in the concluding section, evidence and lessons drawing for 'Make in India' have been synthesized.

Share of Manufacturing, R&D Expenditure and Competitiveness in Selected Countries

This paper focuses on Medium-High Tech (MHT)[1] industry. To calculate share of MHT activities in the total Manufacturing Value Added (MVA) or manufacturing export, UNIDO CIP Statistics has been used. The

UNIDO classifies MHT sector based on ISIC Rev 2 and ISIC Rev 3 (see appendix A1).

ISIC Classification of Medium and High Technology manufacturing	
ISIC	ISIC division, major groups or groups
Revision 2	342, 351,352, 356, 37, 38 (excl. 381)
Revision 3	24, 29, 30, 31, 32, 33, 34, 35

In Table 1 we presented statistical information on the share of manufacturing, R&D expenditure and competitiveness in the selected economies in the period after 2000. Share of the manufacturing sector in the BICS during 2000-07 was higher than the world, and continued to be significant for 2008-15 (with lower share than the previous period). In terms of the importance of the manufacturing sector, China continues to hold a dominant position in the world. In the case of India, the manufacturing sector has only marginally declined during 2008-15 in comparison to 2000-07. Among the other seven countries, the newly industrialised countries like Malaysia, South Korea and Thailand, share was significant in manufacturing value added ahead of the early industrialised economies like EU, Germany, Japan and the USA. South Korea, in fact, experienced moderate growth in their manufacturing from 28 per cent in 2000-07 to 30 per cent in 2008-15. Overall, the global share of manufacturing has declined from 18.22 per cent in 2000-07 to 16.59 per cent in 2008-15.

In BICS, the Gross Expenditure on the R&D (GERD) as share of GDP had increased from 0.94 per cent in 2000-07 to 1.24 per cent in 2008-15, mainly due to sturdy contribution by China. South Korea and Japan had very high GERD. The GERD in the USA and Germany remained significant sponsors of R&D over the recent years. Interestingly, despite intervening global recessionary trends, R&D expenditures in the selected countries (except South Africa among BICS) as well as globally have registered a positive growth.

The UNIDO has adopted a meso-concept of competitiveness, namely, Industrial Competitiveness. According to the UNIDO Competitive Industrial Performance Report 2012-13, industrial competitiveness is defined as the capacity of the country to increase its presence in the international and domestic markets while developing industrial sectors and activities with higher value-added and technological content. The UNIDO Competitiveness Industrial Performance Report 2002-03 adopted a key diagnostic tool (i.e. Competitive Industrial Performance (CIP) index) for benchmarking and measuring industrial competitiveness of nations. The CIP index captures three dimensions of industrial competitiveness- first, capacity to produce and export manufactures; second, level of technological deepening and upgrading; and third, impact on world manufacturing in terms of value addition and trade.

According to the CIP index, China improved its competitiveness score significantly and moved from 22nd to 3rd position during 2000 to 2015 (Refer table 1). Among BICS, India, which is still behind China and Brazil in global industrial competitiveness ranking as per the CIP (with narrowing of gap), has achieved significant improvement in its' ranking against South Africa and Brazil during 2000 to 2015. In the last decade, Germany, Japan and the USA were among the top three industrially competitive economies of the world. This justifies selection of these three early industrialised countries for the present study. Among the newly industrialised economies, in terms of the CIP, South Korea ranked 5th globally in 2015 from its individual rank of 11th in 2000. According to the UNIDO Competitiveness Industrial Performance Report 2012-13, EU-27 captures world's largest share of manufacturing trade equal to 40.3 percent and more than half of the manufacturing exports are MHT products. Also, EU produces 20 per cent of world's manufacturing value added of which one third are MHT products. This makes EU an important player in the MHT segment and has been considered since long industrially advanced.

Share of the MHT industries in India's manufacturing exports increased from 0.19 in 2000 to 0.34 in 2015 (see Table 1). During the same period, China's share improved from 0.45 to 0.59 while USA share declined from 0.75 to 0.65. These are significant as the share has almost remained constant for the group of other six early and newly industrialised economies. India's share of MHT activities in total manufacturing value added is quite low in comparison to Germany, Japan, Malaysia, Korea and the USA. However, India compares well with China in terms of share of the MHT activities in the total manufacturing value added, unlike share of MHT activities in manufacturing exports, in which China is much ahead.

Fiscal Incentives for Firm-level R&D: Rationale and Evaluation

Fiscal Incentives for Firm-level R&D: Design and Rationale

According to the OECD (2001), public support for business R&D requires a mix of direct instruments and market based incentives, as no single mechanism can provide a full range of incentives. For example, market-based mechanisms such as tax credits increases R&D at the margin, implying that more direct forms of support may be needed to stimulate R&D investments substantially. Direct and indirect measures, therefore, need to be balanced in a comprehensive and co-ordinated policy framework. Also, special care should be taken in the way different instruments interact. For instance, some studies have pointed out that increasing direct government subsidies to business R&D may reduce effectiveness of tax incentives, while direct subsidies and research undertaken by public institutions appear to have a mutually reinforcing effect (the more firms invest in their own R&D, the more they would be able to use knowledge generated by public institutions) [Guellec and Van Pottelsberghe, 2000]. Such interactions between different policy instruments call for close co-operation among the various government bodies involved in their design and management. Generally speaking, a piecemeal approach to the R&D policy is perceived to be detrimental for its effectiveness (European Union, 2002).

