Institutional Mechanisms for Promoting Intra-regional Investments and Trade in the IOR-ARC Region in Strategic Sectors:

Cooperation in Knowledge-Based Industries

Draft Report

Institute of Policy Studies of Sri Lanka

October 2013

Executive Summary

- The very nature by which the world economy has evolved over the past three decades has emphasized the increasing role of 'knowledge' as a primary source of wealth creation and as a tool for poverty alleviation
- Many of the economic sectors which have experienced rapid growth over the last few decades, in terms of both output and employment, notably, information and communication technologies (ICT), aerospace, pharmaceuticals, finance and education for example, have been knowledge-intensive sectors
- It has increasingly been recognized that 'knowledge' plays a decisive role in terms of determining a country's comparative advantage. Knowledge constitutes the main competitive advantage of industrialized economies. For economies that are in the process of industrializing, knowledge is viewed as a key apparatus through which they could catapult themselves into the ranks of the developed world
- In light of the growing recognition of the importance of knowledge and KBEs, regional groupings (notably the ASEAN, APEC and the EU) around the world have increasingly sought cooperation on a regional scale to establish a supportive institutional mechanism to assist and complement efforts by member states to make the transition to KBEs
- Within the IOR-ARC, each member economy is at various stages of a KBE development. The economies of Australia and Singapore are at the higher end of the KBE spectrum, and countries such as the UAE, Malaysia and Thailand are gradually moving towards higher-end. There also exist countries such as India, Sri Lanka and South Africa which are at the early stages of making the transition to KBE, whilst latecomers such as Mozambique, Tanzania, Yemen and Bangladesh lag far behind in terms of KBE development
- The diversity within the grouping may pose challenges for cooperation. However, this very diversity in KBE development also presents vast potential for cooperation. For instance, Australia poses higher-end capabilities in terms of education, ICT and biotechnology, Malaysia and Thailand in terms of IT hardware and electronics and countries such as India in IT software. Given this diversity, there exists vast potential for mutual cooperation to better harness these capabilities for the mutual benefit of all member states in the IOR-ARC.

- The conceptual framework of this study builds upon a methodological approach adopted by APEC (2000), where it analyzes a set of quantitative indicators which provide some measure of how each economy fares along four key KBE dimensions – business environment, ICT infrastructure, innovation systems and human resource development – and categorizes all IRO-ARC economies into four main groupings based on their comparative advantage in transitioning to a KBE
- Detailed case studies based on secondary data are undertaken for four IOR-ARC member economies from the four groupings, namely Australia, Malaysia, Mauritius and Bangladesh, which are at various stages of KBE development, and potential areas for cooperation are identified in spurring 'trade and investment' within the grouping across the four key pillars of a KBE.
- Comparison of case study economies reveal clear differences in the state of development across the four dimensions of a KBE, suggesting ample scope for mutual cooperation through trade and investment.
- Creating a conducive business environment for trade and investment to take place is a key prerogative that needs to be undertaken by member economies of the region – specifically those that languish at the lower end of the KBE spectrum – in facilitating trade and investment flows in the region. Governments in all IOR-ARC member economies have a responsibility to create and provide an environment that is conducive for knowledge based industries to operate and thrive, by way of less regulated product markets, freer trade and investment, and more effective incentive systems.
- The analysis of case studies highlights widespread disparities in terms of the availability and access to ICT infrastructure across the grouping. Spurring trade and investment in the ICT sector by way of liberalizing and encouraging investments in the telecommunications sector would come a long way in building the required infrastructure, the transfer of more productive and efficient advanced technology and more affordable access through increased competition In terms of innovation, once again vast disparities could be observed.
- Countries of the likes of Australia and Singapore are significantly ahead in their innovation capability compared to countries such as Bangladesh. Safeguarding intellectual property is essential in spurring innovation. Member nations within IOR-

ARC could adopt common policy matrices and legal frameworks that function efficiently within other IOR-ARC members as backdrop to development of their own indigenous legal policies. This would further stimulate increased trade in advanced technology and technology embodied goods, from developed to lesser developed economies, which could open up more avenues for technology transfer and innovation

- The low availability of venture capital across IOR-ARC member states is another pressing issue stifling innovation. In this light, a common pool of funds at the regional level needs to be mobilized and made available to startups and innovative entrepreneurs in the region.
- Under the HRD pillar, IOR-ARC members of the likes of Australia and Singapore possess world class tertiary education systems which are critical in building a sound stock of knowledge workers. While countries such as Malaysia and Thailand have relatively strong tertiary education institutions, they still have a long way to go in reaching desirable standards, whereas countries such as Tanzania, Bangladesh and Yemen, have extremely weak education systems
- This wide divide in terms of the level of development in the sector provides significant scope of intra-regional trade and investment. Mutually beneficial cooperation along the lines of liberalizing the four modes of education service delivery under GATS would come a long way in assisting lower tier IOR-ARC members to bridge this divide.
- For instance, liberalization of education under mode 3 of GATS would open up avenues for leading tertiary education institutes of advanced IOR-ARC member states to establish offshore campuses in emerging and developing member economies. This would come a long way towards addressing quality and accessibility of tertiary education in lesser developed host economies, which in turn would contribute to the building of a sound knowledge worker base. Similar repercussions would also materialize with the liberalization of the other three modes of service delivery Another area of cooperation on the HDR pillar is the sharing of best practices to encourage the uptake of tertiary education by of a novel financing mechanism. Lessons could be drawn from highly successful programmes within the region itself, such as the HELP programme established by the Australian Government.

- It is hoped that the adoption of such recommendations in stimulating regional cooperation in trade and investment would benefit the whole IOR-ARC region in collectively moving towards a KBE

1 Introduction

Knowledge has increasingly been recognized as a key driver of long-term economic growth and prosperity the world over. Many of the economic sectors that have experienced rapid growth over the last few decades, both in terms of output and employment, notably, information and communication technologies (ICT), aerospace, pharmaceuticals, finance and education, for example, have been knowledge-intensive sectors. Knowledge constitutes the main competitive advantage of industrialized economies. For economies that are in the process of industrializing, knowledge is viewed as a key apparatus through which they could catapult themselves into the ranks of the developed world. In light of the growing recognition of the importance of knowledge and KBEs, regional groupings (notably the ASEAN, APEC and the EU) around the world have increasingly sought cooperation on a regional scale to assist and complement efforts by member states to make the transition to Knowledge Based Economies (KBEs).

The IOR-ARC is a diverse grouping of countries, with economies at various stages of KBE development. The economies of Australia and Singapore are at the higher end of the KBE spectrum, whilst countries such as the UAE, Malaysia and Thailand are gradually moving towards higher-end. There also exist countries such as Tanzania, Bangladesh and Yemen which lag far behind in terms of KBE development. The diversity within the grouping may pose challenges for cooperation. However, this very diversity in KBE development also presents vast potential for mutually beneficial cooperation. The objective of this study is twofold. Firstly, the study aims to identify complementarities and opportunities for cooperation in the spheres of trade and investment across the key dimensions of a KBE. Secondly, it aims to identify possible institutional mechanisms through which the identified areas for trade and investment could be facilitated.

For this purpose, the study employs and builds upon the study mythology developed by the APEC (2000) report titled ‘Towards Knowledge-Based Economies in APEC’. In-depth case studies of four member countries namely, Australia, Malaysia, Mauritius and Bangladesh, representative of diversity in terms of KBE development were selected to identify the relative strengths and opportunities and thereby highlight areas for potential cooperation in trade and investment.

At the outset, section 2 provides a broad overview of the IOR-ARC; its dynamics and present a snapshot of the current level of economic cooperation. Subsequently section 3 surveys the literature on knowledge and knowledge based economies in justifying the need for cooperation in knowledge within the IOR. Section 4 details the methodology adopted for the study and categorizes IOR-ARC member states in terms of their stage of KBE development. Section 5 provides an in-depth analysis of the level of KBE development in the selected case study economies. Based on the case studies, section 6 highlights the challenges and opportunities confronting each country in terms of moving towards a KBE. Section 7 draws on the analysis of the case studies to identify complementarities and opportunities for trade and investment in key dimensions of a KBE and also discusses ways in which regional cooperation could be mobilized to facilitate trade and investment within the region. Section 8 concludes.

2 Overview of the IOR-ARC

The concept of an Indian Ocean Rim Association for Regional Cooperation (IOR-ARC) was first mooted by the former foreign minister of South Africa, Pik Botha in November 1993 during his visit to New Delhi, India. The concept gathered momentum in 1995 with the visit of the South African President to India. The initiative was driven by the perceived need of three leading countries in the region, namely, India, Australia and South Africa to assert leadership over the Indian Ocean region. The importance of efficiently managing the regions marine resources, the fusion of India's 'Look - East' and Australia's 'Look-West' policies, South Africa's search for a regional identity, mounting frustration over the slow progress of existing regional groupings and fears of globalization were amongst the key factors propelling the leaders of the region to consider an IOR-ARC to promote regional economic cooperation (Kelegama, 1998).

Two years following its conceptualization, the IOR-ARC was formally established with the IOR-ARC Charter being adopted by the member states at the Ministerial Level Conference held in Mauritius in March 1997. The grouping originally consisted of seven member states from across three continents, namely, Africa, Asia and Australia. Today the grouping has expanded to comprise of 19 member states, with the original seven members forming the core group. The grouping also includes six dialogue partners and two observers. Member States span the four

geographical sub-regions of South Asia, Africa, the Middle East and Australasia. In so far as its geographical diversity, the grouping also exhibits diversity in terms of culture, race, religion, economic development, and strategic interests. Member states also vary in terms of the size of their populations, economies, resources endowments, openness, trade, and technological development and the composition of their national output.

As spelt out in the IOR-ARC Charter, the principle objective of the association is 'to promote the sustained growth and balanced development of the region and its member states'. In this light trade, foreign investment, scientific and technological exchange, tourism, the movement of persons on a non-discriminatory basis, and the development of infrastructure and human resources, inter-alia, poverty alleviation, promotion of maritime transport related matters, cooperation in the fields of fisheries trade, research and management, aquaculture, education and training, energy, IT, health, protection of the environment, agriculture and disaster management are amongst the key areas identified in which to strengthen regional cooperation amongst the grouping.

2.1 The IOR-ARC in a Snapshot

Geographically, the Indian Ocean is the third largest ocean in the world. The region contains a quarter of the Earth's landmass and is home to one-third of the world's population. More importantly, two-thirds of the world's oil resources, 40 per cent of gold deposits, 90 per cent of diamond deposits and 60 per cent of the world's uranium deposits are concentrated in the region. It is also one of the busiest shipping lanes in the world linking the East with West. As noted earlier, the IOR-ARC comprises of a heterogeneous set of countries bordering the Indian Ocean. By the end of 2011, it is estimated that the grouping is home to an estimated 1.9 billion people with a combined GDP of the region of USD 5,270bn. As can be seen from Table 1, member states vary considerably in terms of economic size, resources endowments, openness and trade and investment liberalization, population, per-capita incomes and the composition of their societies. The region is characterized by the dominance of large countries – notably India, Australia, Indonesia, South Africa, Malaysia and Thailand – the six of whom together account for 74 per cent of the regions total output. The region is also home to much smaller countries such as Kenya, Madagascar and Mozambique.

Table 1: Economic and Social Indicators of IOR-ARC Member Countries

Country	Economic Indicators				Social Indicators			
	GDP Per Capita, 2011 (US$)	GDP Growth Rate (%)	Exports of Goods & Services (% of GDP)	Services Sector (% of GDP), 2010	HDI	Life Expectancy at Birth, 2010	Adult Literacy Rate, 2005-2010*	Population Growth Rate, 2000-2010 (%)
Australia	60,642	1.8	21	78	0.929	82	NA	1.5
Bangladesh	735	6.7	23	53	0.500	69	56	1.4
India	1489	6.9	25	55	0.547	65	63	1.5
Indonesia	3,495	6.5	31	38	0.617	69	92	1.2
Iran	4,526 (2009)	1.8 (2010)	NA	NA	0.707	73	85	1.2
Kenya	808	4.5	27	67	0.509	56	87	2.6
Madagascar	467	1	29 (2009)	55	0.480	66	64	3.0
Malaysia	9,656	5.1	97	45	0.761	74	92	1.9
Mauritius	8,797	4.1	54	67	0.728	73	88	0.8
Mozambique	535	7.1	29	45	0.322	50	55	2.5
Oman	25,221	5.5	53	NA	0.705	73	87	2.1
Seychelles	11,711	5	108 (2009)	NA	0.773	73	NA	NA
Singapore	46,241	4.9	209	72	0.866	82	95	2.3
South Africa	8,070	3.1	26	66	0.619	52	89	1.3
Sri Lanka	2,835	8.3	24	58	0.691	75	91	1.1
Tanzania	529	6.3	30	47	0.466	57	73	2.8
Thailand	4,972	0.1	78	43	0.682	74	94	0.9
UAE	45,653	4.9	78 (2010)	46	0.846	77	62	9.1
Yemen	1,361	-10.5	30 (2010)	63	0.462	65	90	3.1

Sources: World Bank 2012 *World Development Indicators*, World Bank, Washington and *Human Development Report 2012.*

The heterogeneity and disparity between member states could be clearly observed when comparing the per capita income of countries. Countries such as Singapore, the UAE and Australia with per capita incomes above USD 25,000 are highly developed, whilst the grouping also comprises of a number of countries with per capita incomes below USD 1,000 and lag far behind in terms of economic development and social wellbeing. The composition of national output amongst the member country's also varying considerably. Services accounts for more than fifty-percent of national output in countries such as Australia, Bangladesh, India, Kenya, Madagascar, South Africa and Sri Lanka, whereas industrial output accounts for the lion's share in countries such as Malaysia, Thailand and Indonesia. Even in terms of social standings, the region exhibits vast disparities. Countries such as Australia and Singapore rank amongst the top quartile of countries in terms of the human development index, exhibiting very high literacy and life expectancy indicators. There also exist countries such as Tanzania, Mozambique and Yemen which rank amongst the bottom quartile of the HDI ranking.

2.2 The Mechanics of the IOR-ARC

Since the very beginning the IOR-ARC sought to emulate the Asia Pacific Economic Cooperation (APEC) model, thus the concept of 'open regionalism' was enthusiastically embraced by the members of grouping as its key tenant to propel economic cooperation in the region. The concept of open regionalism involves regional economic integration without discrimination against non-members. It includes market integration and also market integration facilitated by government policies to the extent that it does not discriminate against non-members. Thus, unlike the conventional approaches to regional integration, regional integration under open regionalism goes through a market process as well as a non-discriminatory market facilitation process spearheaded by the States.

It is widely argued that open regionalism is a much more flexible and member-friendly arrangement of regional cooperation as opposed to the traditional neoliberal arrangements of preferential trade agreements (PTAs), free trade agreements (FTAs), customs unions (CUs) and Common Markets. Under open regionalism, there exists no laws or contracts – rather, decisions are based on consensus. Compliance with commitments is voluntary and there exists no rigid institutional and bureaucratic structure to specify and monitor compliance. Open regionalism as practiced by the APEC and the IOR-ARC has four main components, namely, (1) trade liberalization, (2) trade and investment facilitation, (3) economic and technical cooperation and (4) trade and investment dialog.

Trade liberalization is at the very core of the concept and is undertaken on a non-discriminatory basis towards non-members, i.e. unilateral trade liberalization. The other three aspects of open regionalism are considered soft-core elements. Trade and Investment facilitation implies measures undertaken to enhance transparency and harmonize trade and investment regimes amongst member countries to spur greater trade liberalization in the long run. Economic and technical cooperation entails the identification of strategic areas for economic and technical cooperation with a view of building capacity for trade and investment cooperation. Finally, regional arrangements most often tend to oscillate between short-lived euphoria and agonizingly protracted stalemates, thus it is critical that a constant dialogue on trade and investment issues

are encouraged amongst government officials, businessmen and academics to keep the enthusiasm alive and going in the long term.

The IOR-ARC institutional mechanism functions on the basis of a tripartite dialogue between business groups, academic groups and senior government officials. The Council of Ministers (CoM) is the highest authority in the association. It meets every two years and spearheads the decision making process and formulates policy, review progress on co-operation, makes decisions on new areas of co-operation and on the establishment of additional mechanisms and Specialized Agencies and decisions on matters of general interest based on inputs and feedback from the tripartite dialogue. The Committee of Senior Officials (CSO) which comprises of senior government officials from member states reviews the implementation of decision taken by the COM and in cooperation and consultation with the four Working Groups, establishes priorities for economic co-operation, develops, monitors and co-ordinates work programs, mobilizes resources for financing work programs, submits periodic reports to the COM, and refers policy matters to the COM for its decision.

The three working groups – the Indian Ocean Rim Academic Group (IORAG), the Indian Ocean Rim Business Forum (IORBF) and the Working Group on Trade and Investment – represent the academic and business communities, and in consultation with each other are entrusted with the task of identifying scope to strengthen regional economic cooperation. Projects undertaken by the working groups could be categorized in to two broad areas, namely (a) trade and investment facilitation and (b) economic and technical cooperation. The findings of the working groups are referred to the CSO and fed to the COM for final decision making. Projects cover areas of standards and accreditations, investment facilitation and promotion, trade promotion, tourism and development, maritime security and human resource development, to name a few(Kelegama 2000).

2.3 Present Status of Trade and Investment Linkages in the IOR-ARC

Intra-regional trade (IRT) within the IOR-ARC has grown since its formation, from US$217Bn in 1996 to US$728Bn by 2007. As of 2007, IRT accounts for 25.5 per cent of the regions global trade. Whilst this figure is comparable with various other successful regional trading

arrangements, it could be somewhat misleading given that intra-subregional trade is heavily lopsided. The IOR-ARC could be divided into four sub-regions, namely Africa, Middle East, South Asia and Australasia (Southeast Asia including Australia). As can be noted from Table 2, subregional trade flows have been asymmetrical. The volume of intraregional trade as a percentage of total trade between the East Asian member states is by far the largest, followed by Middle East, Africa and South Asia respectively. The case of East Asia in particular is noteworthy given that all three East Asian member states are also members of another far more successful regional grouping, namely the ASEAN. By taking East Asia out of the equation, IRT in the IOR-ARC is rather lackluster. Similarly, intraregional FDI shares as a percentage of total FDI ranges from a high of 48.32 per cent in East Asia to a marginal 0.1 per cent in South Asia.

Table 2: Intra-Subregional Trade and Investment in the IOR-ARC Region

Subregion	Intraregional Trade (%), 2011	FDI Share (%), 2009
Africa	3.9 (2007)	NA
Middle East	5.3 (2007)	NA
South Asia	3.26	0.10
Southeast Asia	25.94	8.39
East Asia	39.2	48.32

Sources: Asian Development Bank. 2012. *Asia Regional Integration Centre: Integration Indicators.* (http://aric.adb.org/indicator.php) and RIS, MEA, Government of India and IOR-ARC. 2008. *Trade and Investment Prospects of the IOR-ARC in the New Millennium.*
Notes: NA – not available

3 Potential for Cooperation in the IOR-ARC

As highlighted in the preceding sections, the IOR-ARC is truly a unique regional grouping. Member states span three continents separated miles apart by the Indian Ocean and differ considerably in terms of worldviews, social and regional traditions, economic priorities and polity. This vast diversity of interests and capabilities undoubtedly has the potential to impinge upon substantive regional cooperation; nevertheless this very diversity also opens up vast scope for cooperation. Cooperation in the region to date has however been limited. This study attempts to shed light on the potential for cooperation in the Knowledge Based Economy (KBE) in the IOR-ARC to foster trade and investment in KBEs in the region.

3.1 Knowledge and the Knowledge Based Economy

The very nature in which the world economy has evolved over the past three decades has emphasized the increasing role of 'knowledge' as a primary source of wealth creation and tool for poverty alleviation. Many of the economic sectors which have experienced rapid growth over the last few decades, in terms of both output and employment, notably, information and communication technologies (ICT), aerospace, pharmaceuticals, finance and education for example, have been knowledge-intensive sectors (UNESCAP 2007).

The use of the term 'knowledge' with specific reference to economic thought could be traced back to 1962 when the 'Times' magazine in reference to a publication on knowledge as a factor of production noted that 'Economists take infinite pains in diagnosing the auto, oil and steel industry but almost no one tackles the industry that makes the most important product of all. It is knowledge, defined as information, old or new, which is produced and disseminated by all kinds of agents' (Times 1962, p. citied in IPS 2011). The accumulation and application of knowledge has by now become a decisive factor in terms determining a nation's comparative advantage. Knowledge has increasingly been recognized as the driver of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance (OECD 1996).

It has increasingly been recognized that 'knowledge' plays a decisive role in terms of determining a countries comparative advantage. Knowledge constitutes the main competitive advantage of industrialized economies. For economies that are in the process of industrializing, knowledge is viewed as a key apparatus through which they could catapult themselves into the ranks of the developed world. 'New growth theory' highlights the limitations of input driven growth, thus sustaining long-term growth is heavily reliant on improvements in Total TFP.[1] In this light, the so-called New growth theorist's such as Paul Romer (1990), Grossman and Helpman (1991a, 1991b), Aghion and Howitt (1992) and Gregory Mawkin place emphasis on innovation and technological change into a more central and endogenous role than the conventional general equilibrium models of neo-classical economics.

[1] TFP is defined as the joint effectiveness of all inputs combined in producing output (Helpman, 2004).

Such innovation-driven models view technology as an endogenous variable and the primary determinant of growth. In other words, an increase in the rate of technical progress is anticipated to create more rapid growth in TFP, which in turn would propel long term growth. At the very heart of these models is 'knowledge', thus the increasing emphasis in knowledge and the KBE in driving rapid long term growth (Abdih & Joutz 2005). Empirical evidence has increasingly supported these models. The findings of the OECD Growth Project (2001) concluded that divergences in the growth patterns of the OECD countries could largely be attributed to fundamental differences in the intensity of KBE. The APEC (2000) stresses similar findings.

Whilst the use of term 'knowledge' in economic jargon is as old as the term development, the notion of a 'knowledge- based economy' is a much newer concept and was first coined by the Organization for Economic Co-Operation and Development (OECD) in 1996. Accordingly, a KBE is defined as an economy which is 'directly based on the production, distribution and use of knowledge and information' (OECD 1996, p.7), notably with the use of technology to enhance a country's economic growth and development. The recognition of 'human capital' in people is the main resource in this field, particularly within OECD countries. It is 'estimated that more than 50 per cent of Gross Domestic Product (GDP) in the major OECD economies is now in the knowledge-based' sector (ibid, p.9).

The World Bank (2004, p.1) defines a KBE as one 'where organizations and people efficiently acquire, create, disseminate and use knowledge for greater economic and social development'. Accordingly, the success of a KBE rests on four fundamental pillars. The pillars being, (1) an educated and skilled population that can create, use and disseminates knowledge; (2) an economic institutional regime that provides incentives for the efficient creation, dissemination and use of existing knowledge; (3) an efficient innovation system of firms, research centers, universities, consultants, and other organizations that can tap into the growing stock of global knowledge and assimilate and adapt it to local needs, as well as to create relevant new knowledge; and finally (4) a dynamic information infrastructure that can facilitate the effective communication, dissemination, and processing of information (World Bank 2005, p.11).

The Asia Pacific Economic Cooperation (APEC) expands on the OECD definition, to define a KBE as 'one in which the production, distribution and use of knowledge is the main driver of growth, wealth creation and employment across all industries' (APEC 2000 p.1). Accordingly, in a KBE the ability of enterprises in both high-tech and traditional industries to create and exploit knowledge is fundamental to their success. The major source of competitiveness for firms in a KBE is determined by their ability and capacity to translate ideas into useful products and processes. Empirical evidence strongly suggests that amongst the more advanced industrial nations in the APEC, economic growth is most robust in countries where (1) innovation and technological change is pervasive and complemented by an effective national innovation system, (2) human resource development is persuasive, through the provision of high caliber education and accessibility to such services throughout a person's working life and beyond, (3) Efficient infrastructure – ICT infrastructure in particular – is in place which enables citizens and businesses to readily and affordably access pertinent information from across the globe and finally (4) the existence of an business environment which is supportive of enterprises and innovation (ibid p. 1)

In 1999, the OECD launched the 'Growth Project' at the request of its Ministerial Council to study and analyze the causality behind the disparity in economic growth rates amongst member states since the 1990 and identify factors, institutions and policies that could enhance long-term growth prospects. Findings of the study indicated that the major causes for divergence could be attributed to (1) investment in ICT (2) increased use of labour (3) rise in quality of labour and greater efficiency in which labour and capital are combined (i.e. multifactor productivity), which led to the conclusion that in order to enhance long term-growth, more emphasis should be given to policies focusing on ICT, human capital, innovation and firm creation' (OECD, 2001).

3.2 Why Cooperation in the Knowledge Based Economy?

In light of the growing recognition of the importance of knowledge and KBEs, regional groupings around the world have increasingly sought cooperation on a regional scale to establish a supportive institutional mechanism to assist and complement efforts by member states to make the transition to KBEs. The eASEAN Framework Agreement[2] (2000) is one such regional

[2] ASEAN. e-ASEAN Framework Agreement. Available at: http://www.aseansec.org/5308.htm

undertaking which attempts to foster cooperation amongst ASEAN member states in moving towards a KBE. The agreement attempts to foster cooperation in five ICT related thrust areas namely, information infrastructure, growth of electronic commerce, liberalization of trade in ICT products and services, e-society, capacity building and e-governance. The objectives are to enhance the competitiveness of the ICT sector, to reduce the digital divide within individual member states and amongst member states, to promote cooperation between public and private sector in realizing eASEAN and to liberalize trade in ICT products, ICT services and investment. Similarly, the APEC (2000) study titled 'Towards Knowledge-Based Economies in APEC' also identifies a number of areas for cooperative potential for promoting KBEs.

Likewise eEurope is similar initiative launched by the European Union (EU) in 2000 to promote cooperation among member states in deepening KBE development. eEurope 2002 – the first Action plan implemented under eEurope – focused on extending Internet connection in Europe.[3] Building on this, the eEurope 2005 initiative was undertaken, with the aim of providing a favorable environment for private investment and for the creation of new jobs, to boost productivity, to modernize public services, and to give everyone the opportunity to participate in the global information society. In particular, the objective of eEurope 2005 is to stimulate secure services, applications and content based on a widely available broadband infrastructure.[4] The initiative also focuses on capturing opportunities offered by technological developments such as the development of broadband and multi-platform access, the widespread application of which will result in improved economic growth and employment through the creation of new markets.

Within the IOR-ARC, each member economy is at various stages of a KBE development. The economies of Australia and Singapore are at the higher end of the KBE spectrum, and countries such as the UAE, Malaysia and Thailand are gradually moving towards higher-end. There also

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[3] Europa. eEurope 2005. (Online). Available at: http://europa.eu/legislation_summaries/information_society/strategies/l24226_en.htm

[4] Commission of the European Communities. 2002. Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions - eEurope 2005: An information society for all - An Action Plan to be presented in view of the Sevilla European Council, 21/22 June 2002. (Online). Available at: http://ec.europa.eu/information_society/eeurope/2002/news_library/documents/eeurope2005/eeurope2005_en.pdf

exist countries such as India, Sri Lanka and South Africa which are at the early stages of making the transition to KBE, whilst latecomers such as Mozambique, Tanzania, Yemen and Bangladesh lag far behind in terms of KBE development. As discussed earlier, the diversity within the grouping may pose challenges for cooperation. However, this very diversity in KBE development also presents vast potential for cooperation. For instance, Australia poses higher-end capabilities in terms of education, ICT and biotechnology, Malaysia and Thailand in terms of IT hardware and electronics and countries such as India in IT software. Given this diversity, there exists vast potential for mutual cooperation to better harness these capabilities for the mutual benefit of all member states in the IOR-ARC.

4 Framework for Measuring Knowledge Based Economy in the IOR-ARC

4.1 Review of Existing Frameworks

Whilst there has been a healthy debate internationally on what constitutes the characteristics of a KBE, consensus on a common international framework to measure a KBE is yet to materialize. Different frameworks have been developed by individual countries and international organizations, many of which are based on the 1996 OECD definition of a KBE (ABS 2002). Some are more focused on ICT as the main driver of growth whilst others view ICT as an enabling technology and place prominence on other factors such as skill levels, knowledge creation in the form of research and development (R&D) and innovation, knowledge and technology transfer, as factors contributing to economic growth . The ensuing section will briefly discuss some of the frameworks promulgated by international organizations.

4.1.1 OECD Framework

The OECD's work on KBEs and statistical indicators for measuring KBEs commenced as far back as 1996. The OECD argued that traditional economic indicators have never been completely satisfactory largely owing to the fact that they fail to recognize economic performance beyond the aggregate value of goods and services. As such, in order to fully understand the dynamics of a KBE, new economic concepts and measures are required. The original OECD framework attempted to measure KBEs in terms of direct knowledge using indicators such as expenditure of R&D, number of engineers and technical personnel to measure knowledge inputs and indicators such as the number of hi-tech industries to measure knowledge

output. Such an approach however proved troublesome, owing to the fact that knowledge itself is particularly hard to quantify and price. Thus, in 1999 the OECD developed a slightly modified framework which covered four key areas, namely (1) the creation and diffusion of knowledge, (2) information economy, (3) the global integration of economic activity and (4) economic structure and productivity. Subsequently, in light of the findings of the OECD Growth Project, the framework was revised once more to cover the following broad elements of a KBE framework: (1) the importance of a stable and open macro-economic environment with effectively functioning markets, (2) the diffusion of ICT, (3) fostering innovation (4) investing in human capital and (5) stimulating firm creation. Internationally comparable indicators where used as proxies for each dimension of a KBE.