Table 1: Share of Manufacturing, R&D Expenditure and Competitiveness in Selected Economies

Countries	Share of Manufacturing (% of GDP)		GERD (% of GDP)		CIP Rank		Share of MHT Activities in Total MVA		Share of MHT Activities on Manufacturing Export	
	2000-07	2008-15	2000-07	2008-15	2000	2015	2000	2015	2000	2015
Brazil	16.29	13.65	1.00	1.15	30	36	0.35	0.35	0.48	0.41
China	31.94	31.11	1.16	1.82	22	3	0.43	0.41	0.45	0.59
India	18.07	17.19	0.76	0.80	55	39	0.41	0.38	0.19	0.34
South Africa	18.26	13.92	0.82	0.78	43	47	0.24	0.24	0.40	0.49
BICS	**21.14**	**18.97**	**0.94**	**1.24**			**0.36**	**0.35**	**0.38**	**0.46**
EU27	17.66	15.71	1.37	1.62			0.34	0.39	0.51	0.56
Germany	22.67	22.33	2.42	2.79	1	1	0.55	0.61	0.73	0.74
Japan	21.55	20.18	3.10	3.27	2	2	0.52	0.55	0.85	0.80
Malaysia	28.87	23.34	0.58	1.07	21	21	0.51	0.43	0.76	0.62
Republic of Korea	27.90	30.16	2.52	3.79	11	5	0.59	0.64	0.70	0.76
Thailand	29.45	28.98	0.23	0.39	25	24	0.38	0.41	0.60	0.63
USA	13.80	12.41	2.56	2.76	3	4	0.51	0.41	0.75	0.65
World	**18.22**	**16.59**	**1.54**	**1.65**						

Source: WDI, UIS.stat and UNIDO Statistics CIP Index. Data accessed on 27-June-2018

Note: GERD stands for Gross Expenditure on Research & Development; Competitive Industrial Performance (CIP) rank is out of 142 countries; MVA stands for Manufacturing Value Added

In the past two decades, tax incentives have emerged as the most popular policy instrument to boost private R&D activities. During 2001 and 2011, R&D tax incentives were expanded in 19 out of 27 OECD countries (OECD 2014a). R&D tax incentives reduce firm's tax burden, and have lowered administrative cost in comparison with direct subsidies. Such characteristics make R&D tax incentives a form of innovation policy which is unlikely to lead unintended market distortions (Gaillard and Straathof, 2015). The governments, however, generally finds it difficult to stipulate generosity of tax incentives (either to choose the rate of tax credit or amount of super deduction in tax allowance), which largely determines costs of incentive schemes.

As suggested by Kohler, Laredo and Rammer (2012), and OECD Innovation Policy Platform, (2010), the design of policy for tax incentives on the R&D would consider the following aspects: definition of R&D activities, choice of incremental versus volume-based incentives, choice of the tax instrument and the impact on social contribution and the degree of generosity of the incentive. The other considerations are for the target group of beneficiaries (like preferential treatment of specific types of firms or R&D activities); whether unused claim can be carried over or refunded. Also, the government could adapt itself to the changing patterns of business R&D such as transition to knowledge based economy, enhancing role of small and medium enterprises (SMEs), restructuring business R&D, and increasing specialisation and linkages among R&D performing organizations (European Union, 2002).

The widely followed OECD (1996) framework design/objectives for R&D tax incentives are as follows:

- Making overall strategy to stimulate innovation in industry
- Making provisions for deduction of all qualified R&D expenses
- Flexible policy to accommodate firms at different stages of development
- The value of R&D tax credits must be assessed on a country basis

- Making special provisions relating to small and/or new firms to encourage entrepreneurship and innovative start-ups

R&D Incentives for Firm-level Competitiveness: Literature-based Evaluation

The European Union Report (2014) and OECD (2013) Industry Scoreboard highlighted gain in popularity of R&D incentives. Link (1996) stated two broad categories of fiscal measures, which focussed on the R&D component of the innovation process: R&D tax incentives and other special assistance programmes (subsidy). EU (2014) survey report stated that most of the countries had more than one R&D tax incentives; also the design and implementation of policy instruments varied substantially across or within countries. Studies of 33 countries by European Union in 2014 pointed out that tax credit, tax allowance and accelerated depreciation as widely were used instruments in advance economies.

Over the time question has arisen on the widespread use of R&D tax incentives and their effective implementation in practice. Unfortunately there is limited empirical evidence on the effectiveness of tax incentives on the private R&D expenditures. However, some studies by Grabowski (1968), Howe and McFetridge (1976), Mansfield and Switzer (1984), Klette and Meon (2012), David, Hall and Toole (2000), Hall and Reenen (2000), and Bloom, Griffith and Reenen (2000) evaluated the effectiveness of R&D incentives comparing typically social benefits from increased business R&D to the opportunity cost of using public funds in some way. These are suggestively very complex exercises, so in many cases policy-makers have to rely on the cost-benefit analysis.

While estimating and evaluating effect of the R&D tax incentives, essentially two questions are addressed. First, how is the price of R&D affected by different tax incentive regimes? And second, given the changes in the cost of R&D, how do firms respond? To answer these, Hall and Reenen (2000) suggested two approaches- comparing marginal returns to industrial R&D dollars at the societal level to the opportunity cost of using extra tax dollars in a different way; comparing amount of incremental industrial R&D to the loss in tax revenue.

Generally, the policy-maker calculates policy costs, including the associated administrative costs of the scheme; usually an optimal choice depends on the simple cost-benefit analysis. In theory, an optimal R&D tax incentive would bring private rate of return up to the social rate of return. The existing tax structures of different countries are evaluated by calculating how close they come in bridging this gap.

The literature suggests that the effectiveness of the public intervention in R&D can be studied either from the input side or from mthe output side (Kohler *et al*., 2012). A section of econometric studies focuses on input additionality, i.e. whether public resources really stimulate additional private R&D investment activities or crowd out projects that business would have carried out anyway. These studies are typically based on firm-level panel data and for periods before and after the introduction of tax incentives or analysing the effects of change in the generosity of certain incentives. The R&D demand equations are estimated using dummy variables for tax credit or R&D price elasticity (Mansfield & Switzer, 1985; Mamuneas Nadiri,1993; Mohnen, 1999; Hall and Van Reenen, 2000). In some of the current studies, control group approaches have been used, which compared firms that use R&D tax incentive with R&D active firms that refrained from doing so (*see* Corchuelo and Martinez-Ros, 2009; Czarnitzki *et al*., 2011; Duguet 2010). The downside of this methodology is the availability of the data that often prevent cost–benefit analysis of R&D tax incentives and thus makes it difficult for assessing general adequacy of the measure.