4.1.2 APEC Framework

The APEC (2000) approached the development of a KBE framework in similar light as the OECD Growth Project. Under the directions of the APEC Economic Committee in partnership with organizations in member economies, the underpinnings of the KBE were analyzed by examining the empirical evidence from the individual economies concerned. The analysis came up with four dimensions which characterize KBEs and are largely responsible for the strong economic performance of some economies over the last few decades. The four dimensions being (1) innovation and technological change are pervasive and supported by an effective national innovation system; (2) human resources development is pervasive; (3) an efficient infrastructure operates, particularly in ICT; and (4) the business environment is supportive of enterprise and innovation. The choice of indicators for the study were however limited to the extent of its availability. The study went on further to identify potential areas where cooperation could take place.

4.1.3 World Bank Framework

In addition to the OECD and APEC frameworks, the World Bank Institute – an arm of the World Bank – has also developed a framework to help member countries articulate strategies for their transition to a KBE. The ‘K4D’ framework sets out 69 structural and qualitative variables in five key areas which enable one to benchmark how an economy in terms of a KBE measures up against their neighbors. The five areas are (1) the overall performance of the economy, (2)

economic incentive and institutional regime, (3) education and human resources, (4) innovation system and (5) information infrastructure.

Whilst these frameworks employ different sets of statistical indicators and are grouped according to different aspects, they can be broadly categorized into the following four dimensions (1) innovation system – indicators to reflect the quantity, quality and rate of knowledge and information production/creation in the economy, (2) information and communication technology (ICT) – indicators to reflect the efficiency and effectiveness of knowledge and information distribution in the economy, (3) human resource development – indicators to reflect the quantity and quality of individuals equipped to access and use of knowledge and information for further production/creation and distribution of knowledge and information in the economy and (4) business environment – indicators to reflect a business environment conducive to the production/creation and distribution of knowledge and information in the economy (World Bank 2004).

4.2 Conceptual Framework and Methodology for measuring KBE in the IOR-ARC

Different frameworks place different emphasis on the various dimensions of a KBE. The number of indicators employed also varies with very limited overlap in terms of indicators, implying wide divergence in the selection of indicators. Taking into account the similarity in the structural dynamics of the APEC and the IOR-ARC (i.e. open-regionalism) and the similarity between the APEC (2000) study and the objectives of this research, this study embraces and builds upon the APEC framework for measuring a KBE to identify potential areas where regional cooperation can stimulate trade and investments in KBE in the IOR-ARC. The ensuing section provides a detailed account of the framework to be employed.

4.2.1 Introduction

As mentioned above, the conceptual framework for this study is based on the methodological approach adopted by APEC (2000). It also builds upon the APEC study by incorporating further indicators of a KBE in order to reflect more recent developments in the field. In particular, it shows a set of quantitative indicators which provide some measure of how each economy fares along each of the four KBE dimensions – business environment, ICT infrastructure, innovation

systems and human resource development. Based on the performance in each of these dimensions, the member economies of IOR-ARC are classified into several groups according to their comparative advantage in moving towards a KBE. This classification gives an indication of both similarities and differences among the different groups of countries, and potential areas for cooperation. On the basis of this classification, a representative sample of IOR-ARC economies is chosen for more comprehensive analysis based on a case study approach.

The four dimensions of a KBE referred to above can be interpreted as the fundamental preconditions required for a KBE. *ICT* is seen as an enabling technology for a KBE, given that advanced information systems lower the cost of information, facilitate access to wider pools of information, and encourage the spread of new ideas. Accordingly, moving towards a fully developed KBE requires an advanced communications network and a policy and regulatory framework that encourages competition and supports the development and use of information hardware and applications. Because ICT technology is evolving, the infrastructure has to be renewed and upgraded continuously. A well-developed *innovation system* that encourages continuous R&D is also key in transitioning to a KBE. Since no country has a monopoly on innovative ideas, the growth of a nation's knowledge base depends critically on its culture being open to new ideas, especially to new ideas from outside. A KBE cannot be sustained without *human resources development* through high quality education services and a highly skilled labour force that is employable in knowledge-related industries. Without this background it is essentially impossible to build the other elements of the national knowledge base (such as R&D) to the level needed by a KBE. A major responsibility of government is therefore to ensure that such education services are in place. A KBE can flourish only if the social, political, economic and legal framework of the economy is conducive to the development of the characteristics described above, hence the importance of a facilitative *business environment* cannot be overemphasized. An open environment for trade and investment helps create an incentive for innovation and allows for the implementation of technologies involving significant scale economies. The policy and institutional environment of a KBE promotes a beneficial spillover by encouraging interaction and cooperation among researchers in different institutions, disciplines and industries. It also involves a policy and social framework which is attractive for investment, covering areas such as a competitive but fair regulatory environment for business,

transparency of government and company reporting, an accepted rule of law and low inflation and interest rates.

4.2.2 Grouping of Economies

The IOR-ARC economies have been classified into several groups based on their performance in relation to the four dimensions of a KBE. Statistics on selected indicators pertaining to the four dimensions are given in the tables displayed in Appendix 1. The justification for the choice of indicators is given in Appendix 3. Accordingly, four groups of economies have been identified, namely, economies with:

- High comparative advantage
- Sizable comparative advantage
- Moderate comparative advantage
- Low comparative advantage

Given the fact that a particular country's performance can differ widely across the four dimensions, the grouping is done separately for each dimension of a KBE. Table 3 below illustrates the categorization, which also gives an indication on the potential for mutual cooperation among member economies. The categorization is done based on scores obtained for several indicators under each dimension. The scores for each indicator are given a specific weight, in proportion to its importance and relevance in progressing towards a KBE. Appendix 1 provides an explanation of the weighting mechanism adopted. Higher overall scores correspond to a higher comparative advantage.

Table 3: Grouping of IOR-ARC Economies

	High Comparative Advantage	Sizable Comparative Advantage	Moderate Comparative Advantage	Low Comparative Advantage
Business Environment	Singapore, Seychelles	Malaysia, Thailand Mauritius, UAE	Oman, Mozambique, Madagascar, Australia, South Africa, Sri Lanka, India, Indonesia, Kenya	Bangladesh, Iran, Yemen, Tanzania
ICT Infrastructure	Singapore, Seychelles, UAE, Australia	Oman, Malaysia, Iran	Thailand, Mauritius, South Africa, Indonesia, Sri Lanka	Mozambique, Madagascar, Kenya, India, Bangladesh, Yemen, Tanzania,
Innovation	Australia,	Malaysia, UAE, South	Kenya, Indonesia,	Yemen,

System	Singapore	Africa,	Oman, India, Mauritius, Seychelles, Thailand,	Mozambique, Sri Lanka, Tanzania, Iran, Bangladesh, Madagascar
Human Resource Development	Seychelles, Singapore	Oman, Malaysia, South Africa Australia, UAE	Mauritius, Sri Lanka, India, Yemen, Iran, Thailand, Indonesia, Kenya	Madagascar, Tanzania, Mozambique, Bangladesh

In general, as noted previously, the economies of Australia, Singapore and Seychelles are at the higher end of the KBE spectrum, while those such as Mozambique, Tanzania, Yemen and Bangladesh lag far behind. A majority of IOR-ARC economies cluster around the moderate and low comparative advantage groups, while well-developed KBE dimensions are limited to a few economies. Such trends indicate the potential for mutual collaboration between these sets of economies.

4.2.3 Choice of Case Study Economies

The choice of representative economies for detailed case studies is based on the groupings in Table 4 above and also on the geographic location of economies. Given the objective of the study of identifying opportunities for mutual collaboration, four economies are chosen that correspond to the four levels of groupings. These four countries are assumed to be representative of all other economies in each group and, as such, act as proxies for the other member economies in each grouping. However, in order to also ensure that there is sufficient representation of the diverse geographic area spanning the IOR-ARC member countries, the location of economies is also taken into account. Accordingly, case studies are undertaken for the following four economies:

- Australia – a high performing economy in the Pacific
- Malaysia – an economy demonstrating sizable comparative advantage in East Asia
- Mauritius – an economy with moderate comparative advantage located in the African region
- Bangladesh – a low performing economy in South Asia

The performance of each economy in relation to the four key dimensions of a KBE is analyzed using secondary data on KBE indicators.

5 Country Case Studies

5.1 Australia

Australia is a high income OECD country with a per capita GDP of US$ 67,036. Despite the economic turbulence of 2007/08, the Australian economy has recorded positive GDP growth averaging 1.39 per cent for the period 2005-2012. Throughout much of its contemporary history, the country has boasted superior social indicators and is currently ranked 2nd behind Norway in the Human Development Index of 2012 (UNDP 2013). Historically the Australian economy was resource- and agriculture- based, with modest strides into manufacturing, however in recent years the service sector taken center stage and is by far the largest contributor to GDP (78 per cent). The past two decades in particular has witnessed the country making gradual headway in transitioning to a fully-fledged KBE.

5.1.1 Business Environment

In terms of the Index of Economic Freedoms 2013 published by the Heritage Foundation in partnership with the Wall Street Journal, Australia is the 3rd freest in economy in the world after Hong Kong and Singapore. The country's judicial system is independent and impartial. Property rights are secure, and enforcement of contracts is reliable. Effective anti-corruption measures are in place to discourage bribery of public officials and reinforce a tradition of clean government. Furthermore its regulatory environment, one of the world's most transparent and efficient, is highly conducive to entrepreneurship (Heritage Foundation 2013a). This is also reflected in the ease of doing business index published by the World Bank (2013) Australia ranks amongst the top 10 countries in terms of the most business friendly regulations out of 185 countries. Inflation over time has also been consistently low, averaging 2.9 per cent during 2005-2012 (see Table 1A).

In addition to holding general macroeconomic variables at appropriate levels to encourage investment and growth, successive governments have also committed to promoting free trade, investments and efficiency in capital markets. The country's trade regime is very liberal, tariffs are low as a result of a number of negotiated trade agreements and unilateral tariff cuts. Foreign

and domestic investors receive equal treatment in almost all sectors and the country boasts a well-regulated and well- developed financial sector which is highly competitive and sound.

One area that calls for improvement is with regard to Australia's tax regime. There is room for further strengthening the tax regime to encourage investments by extending tax incentives.

5.1.2 ICT Infrastructure

Being a high income country and especially considering her vast size and geographic location, Australia has a well-developed ICT infrastructure. As of 2012, Australia has achieved universal mobile telecommunication access, 82 per cent of Australian households have personal computers, close to 73 per cent of the population are internet users and 25 per cent of the population are fixed broadband internet subscribers Australia also scores well in terms of ICT penetration is schools as well as its uptake in day to day government operations. Australia also performs well in terms of online government service delivery (see Table 1B)..

In terms of ICT affordability, however, Australian consumers face much higher tariffs in comparison to developing countries, as well as when compared with consumers in US. This aspect needs to be addressed in order to ensure wider access. Electronic commerce is a further area for development in the progression to a KBE. Increasingly Australian businesses have started to use e-commerce to improve efficiencies, open up new markets, and increase revenue; however, there is further room for improvement.

5.1.3 Innovation System

Undertaking R&D is an important innovation activity for the generation of new knowledge. It creates new opportunities to innovate, is a mechanism for solving existing problems, and involves adopting and transforming innovations developed elsewhere. R&D in Australia as a percentage of GDP is high by international standards, and as a result of continued investments in the sector Australia is world-class in terms of scientific publications and citations, and the number of papers produced per capita is one of the highest in the world (see Table 1C).

Higher education expenditure on research and development (HERD) provides a measure of R&D performed in the higher education sector. Australia's HERD accounted for 0.54 per cent of GDP ($6.7 billion) in 2008, which ranked Australia 11th among OECD countries. Government expenditure on research and development (GOVERD) in Australia is also towards the higher end of the spectrum, where the country ranks 10th out of 30 OECD countries. Business R&D makes up the largest and fastest growing (14 per cent annual growth rate) share of GERD. Business funding and expenditure in R&D has gradually increased over time. In 2008–09 businesses accounted for 60.5 per cent and 60.8 per cent of GERD funding and expenditure respectively, in contrast to 44 per cent and 44.1 per cent in 1992–93.

By and far in any market economy it is the private sector that will make the necessary investments and take the necessary risks to determine whether an economy makes a successful transition to a KBE. In this regard, availability of venture capital is key to stimulate innovation by way of sharing risks relating to new product development based on novel ideas and assisting startups. In Australia venture capital availability is somewhat limited when compared to the US and other OECD countries.

Another critical aspect to stimulate innovation in a KBE is the need for a sound intellectual property rights protection regime and its strong enforcement. Innovation is applied knowledge and is often considered as knowledge capital. Knowledge by its very nature is believed to be one of the closest forms of a pure public good; it exhibits characteristics of non-rivalry and non-excludability and hence competitive markets may under-incentivize innovation. Intellectual property (IP) rights, such as patents and copyrights, aim to incentivize innovation by allowing firms to capture a higher share of the social returns to their R&D investments. Australia scores well both in terms of strength of IP protection and enforceability indicators (see Table 1C).

5.1.4 Human Resources Development

A sound education system is fundamental in developing the required human capital stock to drive a KBE. Recognizing its importance, successive governments over the years have expended increasing amounts of public money in the sector. The tertiary education sector in particular has received considerable amounts of public funding in light the crucial role it plays in producing

graduates with the sort of skills, aptitude and understanding that will allow them to contribute effectively to the development and practice of a knowledge economy. Hence unlike in the US or Korea, Australian higher education is almost exclusively provided through public institutions. Decades of continued public investments in the sector has resulted in Australian universities gaining vast amounts of expertise and emerging as a global education hub, which is home to some of the worlds most renowned universities. In fact, five Australian Universities are amongst the top 100 universities in the world (AEN 2013). In recent decades, in light of the growing recognition of the quality of the Australian education system, students from around the world have flocked to Australia to pursue higher education.

More recently it could be seen that well established Australian Universities are entering into offshore markets, by way of providing a number of graduate and postgraduate degrees via distance learning channels such as online e-learning programmes, collaborating with offshore education service providers in extending external degrees as well as establishing offshore campuses.

Another outstanding element of Australia's higher education system is the Higher Education Loan Programme (HELP) formerly known as the Higher Education Contribution Scheme (HECS). The scheme was setup in 1989 under the Hawke Labor Government as part of a push to make tertiary education in Australia more accessible to working and middle class Australians. Under this scheme all students who attend Australian tertiary education institutions are charged higher education fees. However, government loans and subsidies are in place to relieve the costs of tertiary education to make it more accessible to the masses. As such, some students who are supported by the Commonwealth are only required to pay a part of the cost of tuition, called the 'student contribution', while the Commonwealth pays the balance; and some Commonwealth supported students are also able to defer payment of their contribution as a HECS-HELP loan and repay only once they have started to earn an income. HELP debts are administered by the Australian Taxation Office and will be repaid compulsorily over time through the taxation system (Government of Australia, 2013).

While expenditure indicates the resources directed to education and skill formation, it is also important to measure the skill base formed through tertiary education. The number of new university graduates indicates a country's potential for assimilating, developing and diffusing advanced knowledge and supplying the labour market with highly skilled and creative workers. As at 2012, 24.2 per cent of the Australian labour forces possess tertiary education and enrolments on tertiary education is also on the higher side (see Table 1D).

5.2 Malaysia

Malaysia is an upper middle income economy with a per capita GDP of US$ 10,304. It is the third largest economy in ASEAN and the 29th largest in the world. At the time of gaining independence in 1957, Malaysia was largely an agrarian and mining based economy exporting primary commodities such as tin and rubber. With the adoption of a more outward oriented development during the late 1960s, within a period of just over three decades post-independence, the Malaysian economy underwent rapid structural transformations; from a mere subsistence economy to a thriving export-led industrial economy. Lately however, Malaysia's growth has been faltering in comparison to China and India. The government recognizing that the country is losing out on its completive edge in industrial production has since the commissioning of its 8th Malaysia plan in the year 2000 placed increasing emphasis on transforming itself into a knowledge economy in her bid to make the graduation to a higher-income country by the year 2020.

5.2.1 Business Environment

Successive Malaysian governments since independence have invested heavily in both physical and social infrastructure. Notable investments have been made in the areas of trade –transport related infrastructure and in education and training systems geared at supplying industries with a skilled labour and a technical workforce. As a consequence of continued investments in these sectors, the country has been able to create a favorable investment climate for export oriented manufacturing. Since the early 1990s Malaysia's merchandise exports have grown steadily at a rate of 13.5 per cent, notably the export of high technology products as a percentage of total merchandise exports currently stands at 43.4 per cent. This export drive has largely been fuelled by large export-oriented FDI into electronics and electrical goods industries (see table 2A).

Malaysia is currently ranked the 56th freest economy in the world and ranked 9th out of 41 countries in the Asia–Pacific region. Broad-based reforms are currently ongoing to further enhance the entrepreneurial environment and legal transparency. Despite ongoing reforms, economic freedom continues to be constrained by institutional shortcomings that damage prospects for more vibrant long-term economic expansion. The country's perceived level of corruption has increased and the judicial system remains vulnerable to political interference (Heritage Foundation 2013b).

In terms of macroeconomic management, inflation over the period 2005 though to 2012 has been managed within acceptable limits hovering at an average 2.9% p.a. Malaysia also offers generous fiscal incentives to attract both domestic and foreign investment. Total tax rates are also at the lower end of the spectrum. Malaysia also ranks 12th amongst 185 countries in the Ease of Doing Business Index published by the World Bank (2013).

5.2.2 ICT Infrastructure

Malaysia is an emerging global hub and universal provider in terms of its ICT penetration, quality of services, content and infrastructure, and access. As part of her vision 2020 in moving towards a fully-fledged KBE, the 4th Prime Minister of Malaysia Mahathir Mohamad in 1996, initiated the Multimedia Super Corridor Program. This program has seen 4 special economic zones, namely the Kuala Lampur International Airport, The Petronas Towers, Cyberjaya and Putrajaya complete with sophisticated state-of-the-art integrated infrastructure and IT system complemented by sophisticated and efficient transportation systems with an emphasis on public transport being established in the bid to attract world-class multimedia/IT companies.

While laudable progress has been achieved in the realms of communications and multimedia infrastructure, Malaysia lags behind other NIEs in terms of the availability and diffusion of communications infrastructure, ICT penetration rates, development of local content and security of , as reflected by indicators relating to telephone lines, internet and broad band infrastructure etc (see Table 2B. This digital divide needs to be addressed in collectively moving towards a KBE.

5.2.3 Innovation System

Gross expenditure on R&D in Malaysia as at 2006 (latest data available), stood at 0.6 per cent of GDP; a significant proportion of this expenditure has been in the agricultural sector. When compared with her peers such as Singapore, Australia, Japan and South Korea, Malaysia's level of expenditure on R&D is low. S&T and R&D efforts have also been partially constrained by the lack of a critical mass of scientists, engineers and technical personnel to engaging in R&D. In 2006, the number of researchers engaged in R&D per million populations was a mere 364 and the number of technicians in R&D per one million populations was a meager 42 (see Table 2C). The lack of human capital resources geared at R&D activities may partially be attributed to lack of a R&D focus in the majority of the Malaysian higher education institutions.

Despite further room for improvement, given her stage of development, Malaysia scores well in terms of the laws enacted to safeguard intellectual property. An area of concern however is its enforceability. A basic proxy to gauge the relative strength of IP law enforcement is the software piracy rate in a country. Latest WEF figures show that close to 55 per cent of software installed in Malaysia is still pirated, indicating weak enforceability.

As noted earlier, venture capital is critical to assist and spur private enterprises in engaging in R&D. The Government initiated the development of the venture capital industry as an alternative source of financing and allocated RM1.1 billion for the purpose. The Malaysian Exchange of Securities Dealing and Automated Quotation (MESDAQ) was established and its rules were liberalized to act as an attractive exit mechanism for technology-based investments of venture capital corporations (VCCs). The Kuala Lumpur Stock Exchange (KLSE) also provided listing facilities for high-technology companies. The venture capital industry, however, is still at its infancy and will need to be further strengthened.

5.2.4 Human Resource Development

As noted earlier successive Malaysian governments, recognizing that education is key to long term productivity and growth, have invested heavily in the sector. Government expenditure on education has been on a steady incline and currently hovers at an impressive 21.3 per cent of

total government expenditure (roughly 5.13 per cent of GDP). The fruits of continued investments in the sector have been impressive. As at 2010, 16.5 per cent of the labour force possesses primary education, 55.7 per cent possess secondary education while those possessing tertiary education is at an impressive rate of 24.6 per cent (see Table 2D).

Notwithstanding the achievements of the country's education institutions, notably only a few Malaysian universities have achieved a competitive position internationally. High ranked universities in the world are the ones that make significant contributions to the advancement of knowledge through research, teach with the most innovative curricula and pedagogical methods under most conducive circumstances, make research an integral component of undergraduate teaching, and produce graduates who stand out because of their success in intensely competitive arenas during their education and, more importantly, after graduation. The rise of tertiary education graduate unemployment in Malaysia and the productive sectors' complaining of relative shortages of qualified labor, suggest that the higher education system has some significant limitations to overcome.

Notable areas of improvements in light of shortfalls in the sector are (a) improving governance and financing, to achieve greater autonomy, stronger accountability mechanisms, and a unified higher education system; (b) quality concerns, including insufficient number of faculty with the highest credentials and a disjointed quality assurance system; (c) relevance and graduate unemployment problems; and (d) a disjointed research and innovation system, with weak private sector demand for R&D and weak university-industry linkages.

3 Mauritius

Mauritius is classified as an upper middle income country with a per capita income of US$ 8,765. Since gaining independence in 1968, Mauritius, a small island nation in the Indian Ocean of approximately 1.3 million people, has developed from a low-income, agricultural (sugar) economy to an upper middle-income country with expanding industrial, financial and tourist sectors, and with one of the highest per capita incomes among African countries. A combination of factors, including political stability, a strong institutional framework, low levels of corruption and a favourable regulatory environment have contributed towards laying a foundation for

economic growth, while open trade policies have been central in sustaining this growth (Zafar, 2011).

Between 1970 and 2012, real GDP has grown at an annual average of 5.3 per cent compared to a 3.2 per cent average in Sub-Saharan Africa (UNCTAD, 2013). GDP per capita has increased more than tenfold between the same time period, from less than US$ 500 to over US$ 6000. Moreover, the Mauritian economy has remained robust a midst the recession in the euro area that has weakened its external demand. The real GDP growth rate remained positive at 3.3 per cent in 2012, led by strong performances in the financial services, information and communications technology (ICT) and seafood sectors.

Notably, in parallel to its economic growth, Mauritius has also been successful in achieving a corresponding reduction in income inequality, as reflected by a fall in its Gini index from 45.7 to 38.9 between 1980 and 2006, which has led to significant improvements in key human development indicators such as increased life expectancy and lowered infant mortality. Since the 1970s, Mauritius has recorded high growth rates and sustained increases in human development indicators due to a combination of good macroeconomic policies and strong institutions. Proper macroeconomic management – fiscal discipline during boom times, monetary policy that contained inflation at single digit figures and produced interest rates that encouraged domestic savings, and a flexible exchange rate policy which ensured export competitiveness – have been key factors behind sound economic growth. A flexible public policy encouraged the creation of EPZs in the 1980s and embracing of the IT industry in the 2000s.

5.3.1 Business Environment

Mauritius has a relatively conducive climate for business and investment, as reflected by key indicators on the business environment. The Heritage Foundation ranks Mauritius as the eighth freest nation in the world, and number one in the Sub-Saharan African region. There is a sound and transparent legal framework in place that strongly upholds the rule of law. Enforcement of laws regarding intellectual property rights is relatively effective. Anti-corruption measures are in place to effectively control corruption and money laundering, making Mauritius one of Africa's least corrupt countries. The country also has an efficiently functioning regulatory environment,

and the overall start-up process of a business has been simplified with the removal of minimum capital requirements. This is also reflected in the World Bank(2013) Doing Business report, which ranks Mauritius 19th out of 185 economies. Despite an expansionary fiscal policy stance adopted since 2008, public debt and budget deficits are under control and inflation rates have been maintained at a healthy rate of 6 per cent within the 2005-2012 time period.

In line with a spirit of creating and sustaining a dynamic entrepreneurial environment, trade and investment policies are fairly liberal. An open and efficient investment framework facilitates the flow of new investments into the country. FDI flows into Mauritius have increased rapidly in recent years, averaging at 2.4 per cent of GDP in the 2000-2012 time period, compared to 0.4 per cent in the 1970-1980 period, led by several important reforms including removal of the tax on capital account transactions and the waiving of the requirement that foreign investors need approval of the Bank of Mauritius to carry out activity, in addition to a low corporate tax rate of 15 percent. FDI flows are also accompanied by new business ideas, technological know-how and managerial skills. Key sectors attracting FDI include hospitality and tourism, property and real estate, banking and finance, information technology, health, and education. While France, South Africa and the UK have been the main sources of FDI, Mauritius has also benefitted from FDI inflows going into India as it has operated as a tax haven for foreign funds invested in India.

Average tariff levels are low and there are relatively few non-tariff barriers. Trade openness, as measured by total trade as a percentage of GDP is quite high at 133 per cent. Importantly, there has been a steady rise in services exports as a percentage of GDP over the years. However, exports of high technology products as a percentage of manufactured exports has seen a sharp decline from 24 per cent in 2006 to a mere 1 per cent in 2011, which is an area of concern in the context of promoting new ideas and creating an environment that is conducive to innovation. Mauritius has a growing competitive financial sector that is dominated by private commercial banks.

5.3.2 ICT Infrastructure

The Government of Mauritius has actively promoted the development of ICT infrastructure since 1989 and proposed a national ICT policy based on the Singaporean experience. The strategy

involved creating instruments to support the liberalization of its telecommunications sector, creating an ICT literate workforce, improving the capacity of public institutions to harness ICTs, and positioning Mauritius to be a key player in ICTs by creating enabling environment and robust infrastructure (Farrell and Isaacs, 2007). The vision of the government is to make Mauritius a "cyber island" in which ICT would become the fifth pillar of the economy after sugar, textile, tourism and financial services as well as a regional ICT hub. A revised strategy introduced in 2006 focuses on niche markets in the ICT industry, developing strategic partnerships with ICT leaders, investing in a world-class physical and telecommunications infrastructure, emphasizing ICT culture development, providing for an adequate supply of human resources, and establishing a favourable business environment (Farrell and Isaacs, 2007).

Mauritius has indeed been successful in achieving universal mobile telephone access in line with its objectives. However, much more remains to be done if she is to position herself as an ICT hub. The use of internet is in the mid-range at just above 40 per cent. The percentage of fixed broadband subscribers is however much lower at 10.6 per cent and the percentage of households with personal computers is 38.2. Internet access in schools is ranked at 4.1 per cent in the Global Information Technology Report, on a scale of one to seven, whereas ICT use and government efficiency which is a ranking of the extent to which the use of ICTs by the government improve the quality of government services to citizens[5] is ranked at 4.4 out of seven. The percentage of ICT-related exports and imports are low, indicative of the need to facilitate more trade in this area (see Table 3C).

The use of Electronic Commerce is another increasingly important area in transitioning into a KBE. Mauritius records a low score of 0.08 in the E-participation index produced by the World Economic Forum, which assesses, on a 0-to-1 (best) scale, the quality, relevance, and usefulness of government websites in providing online information and participatory tools and services to their citizens. This suggests the need for continuous upgrading and development of ICT infrastructure.

[5] Speeding-up of delivery time, reducing errors, introducing new online services, enhancing transparency.

5.3.3 Innovation System

The innovation system in Mauritius is relatively underdeveloped and substantial investments in research and development and new technologies are required in moving towards a KBE. While the Mauritian Government has identified research as one of the potential generators of innovation for industry and consequently as a determinant in further fostering private sector growth and development, R&D expenditure as a percentage of GDP, is negligible at 0.37 per cent in 2005 (latest year for which data is available), compared to the OECD average of 2.5 per cent in 2009. The number of scientific and technical journal articles produced per million is also minimal at 22. Furthermore, the World Economic Forum, in its 'Government Procurement of advanced technology' index, which measures the extent to which government procurement decisions foster innovation in the country, assigns a score of 3.5 out of 7, indicating considerable scope for improvement. The Global Competitiveness report ranks Mauritius 98th out of 144 countries in terms of innovation, and Mauritius poor standing is reflected in its many sub-indices (Table xx). University-industry collaboration on R&D, which is a key determinant in developing a sound innovation system is also ranked low at 3.3.

As stated previously, the availability of venture capital is central in stimulating innovation, especially in the private sector. The rating assigned by the WEF for Mauritius on the ease for entrepreneurs with innovative but risky projects to find venture capital in the country is low at 2.8. The need for a sound intellectual rights property regime in promoting innovation is also well recognized, which is another area in which Mauritius will need to improve on its path to a KBE.