Kohler *et al*.(2012) highlighted evaluation process from the perspective of output generation for attaining policy goals, including support to SMEs, industry-science linkages, high technology industries, young technology-based firms or certain fields of research. Similarly, Cappelen *et.al* (2008) study based on the output additionality in terms of introducing new products and processes and patent applications- found significant effects of innovation with limited novelty. Another study by Czarnitzki *et al*. (2011) found Canadian R&D tax credit having a positive impact on the frequency of a new product development, introduction of new-to-the-market products and sales share of new products but did not show any impact on the firm profitability and market share. Austrian R&D tax incentives assessment (Falk *et al*., 2009a, 2009b) was on the effects of innovations and growth in sales and employment; positive impacts were observed for the probability of introducing new-to-the-market products. Also, examined the impact of fiscal incentives and direct subsidies for business R&D, and found stronger effects for direct measures and particularly strong impacts for firms using both types of the government support. There were two more studies focusing on firm productivity- one by Cappelen *et al.* (2007) on the impact of Norwegian tax credits and the other by Colombo *et al*. (2011) for the Italian tax incentive schemes. Former showed no significant effect on labour productivity and the latter on the total factor productivity. Meanwhile Warda (2001) established a model named B-index[2] to compare the generosity of R&D tax incentives. The study stated that the cash effect of R&D tax incentives had fallen with the rate of the tax on which an allowance or a credit was applied.

R&D Incentives for Medium and High Tech Industry in Selected Countries

This section discusses the country-specific choices which the government has made while designing fiscal incentives to incentivise business R&D, especially in the medium-high tech industry. The most frequent forms of incentives are exemptions, allowances, tax credits, tax deferrals, accelerated depreciation, rate relief, tax holidays and patent box (*see* Box 1). The OECD countries provide broadly four types of incentives- tax allowance, tax credits, tax deferrals and accelerated depreciation. Based on the available information a summary table (Table 2) on R&D tax incentives of the selected countries was prepared. Tax deduction and accelerated depreciation on the R&D assets/capital are most favourable tax incentives in the BICS. None of the BICS countries offers tax credits while the industrialised countries like Japan, Korea and US prefer tax credit.

Box 1: R&D tax incentives

Exemptions are income or expenditure that excluded from tax base

Allowances are the extra amounts over current business expenses deducted from gross income to arrive at taxable income

Tax Credits are the amount of money deducted from the tax liability

Tax Deferrals is the relief in the form of a delay in payment of a tax

Accelerated Depreciation permits to depreciate the fixed assets at higher rates in the first years of the asset's life. This allows, therefore, decreasing the overall taxable income in the specific periods

Rate Relief is a reduced rate of corporate income tax

Tax Holiday is an exemption from paying corporate income tax for a specified time period

Patent Box is a tax incentive that offers a reduced corporate income tax rate for income derived from patents (it is called a box because there is a box to tick on the tax form)

Source: Author's compilation based on EU (2014) report and OECD- NSETI data collection

Brazil

Brazil national innovation system explains the relationship between primary investment in the science and technology and its national economic development (Nelson, 1993). For enhancement of competitiveness in Brazilian economy, investments in R&D are stimulated by granting fiscal incentives to companies/institutions, which undertake these investments. Coverage of these incentives varies from tax deduction to grants which cover technology support, IT innovative programs, patenting, and patent protection (KPMG, 2012). The incentives apply to nearly all industrial

Table 2: Highlights of R&D Incentives in Selected Countries

Countries	Tax Allowance/ Deductions	Tax Credit	Accelerated Depreciation on the R & D assets/Capital	Reduced Tax Rates	Tax Holiday	Tax Deferrals	Tax Exemptions (Excise & Custom duty)	Grants
Brazil	√		√	√				√
China	√		√	√			√	
India	√		√		√		√	√
South Africa	√		√					
Germany								√
Japan		√						
Malaysia	√							√
Republic of Korea		√						
Thailand	√			√				√
USA		√				√		

Source: Authors' compilation based on Official website of DSIR-India, OECD Innovation Policy China Report, Thailand Board of Investment Guide, KPMG(2012/13), EY(2013-14), PWC(2014), Deloitte (2014).

sectors and are open to almost all types of companies, but benefits can vary according to different economic and legal characteristics (So Paulo, 2015).

Fiscal Measures and Financial Support

Basic Production Programme (PPB), an incentive programme of the Ministry of Science and Technology and Ministry of Development, Industry in Foreign Trade for ICT products, gives tax incentives for manufacturing or assembling specific products within the Free Trade Zones. It is well utilized by companies manufacturing cell phones and computers (Doing Business in Brazil, 2015).

Brazilian Development Bank (BNDES) supports manufacturing firms through: finance for investment projects to establish and upgrade plants, modernize processes and spur technological upgrading and innovation; funding for production, sales, acquisition or leasing of new machinery and equipment; support for the production and export of goods and services marketed abroad.[3] For example, in 2012, the BNDES has provided financial support of R$ 28.9 million to one of leading pharmaceutical companies to produce the products used in treating cancer.

Sectoral Highlights

In 2012, the Brazilian government initiated a new programme to encourage vehicle technology innovation[4]. Inovar-Auto fosters industry competitiveness by encouraging automakers to produce more efficient, safer, and technology-advanced vehicles. Inovar-Auto provides incentives in two ways – firstly, it increases tax on industrialised products (IPI[5]) by 30 per cent for all light-duty vehicles and light commercial vehicles; second, it imposes a series of requirements for automakers to qualify for up to 30 percent discount in the IPI.[6] In other words, IPI taxes would remain unchanged for those manufacturers who meet the requirements, thus incentivising investments in vehicle efficiency, national production, R&D, and automotive technology. The programme is limited to vehicles manufactured between 2013 and 2017, after which IPI rates would return to pre-2013 levels unless modifications to the decree are made.