Several issues have been identified in the Mauritian economy which has constrained the development of an effective innovation system. One key issue is the lack of collaboration between researchers, government and industry. R&D in the private sector – which is the key driver of R&D related investments – is low, given that many private sector companies are SMEs and are therefore incapable of engaging in innovative activities compared to larger companies.[6] There is also a lack of commercialization of research from the public sector and universities due to problems including, (1) management of intellectual property within universities and research institutions; (2) lack of encouragement of commercial research outcomes; (3) lack of adequate

[6] SMEs are constrained by various factors including inability to diversify risks, incomplete information and high capital costs, Difficulties in matching skill base and commercial imperatives with the public sector, lack of ability to absorb new technology.

technology diffusion mechanisms; and (4) lack of support of entrepreneurship and new technology-based enterprises (Bhaw-Luximon, 2013). Such constraints emphasize the need for major reforms in order to boost research and innovation in the Mauritian economy.

5.3.4 Human Resources Development

While heavy investments in education made by the Mauritian government in the 1980s and 1990s has led to high primary school enrollment rates of around 90 per cent, school enrollments in the secondary and tertiary sectors are quite low. Access to secondary education is a key challenge given the highly competitive system for moving from primary to secondary schools. At present close to 35 per cent of students do not qualify the 'completion-of-primary-education' examination and thus drop out of the school system at an early age of 12 (Zafar, 2011). The gross tertiary sector enrollment ratio is also low at 32 per cent. Low enrollment ratios are also reflected in labour force indicators: the percentage of the labour force with secondary and tertiary education levels are 40 per cent and 11 per cent, respectively, compared to corresponding rates of 55 per cent and 24 per cent in Australia. Moreover, the number of researchers and technicians engaged in R&D are a mere 346 and 43 per million people in 2005, the latest year for which data is available. Apart from low enrollments, education quality and relevance are also areas requiring improvement(see Table 3C).

Mauritius has adopted a 'National Strategic Plan for Education and Training' (NSPET) 2008-2020 with an overall goal of making Mauritius a Knowledge Hub to serve the African Region. The strategy is to create an enabling environment for Mauritius to emerge as a Regional Knowledge Hub and a Centre for Higher Learning and Excellence. If Mauritius is to realize this goal, it is evident that issues facing the higher education sector be addressed. The currently low levels of enrollment severely constrain the skill levels of the labour force which is an essential requirement in moving to a KBE. For example, currently only 26.8 per cent of the labour force is engaged in knowledge-intensive jobs, which is far from adequate and compares poorly to the OECD average of 37.9 per cent. Better access to and higher quality of higher education is also important in producing more high-value added goods and services.

Tertiary education in Mauritius is provided by a wide range of institutions. Public tertiary education institutions include the University of Mauritius (UoM), the Mauritius Institute of Education (MIE), the Mahatma Gandhi Institute (MGI), and the Mauritius College of the Air (MCA). The Tertiary Education Commission (TEC) oversees these public institutes and is responsible for allocating public funds and fostering, planning, and co-ordinating the development of postsecondary education and training. These tertiary education institutions are geared towards programmes in very limited or specific disciplines. Additionally, two polytechnic universities, managed by the Technical School Management Trust Fund, operate within the public sector. The Industrial and Vocational Training Board and the Mauritius Institute of Health equally dispense tertiary-level programmes in selected areas.

Mauritius also hosts several regional capacity building institutions, such as the Regional Multidisciplinary Centre for Excellence (RMCE), Africa Training Institute (ATI) and the Regional Technical Assistance Center (RTAC) in Southern Africa (AFRITAC South) to promote regional integration in different regional groupings. The RMCE is an expertise hub for policy development, training and advisory activities and a forum for dialogue which has been established to serve the Common Market for Eastern and Southern Africa (COMESA), East African Community (EAC), Indian Ocean Commission (IOC), Inter-Governmental Authority for Development (IGAD) and Southern African Development Community (SADC) regional development initiatives. As such, it is intended to improve Member States' professional capacity for addressing issues of Regional Economic Integration in core areas such as common macroeconomic policy, trade, finance, business development, investment, and sector strategy. It hopes to incorporate a range of services – starting with training and following on as its role develops with policy development, and expertise/advisory services. Specific activities will include peer to peer learning, conference/seminar programs and probably distance training. The ATI is an IMF initiative, which covers the costs of accommodating and training over 200 sub-Saharan African country officials per year through two-week courses for officials from central banks, ministries of finance, and other government agencies from across sub-Saharan Africa. Its key objective is to contribute towards improved macroeconomic and financial policies through high-quality training. The AFRITAC South is a similar collaborative effort between the International Monetary Fund (IMF) and several bilateral and multilateral donors aimed at

providing technical advice in core macroeconomic and financial management areas and provides technical assistance and training to African countries.

It is important that such higher educational institutions are encouraged to adopt international best practices and to create the right environment for the development of the higher education sector by learning lessons from other developing countries that have been more successful in upgrading education systems, especially at the tertiary level. Issues such as access, relevance, quality, financing and costs, equity, governance, effectiveness and efficiency, teaching, learning and research require priority attention.

5.4 Bangladesh

Bangladesh is an LDC with an estimated population of over 150 million and a real GDP per capita growth of 6.2 per cent in 2012 (UNCTAD, 2013). In real terms the country's economy has grown at 5.8 per cent per annum ever since 1996 in spite of political instability, meager infrastructure, corruption, inadequate power supplies, and slow enactment of economic reforms. Although the services sector accounts for half of the GDP, nearly 45 per cent of the Bangladeshi population is employed in the agriculture sector (DBBCI, 2012). Bangladesh has made progress in improving the conditions for foreign investors and liberalizing the capital markets; i.e., Bangladesh has discussed with foreign firms for oil and gas exploration, better nationwide distribution of cooking gas, and the building of natural gas pipelines and power stations. Development on other economic alterations has been tentative due to resistance from the bureaucracy, public sector unions, and other vested interest groups.

There has been an impressive growth in exports and remittance inflow which has aided the Bangladeshi economy to grow at a steady rate (Tribune, 2011). The largest source of foreign exchange earnings of Bangladesh is through exports of garments and textiles whilst pharmaceuticals, consumer goods and shipbuilding are significant emerging industries. The jute sector of Bangladesh is re-emerging with increasing global demand for green fibers with the nation, approximately, producing over 1.5 million tons in 2011 (FAO, 2013). An additional key source of foreign exchange earnings are through workers who work overseas; primarily, extensive export of labor occurs to Saudi Arabia, Kuwait, UAE, Oman, Qatar, and Malaysia with

remittances being posted at USD 10.9 billion in the financial year 2009-10 (DBCCI, 2012). Other key export areas comprise of fish and seafood, construction materials, cement, fertilizer, cane, ceramics and leather products. Moreover, there has been a steady drop in foreign aid over the last few decades which has been heralded as a positive indication towards self-reliance (Chowdhury. 2012).

5.4.1 Business Environment

Bangladesh, during the period 2003-2008, observed a steady rise in trade of goods (merchandise) as a percentage of GDP. However in 2009, trade in goods declined sharply owing to the global financial crisis, nevertheless trade in goods rose in the following years with the figure reaching its highest posting in 2011 at 54.2 per cent. Also, Bangladeshi trade of goods as a percentage of GDP has been above the South Asian Average during the period 2003-2012.

In terms of the Economic Freedoms index, Bangladesh scores 52.6, making its economy the 132nd freest out of 185 nations in the 2013 Index. The nation's overall score has declined by 0.6 points since the previous year, reflecting declines in labor freedom and monetary freedom that counterbalance a notable improvement in freedom from corruption. In terms of the Asia Pacific region Bangladesh is ranked 28th out of 41 countries. Although Bangladesh has recorded noteworthy growth in economic freedom over the past five years, economic development remains hindered by the fragile rule of law, whilst economic management has degraded following recurrent political crises and persistent poverty.

Inflation too remains high in the nation with an approximate average of 9.8 per cent during the 2003-2012 period, which in turn would serve to cause distortions within the economy which reduce the capacity to attract FDI which currently averages at 1 per cent of GDP. Similarly, although Bangladesh scores 6.7 and an overall ranking of 25 in strength of investor protection (World Economic Forum, 2013), it fares below par with regards to ease of doing business where it records a ranking of 129 (World Bank, 2013). This is primarily due to difficulties faced in bureaucracy associated with starting a business, difficulties in resolving insolvency and obtaining credit.

5.4.2 ICT Infrastructure

Bangladesh has shown steady progress with regards to the network readiness index, with improvements in its ranking from 130th to 114th in 2012 among 142 countries. Within the index, Bangladesh's performance with regards to the affordability pillar is noteworthy; Bangladesh is ranked as having the 4th most affordable mobile cellular tariffs per minute as well as the 17th most affordable fixed broad band tariffs. In addition Bangladesh records a respectable performance under the government usage pillar in 2013, being ranked the 72nd most successful nation in promoting ICT as well as being ranked 68th in terms of the importance of ICT to government vision.

Nevertheless, in relation to fixed telephone lines per 100 people Bangladesh fares below par with approximately 1 telephone line per 100 people between the 2002-2012 the time period, whilst the nation also falls below the South Asian average during the same time period. Mobile cellular subscriptions however have been rising, with 1 mobile cellular subscription per 100 people in 2003 to 64 mobile cellular subscriptions per 100 people by 2012. The numbers of internet users have also been increasing steadily; in 2002 the number of internet users per 100 people was recorded at 0.2 however by 2012 the number had risen substantially to 6.3 internet users per 100 people. However, the number of households with access to internet is low, with Bangladesh being ranked 117 with a score of 2.6 per cent in 2013 under the network readiness index.

5.4.3 Innovation System

According to the Global Innovation index (2013) Bangladesh is ranked 130th out of 142 countries in utilizing innovation as a driver of economic growth and prosperity. Bangladesh has dropped 18 places as opposed to last year when the nation secured the 112th place within the index. In terms of availability of research and training services, Bangladesh scores 3.2 within the Global Competitiveness Index (World Economic Forum, 2013) and is placed at 131 in terms of Intellectual property protection.

Similarly, Bangladesh performs poorly with regard to other indicators relating to the innovation system, such as venture capital availability, government procurement of advanced technology and the number of patent applications by residents and non-residents. Hence when considering

such factors, it indicates that the overall innovation system of Bangladesh is comparatively underdeveloped.

5.4.4 Human Resource Development

In Bangladesh HRD priorities were initially placed on basic education, covering primary education and non-formal education, which later extended to cover secondary education as well. Throughout the early 1990s, only 35 per cent of the country's adult populace was literate, and literacy was deeply skewed among males and females (44 per cent and 22 per cent respectively) as well as for urban and rural areas. Bangladesh's commitment to improving primary education was echoed in its adoption of the Education For All (EFA) agenda in the early 1990s, which delivered the foundation for assistance from numerous development partners. The EFA was upgraded to a national action plan in 2003. The plan was derived from Bangladesh's long-term Perspective Development Plan (1980–2000), portion of which targeted at eliminating illiteracy by 2000 (consequently changed to 2006 and then to 2015). It is in line with the Millennium Development Goals (MDGs), which aim to halve poverty and achieve substantial HRD improvements by 2015.

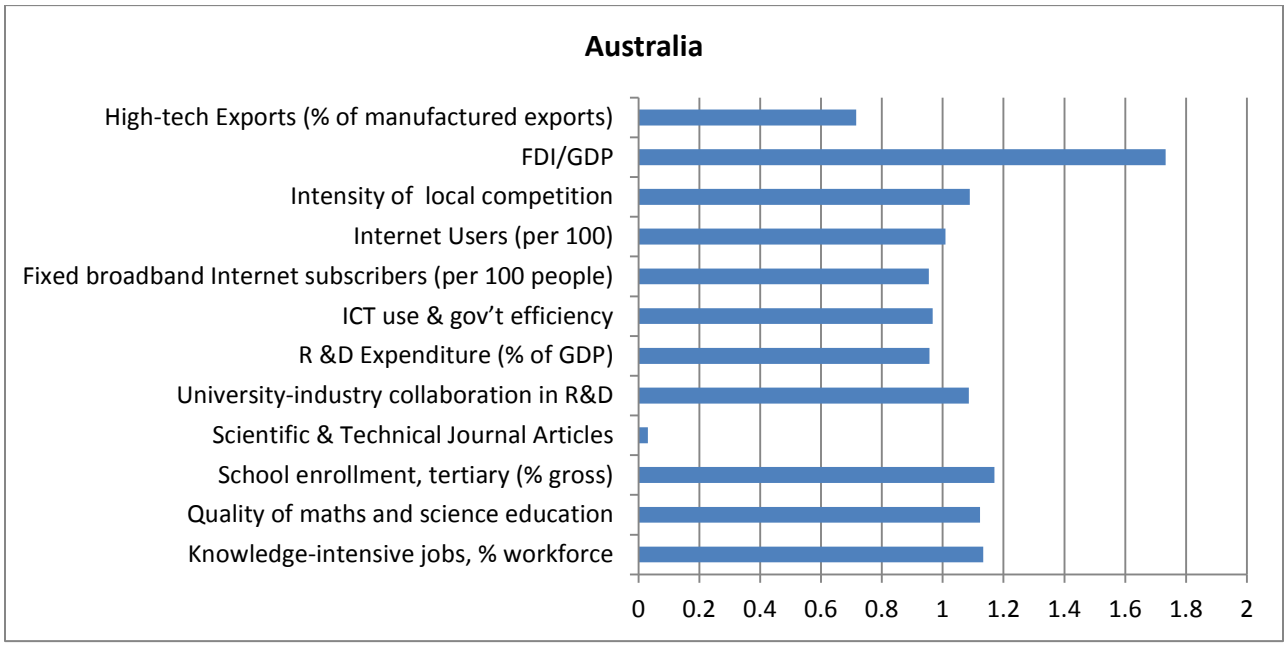
Strengthening primary and secondary education with reference to the contents related to practical life and intellectual growth, is a key HRD challenge, particularly in moving towards a KBE, in the developing countries of Asia including Bangladesh. Tertiary school enrollment, which is crucial in building a knowledge-oriented workforce, is low at around 14 per cent. HRD programs in the country cover almost all aspects of human resource development, but an integrated approach has not yet been adopted. There has been a tendency to emphasize either economic-dominated or social welfare-dominated strategy (Kalam, 2010).

5.5 Country Comparisons

This section brings together summary indicators from the four IOR-ARC countries studied. By comparing and contrasting these, a fairly consistent story emerges about how far each country has already progressed towards a KBE, and the extent to which the various economies are taking necessary steps to move towards a KBE. Following the APEC (2000) Study, the characteristics of selected IOR-ARC member economies relating to their performance as a KBE are graphically

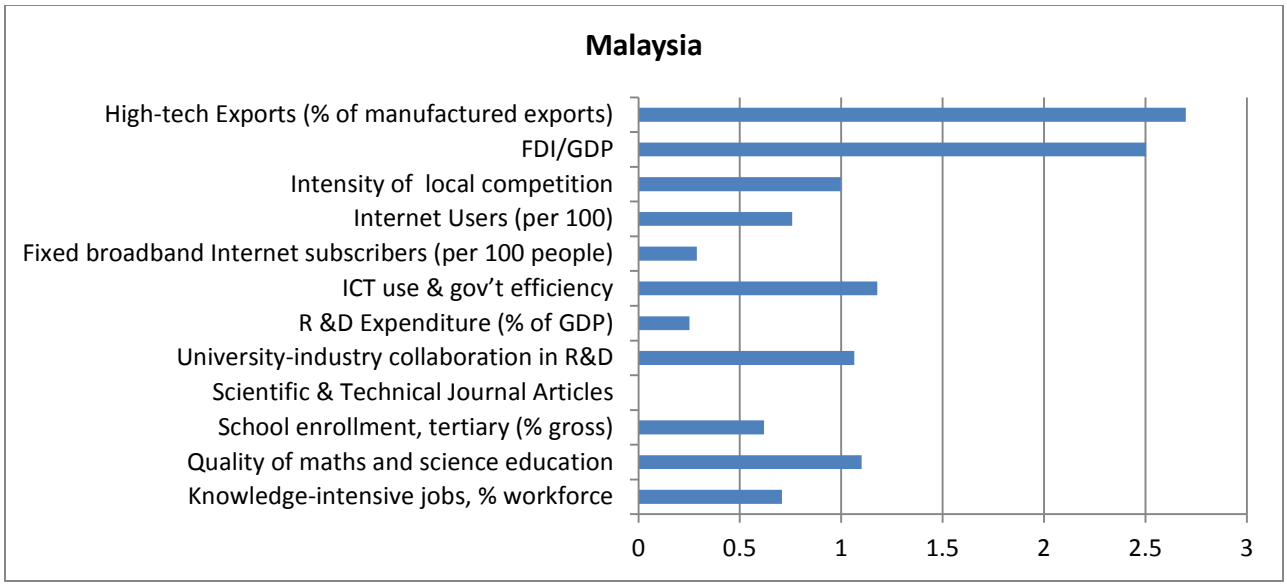
presented through country "scorecards" (charts). These scorecards compare each economies performance to the OECD average, to obtain an understanding of each economy's current standing as a KBE. As shown in Figure 1, the indicators are divided into groups corresponding to the key dimensions of a KBE. Since all indicators used in the analysis cannot be presented in the scorecards due to space limitations, the indicators displayed are limited to those considered to be the most important and relevant in moving towards a KBE.[7] Each indicator is scaled against the OECD average value for the indicator, so that the value 1.0 represents the OECD average value for each indicator.[8] A score less than 1.0 implies that the respective economy performs below the OECD average, whereas a score exceeding one would imply superior performance. By analyzing which of these groups of characteristics are most unfavourable in each country, both in comparison with each other and in relation to the OECD average, it is possible to identify for each group of economies the characteristics that most need to be addressed in progressing towards a KBE.

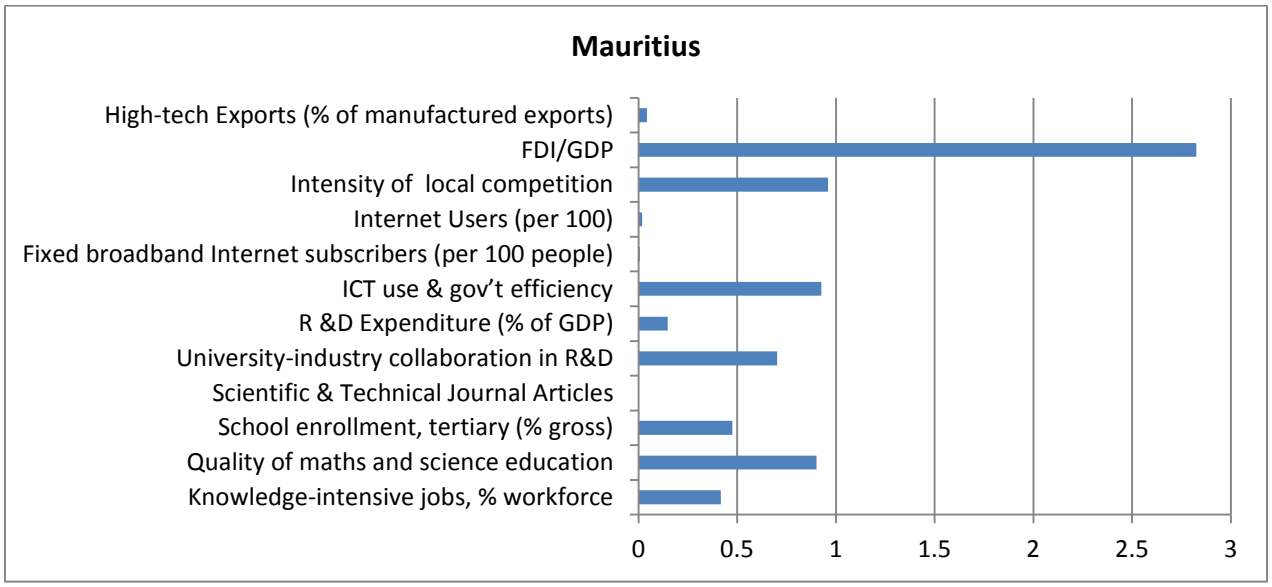
Figure 1: Country Scorecards

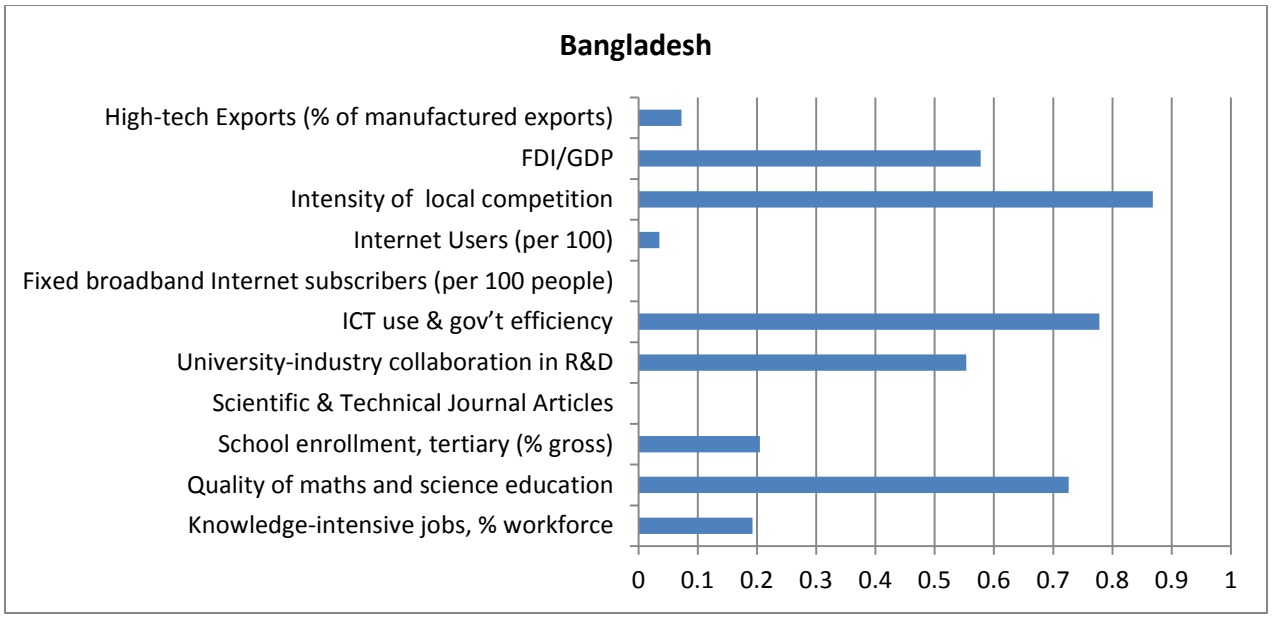


[7] Please refer to Appendix 2 for further explanation

[8] The "OECD average" is the simple (unweighted) average across all (or most) OECD countries. It is intended as a reference value, which is independent of the sample set.


Malaysia
High-tech Exports (% of manufactured exports)
FDI/GDP
Intensity of local competition
Internet Users (per 100)
Fixed broadband Internet subscribers (per 100 people)
ICT use & gov't efficiency
R &D Expenditure (% of GDP)
University-industry collaboration in R&D
Scientific & Technical Journal Articles
School enrollment, tertiary (% gross)
Quality of maths and science education
Knowledge-intensive jobs, % workforce
0
0.5
1
1.5
2
2.5
3


Mauritius
High-tech Exports (% of manufactured exports)
FDI/GDP
Intensity of local competition
Internet Users (per 100)
Fixed broadband Internet subscribers (per 100 people)
ICT use & gov't efficiency
R &D Expenditure (% of GDP)
University-industry collaboration in R&D
Scientific & Technical Journal Articles
School enrollment, tertiary (% gross)
Quality of maths and science education
Knowledge-intensive jobs, % workforce
0
0.5
1
1.5
2
2.5
3



Source: Own calculations using World Bank, World Development Indicators 2012.

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As can be seen in the above figures, the values for Australia either exceed or lie just below the OECD average for all indicators, except with regard to the number of scientific and technical journal articles which lags far behind. The values for all HRD indicators are above one, suggestive of Australia's superior performance in the higher education sector. The FDI to GDP ratio also stands out and is considerably higher than the OECD average. Malaysia also performs well in most KBE indicators, particularly with regard to the business environment. The ratio to the OECD average is in fact over two for high technology exports and FDI flows. However, Malaysia lags behind the OECD average in terms of innovation and HRD indicators, which highlights the need for further improvement. Mauritius scores high with regard to attracting FDI. Nevertheless, all other indicators fall below the OECD average. ICT infrastructure and penetration is a particular area which needs attention. Bangladesh, as an economy with low comparative advantage, performs quite poorly in all indicators displayed above, with all scores being less than one and thus below the OECD average. While significant improvements are required across all four dimensions of a KBE, ICT infrastructure, education and highly skilled workers are areas which call for immediate attention.

6 Challenges and Opportunities in Moving towards a KBE

While all IOR-ARC economies need to adapt their policies to a knowledge-based environment, each country faces different challenges and at the same time possesses varying opportunities in making this transition. Based on the case studies conducted for the four representative IOR-ARC member economies, the challenges and opportunities existing within countries of different stages of development in relation to the four key dimensions of a KBE are highlighted in Table 4 below.

Table 4: Challenges and Opportunities in IOR-ARC Countries

Country	Challenges	Opportunities
Business Environment		
Australia	• Establish greater internationally competitive and efficient tax regimes	• Stable macro-economic environment • Strong property rights regime • Efficient judicial system • Liberal trade and investment regime
Malaysia	• Addressing issues pertaining to corruption and transparency • Observe the independence of a free and fair judiciary • High labour redundancy cost	• Relatively liberal trade and investment regime • Relative skilled and cheap labour • Good employee employer relations
Mauritius	• Rapidly declining levels of high technology merchandise exports	• Relatively liberal trade and investment regime • Sound macro-economic management • Relatively low labour redundancy costs • Decent employer-employee relations
Bangladesh	• Persistent levels of high inflation • Fragile rule of law and recurrent political crises • High levels of bureaucratic red tape associated with doing business • High levels of corruption • Strained employer-employee relations	• Steady improvement in trade in merchandise exports • Strong investor protection • Liberal hiring and firing practices
ICT Infrastructure		
Australia	• Affordability of telephony services • Low fixed broadband coverage	• Universal access in mobile telecommunication • High level of household access to personal computers • High internet usage at household • High ICT penetration in schools and government services

Malaysia	• Low availability and diffusion of communication infrastructure • Low penetration of ICT at the household level	• Well-developed ICT infrastructure
Mauritius	• Low fixed broadband coverage • Low penetration of PC's at household level • Low percentage of ICT related exports and imports	• Universal access in mobile telecommunication •
Bangladesh	• Low penetration of fixed telephone lines • Low access to internet at household level • Low penetration of PC's at household level	• Affordable mobile cellular services • Affordable fixed broad band services
Innovation System		
Australia	• Low availability of venture capital •	• Strong intellectual property rights regime and strong enforcement • Availability of researchers and technical personnel in R&D • High level of university-industry collaboration in R&D • Availability of scientists and engineers
Malaysia	• Low availability of venture capital • Low level of researchers and technical personnel in R&D • Poor enforcement	• High level of university-industry collaboration in R&D • Availability of scientists and engineers • Strong intellectual property rights regime
Mauritius	• Low availability of venture capital • Low level of researchers and technical personnel in R&D • Low level of R&D expenditure • Low availability of scientists and engineers	

Bangladesh	• Low availability of venture capital • Low availability of research and training services • Weak Intellectual property protection • Low government procurement of advance technology	
Human Resources Development		
Australia	•	• Highly educated workforce • Highly developed tertiary education sector • Novel mechanisms for funding tertiary education • High percentage of knowledge workers
Malaysia	• Low availability of knowledge workers • Issues regarding quality of tertiary education • Lack of research focus in tertiary education	• Moderately well-educated labour force • Developed primary and secondary education sectors •
Mauritius	• Low availability of knowledge workers • Constrained access for secondary education • Low enrollment in secondary and tertiary education • Issues regarding quality of education • Lack of research focus in tertiary education	• High primary school enrollment
Bangladesh	• Considerably low availability of knowledge workers • Low enrollment in secondary and tertiary education • Poor quality of education	

7 Potential Areas for Cooperation in Promoting KBEs in IOR-ARC

The above table highlights the significant differences in opportunities and challenges confronting economies at varying levels of development in relation to all four dimensions of a KBE. Such disparities provide ample potential for mutually beneficial trade and investment to take place among the IOR-ARC economies in collectively moving towards a KBE. Moreover, given that trade liberalization and trade and investment facilitation are two of the four key components of the IOR-ARC roadmap, stimulating trade and investment flows should be considered a key priority in collectively moving towards a knowledge economy. In fact, several examples of trade and investment initiatives in knowledge-based industries among IOR-ARC member countries can be identified at present, as pointed out in subsequent sections, which indicate the potential for further collaboration.

7.1 Business Environment

The nature of the business environment in each country plays a pivotal role in providing a facilitative environment for trade and investment to take place in relation to each KBE component. The fundamental purpose of the government in a KBE is to create and provide an environment that is conducive for knowledge based industries to operate and thrive by way of less regulated product markets, freer trade and investment, and more effective incentive systems. In this regard the following aspects of the business environment need particular attention; (1) a liberal trade and investment regime; (2) prudent macroeconomic management, and (3) an enabling environment.