To intensify electronics and information technology, Brazilian government has cut down taxes on modems and net components and revised industrial policy like cutting PIS and Cofins. Also, it provided incentives for manufacturing tablets, following moves made in 2005 by the former President of Brazil, who had also cut taxes and created credit lines for purchases of computers and laptops made in Brazil costing up to 3,000 reals (Simoes, 2011).

China

Since 1995, the strategy of Chinese government has been to enhance scientific, and technological and innovation capacity of the country which later transformed into the national development agenda (Stewart, 2007). The past decade has witnessed a rapid expansion of R&D efforts and the ratio of R&D expenditure to GDP went up from 1.16 per cent in 2000-07 to 1.82 per cent in 2008-15 (Table 1).

Fiscal Measures and Financial Support

In the Guidelines for the National Medium-and Long-Term Science and Technology Development Plan (2006-2020), the Chinese government has implemented some preferential policies like tax policies, government procurement and banking and financial policies, to encourage innovation in the private sector. As well as some banking and financial support like extending preferential loans to key high-tech industrial projects and encouraging venture capital investment with government funding.

The proposals include a number of new tax incentives like consumption-based VAT, preferential tax policies to promote innovation, accelerate commercialisation of scientific and technological outputs, and upgrading of equipment. Also, there is scope for widening of the coverage of tax incentives such as tax deduction on R&D expenditure; tax relief for new- and high-tech companies; further accelerated depreciation of R&D equipment; preferential tax treatment in the case of purchase of advanced scientific research equipment; and preferential tax policies to nurture technological innovation in the SMEs. The support oriented policies include facilitating establishment of overseas R&D centres through support in foreign exchange and adequate financing. Apart from theses tax incentives, the Chinese government also gives preference to domestically produced high-tech equipment and products with domestic IP ownership in its procurement policies.

Sectoral Highlights

In the 11th five year plan (2006-2010) of the Chinese government, following four industries were identified to be given focus in the high-tech sector:

- Electronics and information technology manufacturing
- Biotechnology
- Aviation and space, and
- New materials

The Minister of Science and Technology pointed out[7] that during the last five years, there has been structural change in China's R&D investment where government investment increased steadily, while private investment accelerated sharply. R&D funding reached US $211 billion in 2014, with private sector accounting for 76 per cent of the share. China is attempting to transform itself from world's manufacturing hub to a robust R&D destination, and to do so, a series of incentives and programmes are being initiated to encourage R&D activities. Some of the major incentives for R&D and innovation are listed as follows:

- High/New Technology Enterprise (HNTE) incentive grants a 15 per cent preferential corporate income tax (CIT);
- For newly established HNTEs in the Five Special Economic Zones and Shanghai's Pudong New Area,

- Tax holiday of 2 years (full exemption) followed by 3 years of 50 per cent reduction in CIT
- CIT super-deduction of 50 per cent extra for eligible R&D costs
- Income tax exemption for transfer of technology

These incentives are often being accessed by auto-parts manufacturers and pharmaceutical companies.

India

Mani (2008) pointed out that investments in R&D have declined across industries in India, and innovation performance is concentrated in specific industries such as pharmaceutical industry. However, the government is keen to promote R&D and innovation-driven competitiveness across the board in the manufacturing sector to strengthen technological depth and for enhancing domestic value-addition.

The Finance Minister has announced in 2016-17 Union Budget (national expenditure and revenue statement), certain new policies for R&D/Innovations in the industry. Apart from the ongoing policies, key announcements from the recent budget explicitly promoting innovations are the following.

- Special tax rate on proceeds of patent commercialisation – 10 per cent rate of tax on income from worldwide exploitation of patents developed and registered in India
- 100 per cent tax deduction on profits of innovation based start-ups for the first three years

Fiscal Measures and Financial Support

India has three different types of financial arrangements for financing innovations. They are research grants, tax incentives and venture capital. The former two are totally provided by the government agencies while the latter is gaining popularity as a private source of funding for innovation/R&D.

India principally employs R&D tax allowance (super deductions), tax holidays, custom duty exemptions for imports, write-offs on R&D expenses, and depreciation allowance for capital expenditure in the high technology industries. The super deduction rate stands at 150 per cent and tax holiday incentives are significant.

Sectoral Highlights

Over the last two decades, India has initiated several long-term innovation projects in selected areas in the public-private partnership mode. These are mainly in the areas of drugs and pharmaceuticals and biotechnology. The pharmaceutical and the biotechnology sectors enjoy the special privilege in this regard; and are eligible for duty-free import of specific items (comprising analytical and specialty equipment) and pharmaceutical reference standards required for the R&D.

India has also initiated several projects in the area of renewable energy like solar under government patronage. There are specific schemes[8] to fund technology development and commercialization in the industry and in SMEs. Additionally, India also promotes technology incubation units and frugal innovations.

Under the National Policy on Electronics, several initiatives are being taken to promote R&D and Intellectual Property development in the Electronic System Design & Manufacturing (ESDM) sector. A working group has been formed and following initiatives[9] have been undertaken.

- Setting up of Electronics Development Fund for promoting Venture Funds in the ESDM area;
- Setting-up of Incubators for supporting start-ups in the ESDM sector;
- Development of Conditional Access System (CAS) for Set Top Boxes; and
- Other projects as recommended by the Working Group.

South Africa

Fiscal Measures and Financial Support

In 2006, R&D tax incentives programme was introduced to encourage private sector investment in the R&D activities. In 10th January 2012, the government of South Africa amended section 11D of the Income Tax Act, 1962, under which companies performing R&D qualified for incentives (Guide to Science and Technological R&D Tax Incentive, Department of S&T South Africa). South African government gives a deduction of 150 per cent of expenditure on the eligible R&D activities during the year of assessment. Capital expenditure on R&D assets is deductible over three years at 50 per cent in the year in which the asset is brought into use, followed by 30 and 20 per cent in the next two years of assessment. Deductions on depreciation of R&D assets are allowed on building, machinery, plant, equipment or article of capital nature used for the purposes of R&D in the year in which it was brought into use. If part of the building was used for eligible activities and regularly for R&D, and was equipped specifically for such use.

Some of the major existing programmes of South Africa's Department of Science and technology on R&D support, which provides grants to private sector, are Manufacturing Competitiveness Enhancement Programme (MCEP) and Support Programme for Industrial Innovation (SPII). The MCEP offers direct financial support in terms of grants and loans to enhance competitiveness of the existing manufacturing companies and related activities, to help them acquire new assets to upgrade or expand manufacturing capacity, to implement cleaner (green) production and energy-efficient technologies, to fund working capital, and/or undertake feasibility studies on qualifying activities.

Besides, financial support and incentives, other measures include partnerships with and technical support through government research institutions and universities, contracts for public R&D work, collaborations and partnerships with local and multinational companies and organisations, administration of intellectual property laws and regulation in the spheres of innovation and industrial policy and sector based skill training initiatives.

European Union

The strategy for growth in Europe set out by the European Commission in Europe 2020 document[10], focused on the R&D investment as one of the priority strategies out of five other targets[11] to become more competitive economy in the coming decade. As stated in this vision document, by the year 2020, European investment in the R&D should reach at least 3 per cent of the GDP. This target seems ambitious given that the average GERD was 1.57 per cent during 2008-13. Over time, the gap in innovative performance among member-states is narrowing down due to coordinated and effective innovation policies. Still, there are significant differences; the performance of the most innovative countries like Sweden, Denmark, Germany and Finland is around three times better than the least innovative states (EU, 2014).

Fiscal Measures and Financial Support

According to the EU (2014) study[12] on R&D tax Incentives, Germany and Estonia are the only countries not having a tax policy aiming to stimulate innovation, although tax incentives are common and most of the countries are offering more than one type of instruments. R&D tax credit is the most popular instrument (present in sixteen countries), followed by enhanced allowances (fourteen countries) and accelerated depreciation (nine countries) among the members of the EU. Majority of the tax incentives are based the on corporate incomes. Interestingly, in eight countries benefits are set against social contributions and/or wage.

Germany

Within the EU, we take up Germany as a special case given its status as a manufacturing powerhouse with global competitiveness till-date.

Germany has benefitted from early industrialisation and has often followed heterodox approaches in policy-making; distinct from the other industrialised countries of the West. The German federal government promotes[13] research through the so-called High-Tech Strategy. This initiative defines areas of significance given their contribution/importance to solving global challenges. Germany's high-tech strategy aims to translate novel ideas into innovative products and services based on five pillars. According to the guideline of German Federal Government, five pillars include: prioritising future challenges relative to the prosperity and quality of life; consolidating resources and promoting transfer; strengthening the dynamism of innovation in the industry; creating favourable conditions for innovation; and strengthening dialogue and participation.

Fiscal Measures and Financial Support

Germany has three basic research categories: fundamental research, industrial research, and experimental research; financed by the European Union (EU), the German Federal Government, and the individual German states. The R&D incentives are mainly in the form of non-repayable cash grants awarded on a "per project" basis on an average of 50 per cent of eligible R&D cost. All the research programmes financed by the German Federal Government add to the tune of approximately EUR 5 billion annually[14] and are reserved for R&D projects in the form of non-repayable project grants, particularly for the SMEs. A specific funding scheme called "KMU-innovativ" focuses on the participation of the SMEs within high-tech strategy. Alternatively, R&D loans are provided under different government programmes. For instance, the ERP innovation programme offers 100 per cent financing of eligible R&D projects costing up to EUR 5 million.

Sectoral Highlights

German government gives priority[15] to climate, energy, health/ nutrition, mobility, security and communication sectors. Financial support is provided to key areas in information and communication technologies, optical technologies, production technologies, material technologies, biotechnology, nanotechnology, microsystems' technology and innovative services. The public and private sectors have made a significant commitment to spend around three per cent of the national GDP per year on the R&D activities. This amounts to approximately EUR 70 billion R&D spending annually.[16]

Japan

Japan has been the most successful industrial and technologically advanced country, outside the Western Hemisphere, and is known for its concerted policy action towards technology- driven industrial development after the World War II. The Japanese experience has over the years attracted significant scholarly attention, and there is rich evidence and literature to draw upon.

Fiscal Measures and Financial Support

At present, to facilitate R&D, the government offers five different categories of tax incentives- tax credits for increasing R&D expenses; tax credit for R&D by SMEs; tax credit for special R&D expenses including national research laboratories, foreign research laboratories etc; tax credit for R&D facilities for fundamental technologies, and tax incentives for technological research associations.

In 2015, the Ministry of Economy, Trade and Industry (METI) sought for key tax reforms[17] to ensure internationally competitive R&D tax incentives aiming to maintain and strengthen business R&D initiatives to support Japan's global competitiveness. Besides, creating a framework under which efficient and effective business R&D investment could be stimulated, including promotion of open innovation. In view of this, following key tax reforms were listed in FY2015.

- Enhancing the open innovation-based credit;
- Increasing tax credit rates significantly up to around five times the normal rates and providing a special upper limit to the tax reduction;
- Expanding the scope of research expenditures subject to tax credit, including the technology license fees paid to the SMEs and start-ups;
- Extending the measures for raising the upper limit subject to the volume-based credit (30 per cent of the corporation tax).

Sectoral Highlights

In line with the R&D incentives, some sectoral incentives have also been proposed. Significant reforms in motor vehicle taxation have been proposed by the METI in FY2015.

- The automobile acquisition tax would be abolished when consumption tax rate reaches 10 per cent;
- Expansion of tonnage tax reductions/exemptions in the tax incentive for eco-friendly vehicles;
- Introducing new method of tax accordance aligned with eco-friendly performance, expanding special provisions for Greening of Vehicle Taxation;
- Tax deduction measures for Mini-vehicles (kei-car) with superior eco-friendly performance would be introduced.