An open trade environment is an essential requirement for a KBE, given that it aids in creating incentives for facilitating innovation and permits the implementation of novel technologies. Openness to trade generally implies openness to new ideas, which is also fundamental for a KBE. The importance of trade liberalization lies not in the traded goods and services themselves, but in the ability to learn from the activity. Traded goods embody applied knowledge and hence liberalized trade is an indispensable prerequisite for a KBE. Therefore, the trading environment has to be more receptive to the international flow of technology. In this regard, low tariffs and mutual recognition of standards among countries is crucial in setting a favourable environment for a KBE.

In conjunction with an open trading regime, FDI plays a crucial role in diffusing technology. Given the fact that multinational companies are leaders in innovation, their activities can be important in acquiring knowledge. For instance, technological spillover can occur through training of local employees, and linkages with domestic suppliers, contractors, subcontractors, and buyers. Therefore, policies to attract the right types of FDI that can contribute to local innovative activity are an important area for a KBE. In this context, potential areas of cooperation within IOR-ARC include the improvement of investment procedures, identification and elimination of obstacles to investment, voluntary investment liberalization based on mutual cooperation, and guarantee of transparency for investments.

Prudent macroeconomic management is also essential in ensuring that countries can take advantage of benefits arising from cooperation and collaboration. Maintaining key macroeconomic variables such as inflation rates, budget deficits and public debt at manageable levels is key in this regard. In this context, IOR-ARC member countries could learn valuable lessons from regional capacity building institutions such as the RMCE, ATI and AFRITAC South located in Mauritius which, as discussed previously, focus on providing training to selected officials on issues including macroeconomic and financial policy management.

The quality of institutions and policies are decisive in facilitating the progression to a KBE. Whilst the institutional environment encompasses macroeconomic stability and openness to trade, they also encroach upon the enabling environment for markets to function efficiently, and cover areas such as the strength and quality of legal and judiciary systems, the financial system, taxation procedures, labour relations, investment procedures, land tenure, and customs administration.

7.2 ICT Infrastructure

Table xi shows that there are noteworthy variances among IOR-ARC economies in the investment scale with relation to telecommunication penetration rates of telephones, mobile phones and personal computers (PC) along with internet usage, which are proportional to economic capability and technological standing. This is due to the fact that development and

effective employment of ICT generally involves labour and capital with the growth of advanced technology.

In order to facilitate development of ICT infrastructure, it is recommended that member economies liberalize the investment regime such that tax breaks be awarded to companies engaged in developing the overall ICT infrastructure level within the national economy. This would yield a substantial network of ICT infrastructure which in turn could lead to a greater penetration of ICT facilitated services. In addition, the telecommunications sector must be liberalized; primarily this is due to limitations on the telecommunications service industry which determine entrepreneurs' equity as well as the amount of entrepreneurs, along with the level of competition. A lesser level of competition implies a lesser incentive to invest in innovative and new services or advanced networks, whilst raising the service charge, which in turn implies a low penetration rate and extent of use of ICT.

It is further recommended that IOR-ARC member economies engage in constructing public-private partnerships geared towards mega ICT infrastructure projects. These public-private partnerships could draw upon already existing projects such as the Multimedia Super Corridor program of Malaysia. Moreover, to compliment such initiatives, tariff lines across ICT related imports should be relaxed such that it allows a greater facilitation of trade as well as increasing the penetration of ICT related products in member economies.

Several investors within the IOR-ARC region have already taken steps toward promoting regional cooperation in ICT related infrastructure. For example, the Malaysian Axiata group, one of the largest Asian Telecommunication companies, operates across Malaysia, Indonesia, Sri Lanka, Bangladesh and Cambodia with significant strategic stakes in India, Singapore and Iran. Axiata plays a catalytic role in bridging the communication gap in its partner countries by offering a broad range of mobile and broadband services at affordable rates. Emirates Telecommunication Corporation (ETC) – Etisalat, a UAE based leading telecommunication provider in the world, is yet another example. ETC operates across 18 countries including Sri Lanka, Tanzania, Indonesia and Iran in the IOR-ARC.

7.3 Innovation System

The respective country case studies show that the member economies have varying levels of innovation capability; nations such as Australia and Singapore are significantly ahead in their innovation capability compared to countries such as Bangladesh. As mention earlier, markets fail to incentivize an adequate level of innovation, and hence government intervention is key in addressing this market failure. In this context, safeguarding intellectual property (IP) is essential in spurring research and development. Member nations within IOR-ARC could adopt policy matrices and legal frameworks that function efficiently within other IOR-ARC members as a backdrop to development of their own indigenous legal policies. However, efficient enforcement is as important as the presence of an effective IP protection regime. Accordingly, top tier nations should provide technical and monetary assistance to lower tier members within the region to aid in this endeavor. This would be mutually beneficial as higher tier nations may benefit through increased trade, whilst allowing low tier members to develop and foster an environment conducive to promoting innovation.

As noted from the case studies, the availability of venture capital is a major issue in stimulating innovation. The limited availability of venture capital could owe to the high risk associated with innovation, whilst in low tier nations it could also include the lack innovation funding mechanisms though business angels and venture capital firms. As such, it is recommended that the IOR-ARC mobilizes a common pool of funds at a regional level for individual enterprises and entrepreneurs to access and utilize if and when needed.

Establishment of a data bank to facilitate R&D that would lead to innovation is another important initiative that could be undertaken at a regional level. This would enable IOR-ARC member countries to draw on various types of data required for conducting high-quality research. Given the dearth of disaggregated data in many developing IOR-ARC economies, this initiative could play a major role in overcoming this barrier. Furthermore, it is recommended that a knowledge sharing mechanism be established such that there is subsidized access to scientific journals and technical articles which could be accessed by individual enterprises, entrepreneurs and academics to engage in innovation across the IOR-ARC members. Additionally, it is encouraged that research collaborations among universities, think tanks, institutions and

companies be carried out within IOR-ARC region through liberalization of mode 4 under the General Agreement on Trade in Services (GATS) and mutual mobility and exchange programs.

7.4 Human Resource Development

As noted from Table XX, it could be observed that there exist substantial variances in the level of development under the HRD pillar across the member economies. Countries with a high comparative advantage in KBEs, such as Australia and Singapore, exhibit world class education systems and are home to a highly skilled labour force with a significant stock of knowledge workers. On the other hand, countries with a low comparative advantage in KBEs such as Bangladesh, Tanzania and Yemen possess relatively weak education systems and lack a labour force with sufficient skills to move towards a KBE. This disparity across the member economies opens up a vast scope for cooperation amongst IOR-ARC members.

Preceding analysis shows that tertiary education plays a significant role in developing a nation's critical mass of knowledge workers in transitioning into a KBE. It is therefore essential that prudent and substantial strides be undertaken in developing the tertiary education sector in the lower tier IOR-ARC member economies. A key area of focus in this regard lies in exploiting the potential of offshore campuses in stimulating investment. Higher tier IOR-ARC nations, such as Australia, can encourage outward oriented investments by way of setting up offshore campuses in the IOR-ARC region. Concurrently, lower tier economies should liberalize their investment regimes under GATS mode 3 to facilitate such investments to take place. Furthermore, in recognition of the value of tertiary education and skill levels, fiscal incentives, in the form of tax holidays etc., as well as ancillary infrastructure must be provided to aid in the establishment of campuses. Setting up of offshore campuses, could stimulate competition within tertiary education establishments leading to a rise in quality of education delivered as well as cheaper access. Moreover, foreign establishments could increase the possibility of spillover by way of cross movement of academics and students among tertiary education institutions.

In fact, higher-end IOR-ARC economies have already taken several initiatives in extending educational services to lesser developed member economies. Navitas Group – Australia's largest private education provider and the world leader in the development and provision of educational

services and learning solutions – is one such example. Navitas Group gives the opportunity to students, professionals and migrants in seven different countries (including four IOR-ARC member countries Indonesia, Kenya, Singapore and Sri Lanka), to study in Campuses located in Australia, Canada and the UK through the groups comprehensive University Programs conducted in coordination with its affiliate institutes in partner countries.[9] Informatics Education Ltd is another example. With its parent company located in Singapore, Informatics Education Ltd offers a wide spectrum of programs, ranging from foundation programs to diploma, undergraduate and postgraduate degrees to students across 53 countries in Asia Pacific, Africa, Middle East and Europe, including several IOR-ARC member countries such as Malaysia, Sri Lanka and Indonesia.

Another form of facilitating trade within the tertiary education sector is increasing the capacity to engage in distance learning initiatives. This would require liberalization of legislature relating to cross border supply i.e. mode 1 under GATS, whilst a proper regulatory and accreditation body would have to be established locally to ensure quality and provide recognition of such education initiatives. Much of the benefits arising would pertain to wider and more affordable access to tertiary education, hence augmenting the development of knowledge workers.

In addition, trade within the tertiary education sector could be further strengthened via liberalization of visa regimes of member economies in order to encourage prospective students to seek higher education opportunities in recognized universities within the IOR-ARC region, which would contribute towards building skills in relation to research ability, creativity and enhancing knowledge potential. Liberalization of visa regimes could also be adopted to facilitate movement of knowledge workers, i.e. in particular scientists and engineers, under mode 4 of GATS.

Furthermore, it is encouraged that developed IOR-ARC economies extend both monetary and technical assistance to develop and strengthen means of access to and delivery of secondary and

[9]The group offers University programs to students in Singapore through the Singapore Campus of Curtin University, while it offers programs to students in Sri Lanka, Kenya and Indonesia through Edith Cowan University program through ACBT, Edith Cowan University program through AUSI, Deakin University Melbourne through MIBT, respectively.

tertiary education, especially amongst least developed IOR-ARC member economies. Such assistance could be channeled to develop necessary education infrastructure, such as building and equipping laboratories to undertake scientific research and sharing knowledge and best practices i.e. teaching methods, curriculum etc. Additionally, a key constraint to access education in developing countries within the region is the affordability of education. Governments of such economies are severely constrained in financing the cost of education given the multiple development challenges confronting these member economies. In this context, the HELP scheme initiated in Australia may provide a viable solution to this issue. It is prudent that the IOR-ARC members adopt a similar model for financing education drawing upon Australia's experience with the HELP scheme. It is also recommended that preferential allocation of research scholarships and fellowships are granted within the IOR-ARC region.

8 Conclusion

The IOR-ARC is a truly exceptional regional grouping, with member states spanning three continents separated miles apart by the Indian Ocean and recording considerable differences in terms of worldviews, social and regional traditions, economic priorities and polity. While this vast diversity of interests and capabilities undoubtedly has the potential to hinder regional cooperation initiatives, this very diversity also opens up vast scope for cooperation.

In light of the growing recognition of the importance of moving towards KBEs and the strong link between KBEs and economic growth and development, cooperation in KBEs by fostering trade and investment linkages is an important area warranting renewed attention of IOR-ARC member states. The analysis undertaken in this study shows that member economies in the IOR-ARC are at various stages of a KBE development along the four key dimensions of a KBE, in line with their respective levels of economic development. The country-specific case studies also show that a specific country's performance could defer along each dimension. Such disparities suggest that there is ample scope for trade and investment to take place across the four key pillars of a KBE among IOR-ARC member states. The study identifies specific avenues through which trade and investment could take place between member countries in making the transition towards a KBE.

Creating a conducive business environment for trade and investment to take place is a key prerogative that needs to be undertaken by member economies of the region, specifically those that languish at the low end of the KBE spectrum. In terms of building ICT infrastructure, the study recommends the liberalization of the investment regime in the form of tax breaks to companies engaged in developing ICT infrastructure. Building public-private partnerships geared towards mega ICT infrastructure projects is another important initiative in this regard. Adopting policy frameworks to ensure the safeguarding and enforcement of an IP regime is central in spurring R&D among member economies to strengthen innovation systems. The establishment of a common pool of funds to address the limited availability of venture capital, a data bank and other knowledge sharing mechanisms with subsidized access to scientific journals and technical articles for member countries are other important recommendations in light of supporting innovation systems in member economies. Developing human resources, especially those with the skills and capabilities of knowledge-related activities is crucial in making the required transition to a KBE. The sharing of knowledge of higher-end economies with other economies by way of building off-shore campuses, promoting distance learning and providing technical and monetary assistance to expand access to knowledge are key areas for potential cooperation, as identified in the study.

Appendix 1: Assigning Scores for KBE Performance

The indicators relating to the four key dimensions of a KBE are given weights according to their importance and relevance in moving towards a KBE. Thereafter the weighted average is calculated for each of the four dimensions of a KBE for each country. A higher the weighted average corresponds to better performance. The respective weights given to each indicator are shown in the table below. The significance of the indicators to which the largest weights have been assigned is explained below.

Business Environment

Indicator	Weight	AUS	BAN	IND	IDN	IRAN	KEN	MAD	MAL	MAU	MOZ
High-tech Exports (% of manufactured exports) (2010)	0.15	11.8	1.2	7.2	11.4	4.5	5.7	1	44.5	0.7	1.3
Trade in Services (% of GDP)	0.05	8.8	7.1	14.3	6.2		17.7	NA	26.1	48.2	19.5
FDI/GDP (2010)	0.25	2.7	0.9	1.4	1.9	0.9	0.6	9.9	3.9	4.4	8.6
Transparency of Govt Policymaking	0.15	5	3.9	4.4	4.1	3.5	3.8	3.2	5	4.8	4.2
Openness (Total Trade as % of GDP)	0.05	41.1	59.9	52	49.7	53.4	69.1	62	171.8	132.8	68.6
Intensity of local competition	0.25	5.9	4.7	5.4	4.4	4.3	4.9	4.4	5.4	5.2	3.8
Weighted Average	1.0	7.755	5.985	7.295	7.135	5.6	7.63	7.795	20.185	12.795	8.71

	Weight	OMN	SEY	SIN	SA	SL	TAN	THAI	UAE	YEM
High-tech Exports (% of manufactured exports) (2010)	0.15	0.6	3	49.9	4.3	1	3.5	24	3.2	0.4
Trade in Services (% of GDP)	0.05	12.8	107.3	97.9	8.4	11.3	17.2	24.8	NA	12.7
FDI/GDP (2010)	0.25	1.1	17.4	18.1	0.3	1	1.9	3	1.3	0.2
Transparency of Govt Policymaking	0.15	4.9	NA	6.3	4.8	4.1	4.1	4.2	4.7	2.2
Openness (Total Trade as % of GDP)	0.05	108.2	226.5	403.3	58.3	60.7	NA	150.3	151.1	54.5
Intensity of local competition	0.25	5.1	4.5	5.5	5.1	5.5	4.2	5	5.7	4.7
Weighted Average	1.0	8.935	28.58	39.94	6.56	6.54	4.12	15.485	11.22	5.445