Malaysia

Malaysia uses foreign direct investment and export-led manufacturing strategies to follow the success path of Asian Tigers. However, since the Asian economic crisis of 1997, through the recent global financial crisis, Malaysia is experiencing slower growth. A study by the OECD on the Innovation policy of Southeast Asia (2013) highlighted some recovery after the global crisis, but expressed concern since multinational enterprises of Malaysia mostly confining to manufacturing and assembly activities, rather than research and development. Lately, Malaysia is emphasising on innovation as the driver of economic growth to escape infamous “middle income trap”. Major challenges of the newly industrialised countries, like Malaysia, are in the domain of advanced manufacturing technology. Malaysian government is playing a crucial role in the promotion and execution of newer technologies among local manufacturing companies through the Ministry of Science, Technology and the Environment (MOSTE).

Fiscal Measures and Financial Support

The R&D incentives in Malaysia include Investment Tax Allowance, 200 per cent of super deductions, and enhanced benefits for pioneer status. [18] Nature of these incentives depends on the type and the nature of the R&D projects. For example, contract R&D attracts 100 per cent investment tax allowance whereas in-house R&D is eligible for 50 per cent tax allowance.

Science Fund is a grant provided by the Malaysian Government to carry out R&D projects, which can lead to the discovery of new ideas and advancement of knowledge in applied sciences, focusing on high impact and innovative research. [19]

Sectoral Highlights

Many incentives and grants are provided to encourage R&D activities, especially in the areas of electrical and electronics, machinery and equipment, chemical, medical and aerospace.[20] Malaysia’s product innovations are broadly achieved by the MNCs; the local firms are limited to less sophisticated products.

Malaysia’s primary care model has been acknowledged by the World Health Organisation as a viable system to achieve “Health for All”. The demand for quality health care continues to rise in Malaysia with increasing affluence and rising consumer awareness. In 2014, about 7.25 per cent of the country’s GDP was expected to be spent on health care. In the Pharmaceutical industry, Malaysian government offers incentives for contract R&D and in-house R&D. Investment Tax Allowance of 50 per cent is allowed on qualifying capital expenditure for 10 years to be offset against 70 per cent statutory income. Investment Tax Allowance (ITA) of 100 per cent is offered on qualified capital expenditure for 10 years to be offset against 70 per cent of statutory income (Guide on Pharmaceutical Industry 2013, Malaysian Investment Development Authority).

Malaysian government promotes production of high value-added parts and components. Companies manufacturing transmission systems, brake systems, airbag systems and steering systems are eligible for better fiscal incentives[21] Pioneer Status (PS) for 100 per cent fiscal deduction for 10 years or Investment Tax Allowance (ITA) of 100 per cent for five years. Similar incentives are also granted for investment in the assembly or manufacturing of hybrid and electric vehicles. The specific provisions in this category are as follows:

- 100 per cent ITA or PS for a period of 10 years;
- Customised training and R&D grants in addition to the existing grants;
- 50 per cent exemption on excise duty for locally assembled/ manufactured vehicles or provision of grant under the Industrial Adjustment Fund (IAF); and
- PS of 100 per cent for 10 years or ITA of 100 per cent for five years for the manufacturing selected critical components supporting hybrid and electric vehicles, such as electric motors, electric batteries, inverters, battery management system, electric air conditioning, air compressors, and inverters.

Republic of Korea

Republic of Korea, the most appropriate example of newly industrialised country from Asia, has achieved remarkable economic growth in the last four decades. This is attributed to a large part to the presence of strong national innovation system where private industries and government sponsored research institutes have played vital role in the economic development. Study by the OECD Innovation Policy Korea (2014d), highlighted how Korea has maintained a high level of R&D expenditure, consistently focussed on generating human capital and a skilled labour-force, good and improving innovation framework conditions, large knowledge-intensive and internationally competitive firms, and a strong ICT infrastructure.

Fiscal Measures and Financial Support

The Korean government has been providing various types of tax credits and exemptions to stimulate R&D activities. Korea's R&D tax credit is provided either on the volume of R&D expenditure or incremental R&D expenditure. Special Tax Treatment Control Law of Korea provides various tax incentives that include:

- tax credits for research and manpower development;
- tax credits for technology transfer;
- tax credits for merger or acquisition of innovation-driven SME;
- tax credits for investment in facilities for technology and manpower development;
- special taxation for acquisition cost of technology, and
- reduction or exemption from corporate tax (e.g. high-tech enterprises moving to special research and development zones).

The specific provisions under the law allow: deduction from income and corporate tax up to a certain percentage (25 per cent for SMEs and 3~6 percent for non-SMEs) of research and human development costs related to general R&D activity; deduction from income or corporate tax of up to 10 per cent of spending on research and human development facilities; exemption from local tax on real estate owned by corporate in-house R&D institutes; and no tax on researchers' income when it is from a research activity.

Sectoral Highlights

As per the OECD Innovation policy report on South Korea, 17 new growth engines (sectors) have been identified, wherein more generous tax incentives are given to companies involved in those sectors (a deduction from income and corporate tax of up to 30 per cent for the SMEs and 20 per cent for the non-SMEs for research and human development costs related to the new growth engines). Also, the total amount of R&D tax credits was provisionally estimated at KRW 2.85 trillion in 2012, an 8.8 per cent (KRW 231.4 billion) increase over 2011 (OECD, Korea Reviews of Innovation Policy, 2014).

Korea's Industries Report 2012 emphasised on steady increase in R&D investment in pharmaceuticals and in continued development of new drugs especially in the biosimilar,[22] with trends suggesting South Korea's growing dominance in this segment. The scope of corporate tax breaks has been expanded to more R&D projects related to drug development and new funding sources for R&D related to new drug projects to establish South Korea as a global leader in pharmaceutical industry.

Thailand

Since 1980s, Thailand's economic performance has been dependent on the foreign investment and exports. It has become a key production base for global automotive and electronics firms from Japan, US and Europe. Recent study by the OECD on Innovation Policy in Southeast Asia (2013b), highlighted Thailand facing huge competition pressure from lower-cost emerging economies such as Vietnam, and has lagged by more technological learning-intensive economies of South Asia (Singapore, Korea, China and Taipei). To cope up with the technological competitiveness, Thai government has adopted a dual-track policy to enhance capabilities of Thai firms by expanding foreign investment, exports and tourism. Supporting and strengthening Industrial clusters in automobiles, food, fashion and software is a key focus of the industrial innovation policy of the Thai government. The government is also focusing on skill development of labour-force, investing in ICT infrastructure, enhancing the quality of teaching and research at Thai universities, investing in targeted public research facilities, and providing R&D incentives to foreign and local firms.

Fiscal Measures and Financial Support

The Board of Investment (BOI) in Thailand is primarily responsible for granting tax incentives on the basis of region, sector, exports and free-trade zones. The incentives are classified into two groups based on the activity and the merit. For each group, BOI has summarised tax and non tax incentives for broader sectors like agricultural, mineral, light industry, metal, machinery & transport, electronics & electrical appliances, chemicals, paper and plastics and service.[23] The BOI has identified six activities (A1:A4, B1:B2) based on importance (see Box 2).

Sectoral Highlights

Manufacturing of automobile engines, vehicle parts using high technology, electronics and electrical appliance, and active pharmaceutical ingredients qualify mainly for A2 and A3 activity. Additional incentives are granted based on the merits of the project such as for R&D (in-house, outsourced in Thailand or joint R&D with overseas institutes) has 200 percent of additional cap on expenditures (Guide to the BOI 2015).

United State of America

The United States had led the world in S&T in the 20th century, and pioneered second industrial revolution by transforming industrial production through use of technology. Technology-driven industrialisation became the key to long-term competitiveness of the US Economy, strengthening its position as the wealthiest nation. Introduction of digital technologies is often hailed as signature to ushering in third industrial revolution, and the US has again come to the forefront of the associated technology frontier. However, OECD STI outlook, 2014 suggests that the US lead is narrowing down despite its leading universities and global technology companies. The R&D and patenting by businesses have also grown less rapidly than in the past.

Fiscal Measures and Financial Support

- In the recent times, the US has been promoting innovations focused more on sustainable growth and quality jobs. In 1994, the US

Box 2: Identified Activities by BOI, Thailand for Incentives

A1 (knowledge-based activities focusing on R&D design to enhance the country's competitiveness) provides 8 years of Corporate Income Tax(CIT) exemption (without cap) + merit based incentives + exemption of import duties on machinery, raw materials + non tax incentives.

A2 (infrastructure development and activities using advance technology to create value added) provides 8 years of CIT exemption + merit based incentives + exemption of import duties on machinery, raw materials + non tax incentives.

A3 (High technology activities) provides 5 year of CIT exemption + merit based incentives + exemption of import duties on machinery, raw materials + non tax incentives.

A4 (Lower technology than A1-A3 but value added to domestic resource and supply chain) provides 3 years of CIT exemption + merit based incentives + exemption of import duties on machinery, raw materials + non tax incentives.

B1 (Supporting industry that does not use high technology, but add value to supply chain) exempted CIT + provide additional grants + exemption of import duties on machinery, raw materials + non tax incentives.

B2 (Supporting industry that does not use high technology, but still add value) provides exemption of import duties on raw materials + non tax incentives.

Source: Thailand Board of Investment (2015), "A Guide to the Board of Investment (2015)".

launched following two incentive programmes on business and occupation (B&O):

- Tax credit for R&D spending, referred to as the "high tech credit programme" and
- Tax Deferrals for High Technology Businesses, referred to as the "high tech deferral program"

The legislative goals of these programmes were to create jobs, increase employment for US citizens as well as expand company's growth, growth in R&D, introduction of new products and study diversification of the overall state economy. These programmes[24] became effective from January 1, 1995 and expired on January 1, 2015 (State of Washington, Department of Revenue). Meanwhile they were evaluated from time-to-time by the US Department of Revenue. The evaluation report on High Technology, 2013 states that, till 2012 taxpayers invested approximately $8.2 billion in facilities, machinery and equipment which qualified for high tech deferral. Additionally, $434.2 million were taken by taxpayers utilizing high tech business and occupation tax credit. Over 2,400 taxpayers participated in these programmes. Similarly, for high-tech credit the number of taxpayers utilizing the credit dropped from 638 in 2000 to 594 in 2012, even the amount of credit had fallen – from $29.2 million in 2000 to $22.2 million in 2012 (Nelson, 2013).

Sectoral Highlights

According to the Nelson study (2013) business must conduct R&D in one of the five industries to qualify for high-tech incentives. The five industries are advanced computing, advanced materials, biotechnology, electronic device technology, and environmental technology. Similarly, a sales and use tax deferral/waiver programme, effective since July 1, 2006 is available for investments in construction or renovation of structures, or machinery and equipment used for biotechnology product or medical device manufacturing.

Concluding Remarks and Lessons for 'Make in India'

In this paper, we have revisited the theoretical arguments behind governments' motivation and rationale for promoting R&D in industrial firms and have produced a wide review of contemporary fiscal incentives that the governments can offer. Our analysis has purposely covered some of the early and the newly industrialised countries, and has highlighted the latest policies in the large emerging economies (BICS) including India and China. This may help in understanding the relevance of such policy paradigms for industrial development and competitiveness, placing India in context.

India is very keen to expand its manufacturing base to provide jobs and boost export-led growth in manufacturing sector; comparable with the newly industrialised nations of Asia and emerging economy peers like China. Manufacturing sector has received strong push in the recent years with quantitative targets being set for the years to come in terms of its contribution to national income and employment generation. The present government has offered stronger articulation, and has sharpened the focus under its 'Make in India' initiative in terms of sectoral strategies. India uses a mix of policy options, encouraging global competition as well as offering variety of incentives to strengthen domestic industry. India has outlined the need for increasing technology intensity in manufacturing for long-term competitiveness and for gaining acumenship to produce technologically advanced products.

We highlighted India's global position in medium and high technology industries in terms of value-addition (share in total MVA) and exports (share in total manufacturing exports). Clearly, India needs to improve with regard to export competitiveness of medium and high technology industries. To achieve this goal, India has to improve its quality and variety of products in this segment by deepening technology intensity and acquiring capabilities to producing technologically sophisticated products. Therefore, desired efforts towards effective use of technologies, and acquisition and adaptation of know-how have to be supplemented with increased flow of new and relevant innovations.

India's robust innovation network has evolved over the years primarily under the public patronage. In the last two decades India has not only encouraged FDI and private sector R&D but has also experimented with several models of public-private partnership for the joint R&D projects. India has also seen spontaneous supply of cost effective innovations suited to local needs, driven by individual innovators often outside the formal innovation support systems. India has maintained host of incentives for firm-level R&D. Fiscal incentives primarily in the form of tax relief have been in force and have undergone revisions from time-to-time. We have particularly elaborated the available global evidence on the effectiveness of fiscal incentives for firm level R&D and the conclusion is nuanced. Nevertheless, countries make use of such policy options to affect innovations at margin.

However, such policies when used in conjunction with industrial policies having sectoral and sub-sectoral focus, space may be created for specific innovations for immediate use in relevant industries. The evidence presented in this paper on the contemporary sectoral incentives in the medium and high tech industries suggest spontaneity of such policies across the selected countries. Such policies have often benefitted sectors like automobiles and in specialised segments like fuel-efficiency and vehicular technologies based on the alternative sources of energy. New industries in electronics and computers, information technology, biotechnology and pharmaceuticals, new materials, etc. have much to owe to such policies in various countries. The sectoral policies and well defined fiscal incentives have facilitated cost-effective procurement and availability of raw materials and equipment for R&D, technology acquisition and innovation in these sectors.

Sector specific incentives for innovations offer better articulation of government's intention and may enhance the probability of utilisation of associated fiscal incentives. India has so far been promoting generic innovations. While this works best for public-funded research institutions, firm-level R&D may be driven by sector-specific dynamics. India's newer policy stance has been to provide direct and indirect financial support to start-up enterprises and small and medium enterprises in the form of easy credit and venture capital; funding projects through dedicated technology funds and incubation infrastructure. In some cases, the government tries to encourage private sector R&D which would have wider developmental impact for instance in health and environment. With such policies, the government is likely to end up creating obvious circumstances for particular kind of R&D in the private sector but may not facilitate technology generation in numerous industries. Informed policy making, would, therefore, entail identifying sectors with potential for innovation and technological value-addition and tuning fiscal incentives aimed at encouraging innovations in the sectoral context.

Endnotes

1. The definition of MHT sector is adopted from UNIDO. Also, MHT industry has been selected within manufacturing, since products with high and medium technology content has largest share in trade for both developing and developed countries (UNIDO policy brief, Jan 2013).
2. B-index defined as the net present value of after tax costs of spending per dollar on R&D divided by one minus the corporate income tax rate.
3. UNIDO Industrial Development Report, Sustainable Employment Growth: The Role of Manufacturing & Structural Change (2013).
4. Brazil's Inovar-Auto Incentives Pragram, February 2013.
5. IPI is a basic form of sales taxes on industrial products in Brazil.
6. The programme assumes that all automakers comply with the requirements unless they are not able to demonstrate compliance. In that case, they need to return the gained credits to the government.
7. Adopted from Official Website of The State Council The People's Republic of China http://english.gov.cn/news/top_news/2015/10/28/content_281475221832122.htm
8. As announced in Union Budget 2014-15 to establish Technology Centre Network to promote innovation, entrepreneurship and agro industry
9. Department of Electronics & Information Technology, available at <http://deity.gov.in/esdm/rdip>

[10] Argument taken from EU(2010), "EUROPE 2020- A strategy for smart, sustainable and inclusive growth"

[11] The other targets are relate to employment, climate change and energy sustainability, education, and poverty and social exclusion.

[12] European Union (2014), "A study on R&D Tax incentives-Final Report"

[13] Information accessed from Federal German Development Agency—Germany Trade & Invest.

[14] ibid.

[15] ibid.

[16] ibid.

[17] Japan External Trade Organisation, Incentive Programs, R&D tax Incentives, available at <https://www.jetro.go.jp/ext_images/_Invest/pdf/support/RandD_tax_incentives_.pdf>

[18] Information adopted from official website of Malaysian Investment Development Authority.

[19] Information adopted from official website of Ministry of Science, Technology and Innovation (MOSTI).

[20] Information adopted from official website of the Malaysian Investment Development Authority (MIDA), Investment in R&D.

[21] Access to official website of Malaysian Investment Development Authority (MIDA) Available at http://www.mida.gov.my/home/incentives-in-manufacturing-sector/posts/

[22] Biosimilar are a type of biological products that are licensed (approved) by FDA because they are highly similar to an already FDA-approved biological products, known as the biological reference product, and have been shown to have no clinically meaningful differences from the reference product.

[23] Information adopted from official website of Board of Investment, Thailand.

[24] Information adopted from Official website of State of Washington, Department of Revenue

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Appendix A1:

ISIC Revision 2	ISIC Revision 3
342 - Printing, publishing and allied industries 351 - Manufacture of industrial chemicals 352 - Manufacture of other chemical products 356 - Manufacture of plastic products not elsewhere classified 37 - Basic Metal Industries 38 - Manufacture of Fabricated Metal Products, Machinery and Equipment 381 - Manufacture of fabricated metal products, except machinery and equipment	24 - Manufacture of chemicals and chemical products 29 - Manufacture of machinery and equipment n.e.c. 30 - Manufacture of office, accounting and computing machinery 31 - Manufacture of electrical machinery and apparatus n.e.c. 32 - Manufacture of radio, television and communication equipment and apparatus 33 - Manufacture of medical, precision and optical instruments, watches and clocks 34 - Manufacture of motor vehicles, trailers and semi-trailers 35 - Manufacture of other transport equipment

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