ICT

Indicator	Weigh t	AUS	BA N	IND	IDN	IRA N	KEN	MA D	MA L	MA U	MO Z
Mobile Subscribers (per 100) (2010)	0.10	101	46.2	61.4	91.7	91.2	6.6	37.2	119. 2	79.3	30.9
Computers (per 100)	0.05	81.1	3.1	6.1	10.8	33.7	4.1	1.4	41	3	7.5
Internet Users (per 100)	0.20	74	2.6	4.2	3.9	20.8	4	1.1	55.6	1.4	1.1
Broadband Subscriptions (per 100)	0.10	24.2	0	0.9	0.8	0.7	0	0	7.3	0.2	0.1
Govt Prioritization of ICT	0.20	5.2	5	5.1	4.5	4.2	4.6	3.6	5.9	5.3	4.7
ICT use & gov't efficiency	0.35	4.6	3.7	4.4	4.1	4.3	4.4	3.2	5.6	4.4	3.6
Weighted Average	1.0	34.02 5	7.59	9.93 5	12.90 5	17.38	4.12 5	5.85	28.9 6	10.98	5.89 5

Indicator	Weight	OMN	SEY	SIN	SA	SL	TAN	THAI	UAE	YEM
Mobile Subscribers (per 100) (2010)	0.10	165.5	136	145.2	100.5	83.2	46.8	103.6	145.5	46.1
Computers (per 100)	0.05	45.6		84	18.3	12.3	2.6	22.8	76	4
Internet Users (per 100)	0.20	27.7	41	82	10.1	5.9	0.7	11.4	65	2.9
Broadband Subscriptions (per 100)	0.10	1.5	NA	24.9	1.5	1.1	0	4.6	10.5	0.3
Govt Prioritization of ICT	0.20	5.5	NA	6.3	4.3	5.5	4	4.2	5.9	2.9
ICT use & gov't efficiency	0.35	5.1	4.3	6.1	3.8	4.9	3.7	4.1	5.9	2.7
Weighted Average	1.0	27.405	41.65	41.005	15.325	13.04	7.045	16.515	35.645	6.945

Innovation System

	Weight	AUS	BAN	IND	IDN	IRAN	KEN	MAD	MAL	MAU	MOZ
Scientific & Technical Journal Articles (2009)	0.10	0.09	0.0001	0.002	0.0001	0.009	0.0007	0.0002	0.005	0.002	0.0001
R &D Expenditure (% of GDP) (2007-09)	0.30	2.4	NA	0.76	0.08	0.79	0.42	0.15	NA	NA	0.21
University-industry collaboration	0.30	5.1	2.6	3.8	4.2	3.4	4.2	3.2	5	3.3	3.5

in R&D											
Capacity for Innovation (2011)	0.20	4	2.4	5.1	3.8	3	3.3	2.5	4.3	2.8	2.3
PCT patents, applications (per million) (2011)	0.10	83.1	0	1.2	0.1	0.1	0.1	0	9.5	0.1	0
Weighted average	1.0	11.37	1.77	2.51	2.05	1.87	2.06	1.51	4.75	2.20	1.57

	Weight	OMN	SEY	SIN	SA	SL	TAN	THAI	UAE	YEM
Scientific & Technical Journal Articles (2009)	0.10	0.004	0.005	0.08	0.006	0.001	0.0003	0.003	0.003	0.0001
R &D Expenditure (% of GDP) (2007-09)	0.30	NA	NA	2.66	0.93	0.11	0.43	0.21	NA	NA
University-industry collaboration in R&D	0.30	3.8	3	5.6	4.5	3	3.8	4	4.6	1.9
Capacity for Innovation (2011)	0.20	3.2	NA	4.3	3.4	3.3	3.2	3.2	3.8	1.5
PCT patents, applications (per million) (2011)	0.10	0.4	NA	123	6.7	0.7	0	0.6	4.5	0
Weighted average	1.0	2.57	2.10	15.65	2.98	1.66	1.91	1.96	3.70	1.23

HRD

	Weigh t	AUS	BA N	IND	IDN	IRAN	KEN	MA D	MAL	MAU	MO Z
Secondary Education Enrolment (% gross)	0.05	149.3	42.3	60	79.5	83.1	59.5	31.5	68.7	87.2	25.5
Quality of math & science education	0.20	5.1	3.3	4.7	4.3	4.6	4.2	3.5	5	4.1	2.8
Internet Access in Schools	0.25	5.9	2.5	4	4.7	2.9	3.7	2.4	5.2	4	2.7
HDI	0.10	0.93	0.5	0.55	0.62	0.71	0.51	0.48	0.76	0.73	0.32
Knowledge-intensive jobs, % workforce	0.40	42.9	7.3	NA	7.4	15	NA	2.4	26.8	15.8	NA
Weighted average	1.0	27.21 3	6.37	11.9 2	9.03 2	11.87 1	11.58 2	3.883	16.53 1	12.57 3	5.67 4

Indicator	Weight	OMN	SEY	SIN	SA	SL	TAN	THAI	UAE	YEM
Secondary Education	0.05	91.3	119.2	103	93.9	87	27.4	77	95.2	45.7

Enrolment (% gross)										
Quality of math & science education	0.20	4	NA	6.4	2.1	4.2	2.9	4.2	4.9	1.7
Internet Access in Schools	0.25	4.8	NA	6.3	3.4	3.4	2.7	4.5	5.7	1.5
HDI	0.10	0.71	0.77	0.87	0.62	0.69	0.47	0.68	0.85	0.46
Knowledge-intensive jobs, % workforce	0.40	24.3	NA	51	23.7	19.7	2.6	10.8	36.1	17
Weighted average	1.0	16.356	48.142	28.492	15.507	13.989	3.712	10.203	21.69	9.846

Intensity of local Competition

Competition plays an important role in bringing down costs and thereby making goods and services more affordable. It can also lead to more entrants into a market, greater technology diffusion, improved quality and a higher rate of innovation. With regard to a KBE, insufficient competition has been a key factor hindering the use of ICT and other knowledge-related infrastructure. For example, research has shown that the United States was able to benefit from ICT investment ahead of other OECD countries as it had a high level of competition, particularly in the telecommunications industry, strengthened through regulatory reforms in the 1980s and 1990s.[10] On the other hand, higher price levels in other OECD countries could be associated with a lack of competition within these countries.

ICT use and government efficiency

In countries that are not major producers of ICT goods, the benefits of ICT infrastructure are largely dependent on spillover or network effects linked to the use of ICT in production processes. Evidence from firm-level and sectoral studies suggest that TFP growth is linked to the productivity-enhancing benefits of ICT use.[11] Furthermore, a strong relationship has been observed between ICT use and new work practices such as team working and employee involvement, which is a key feature of progression towards a KBE.

University-industry collaboration

[10] OECD, 2001.
[11] Ibid.

University-industry collaboration in R&D is a vital element in developing an effective innovation system in a country in order to ensure that research findings are effectively utilized by enterprises and businesses in an economy. A key element of innovative systems in OECD countries is the increased interaction between science and industry, which is indicative of the growing interest of the business sector in scientific research and the researchers, technologies methods and instruments that accompany it.

R&D Expenditure (% of GDP)

Undertaking R&D is an important innovation activity for the generation of new knowledge. It creates new opportunities to innovate, is a mechanism for solving existing problems, and involves adopting and transforming innovations developed elsewhere. Research has shown that countries that invest in their own R&D benefit the most from foreign R&D (OECD, 2001). R&D has also been recognized as an important driver of total-factor productivity growth (TFP).[12]

Knowledge-intensive jobs (% of workforce)

The skills base and occupational composition of the labour force is a strong indicator of the trend towards a KBE.

[12] TFP reflects many types of efficiency improvements, such as improved managerial practices, organizational changes and innovative ways of producing goods and services.

Appendix 2: Country-Specific Indicators

Table 1: KBE Indicators for Australia

1A: Business Environment

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
FDI/GDP ratio	-3.5	4.2	5.3	4.3	3.1	3.1	4.8		
Openness (Total Trade as % of GDP)	38.0	39.8	38.9	45.4	39.3	39.6	41.3	40.8	
Trade in Goods (Merchandise) as % of GDP	33.4	35.3	36.1	36.8	34.6	36.4	37.1	34.1	
Exports of high technology products as % of (manufactured) exports	12.8	12.3	10.3	10.8	11.9	11.9	11.9		
Trade in services as % of GDP	8.9	8.9	9.6	8.9	9.1	8.7	8.2		
GDP per capita growth (annual %)	1.8	1.5	2.2	2.0	-0.2	0.8	1.2		
Intensity of local competition (rating)									5.9

1B: ICT Infrastructure

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mobile Subscribers (per 100)	90.3	95.3	100.7	102.8	101.4	101.0	108.3	106.2	
No. of telephone mainlines per 1000 population	49.6	47.9	46.2	43.6	48.9	47.7	46.8	45.7	
Households with personal computers (%)									82.6
Internet Users (per 100)	63.0	66.0	69.5	71.7	74.3	76.0	79.5	82.3	
Broadband Subscriptions (per 100)	9.9	18.8		23.9	23.2	24.1	23.9	25.1	
Mobile Cellular tariffs, PPP $/min									0.54
ICT goods exports (% of total goods exports)	11.8	11.7	10.7	9.1	10.5	10.6	9.8		
ICT goods imports (% of total goods imports)	1.7	1.5	1.4	1.1	1.1	1.0	0.8		
ICT use & gov't efficiency									4.6

1C: Innovation System

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
Scientific & Technical Journal Articles	15972.4	17216.9	17833.8	18776.4	18923.3				
R &D Expenditure (% of GDP)		2.2		2.4					
University-industry collaboration in R&D									5.1
Patent applications, residents	2555	2837	2718	2821	2494	2409	2383		
Patent applications, non-residents	21302	23166	24122	23525	21187	22478	23143		
Intellectual property protection									5.3
Software piracy rate, % of software installed									23
Venture capital availability									3.3
E-participation index									0.76

1D: Human Resource Development

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
School enrolment, Secondary (% gross)	127.7	127.3	125.9	127.2	129.2	131.3			
School enrollment, tertiary (% gross)	72.1	71.2	72.1	72.3	75.9	79.9			
Labor force with secondary education (% of total)			56.3	56.0	55.3	55.7			
Labor force with tertiary education (% of total)			20.3	21.2	23.4	24.2			
Public spending on education, total (% of government expenditure)	4.9	4.8	4.7	4.6	5.1				
Researchers in R&D (per million people)		4203.6		4293.9					
Technicians in R&D (per million people)		1007.1		1127.2					
Quality of Management Schools									5.3
Quality of math & science education									4.9
Knowledge-intensive jobs, % workforce									42.9

Table 2: KBE Indicators for Malaysia

2A: Business Environment

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
FDI/GDP ratio	2.7	4.7	4.7	3.3	0.1	3.7	4.2		
Openness (Total Trade as % of GDP)	203.4	202.7	192.6	177.1	163.8	170.2	167.4	163.1	
Trade in Goods (Merchandise) as % of GDP	178.1	179.4	167.0	154.3	139.1	147.2	144.3	139.7	
Exports of high technology products as % of (manufactured) exports	54.6	53.8	52.3	39.9	46.6	44.5	43.4		
Trade in services as % of GDP	29.1	27.5	29.8	26.4	27.6	26.1	25.8	26.5	
GDP per capita growth (annual %)	3.4	3.6	4.4	3.0	-3.2	5.3	3.3	3.9	
Intensity of local competition (rating)									5.4

2B: ICT Infrastructure

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mobile Subscribers (per 100)	74.9	73.2	86.3	100.8	107.9	119.2	127.0	140.9	
No. of telephone mainlines per 1000 population	16.7	16.3	16.1	16.4	16.2	16.2	15.7	15.7	
Households with personal computers (%)									64.1
Internet Users (per 100)	48.6	51.6	55.7	55.8	55.9	56.3	61.0	65.8	
Broadband Subscriptions (per 100)	1.9	2.8	3.8	4.8	5.5	6.5	7.4	8.4	
Mobile Cellular tariffs, PPP $/min									0.19
ICT goods exports (% of total goods exports)	43.4	42.7	39.4	24.5	36.5	34.0	29.4		
ICT goods imports (% of total goods imports)	38.0	36.1	33.5	23.4	30.1	29.8	25.6		
ICT use & gov't efficiency									5.6

2C: Innovation System

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
Scientific & Technical Journal Articles	614.6	724.1	808.1	951	1351.3				
R &D Expenditure (% of GDP)		0.63							
University-industry collaboration in R&D									5.0
Patent applications, residents	522	531	670	818	1234	1231	1076		
Patent applications, non-residents	5764	4269	1702	4485	4503	5152	5376		
Intellectual property protection									4.9
Software piracy rate, % of software installed									55
Venture capital availability									4
E-participation index									0.5

2D: Human Resource Development

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
School enrolment, Secondary (% gross)	70.3	70.3	69.0	69.1	68.3	69.1			
School enrollment, tertiary (% gross)	29.3	30.6	33.0	37.5	40.2	42.3			
Labor force with secondary education (% of total)			56.3	56	55.3	55.7			
Labor force with tertiary education (% of total)			20.3	21.2	23.4	24.2			
Public spending on education, total (% of government expenditure)		4.5	4.4	4.0	6.0	5.1			
Researchers in R&D (per million people)		364.6							
Technicians in R&D (per million people)		43.0							
Quality of Management Schools									5.0
Quality of math & science education									5.0
Knowledge-intensive jobs, % workforce									26.8

Table 3: KBE Indicators for Mauritius

3A: Business Environment

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
FDI/GDP ratio	0.64	1.56	4.35	3.97	2.81	4.43	2.42	3.13	
Openness (Total Trade as % of GDP)	121.6	129.6	124.1	116.5	105.3	114.2	117.2	118.3	
Trade in Goods (Merchandise) as % of GDP	84.3	91.5	78.7	73	64.2	68.4	68.6	74.8	
Exports of high technology products as % of (manufactured) exports	2	24	8	7	2	1	1		
Trade in services as % of GDP	44.81	45.92	48.44	46.30	43.54	48.09	51.37	55.72	
GDP per capita growth (annual %)	0.44	3.16	5.23	4.84	2.51	7.19	3.35	2.73	
Intensity of local competition (rating)									5.2

3B: ICT Infrastructure

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mobile Subscribers (per 100)	52	61	73	80	84	92	99	113	
No. of telephone mainlines per 1000 population	28.45	28.21	28.28	28.32	29.05	29.84	28.67	26.57	
Households with personal computers (%)									38.2
Internet Users (per 100)	15.2	16.7	20.2	21.8	22.5	28.3	35	41.4	
Broadband Subscriptions (per 100)	0.43	2.2	1.75	3.64	5.33	7.16	9.77	10.57	
Mobile Cellular tariffs, PPP $/min									0.19
ICT goods exports (% of total goods exports)	13.3	13.7	4.5	3.8	0.8	1.1	0.5		
ICT goods imports (% of total goods imports)	12.8	11.7	5.7	5.5	5.3	5.1	4.3		
ICT use & gov't efficiency									4.4

3C: Innovation System

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
Scientific & Technical Journal Articles	15.4	19	17.8	21.1	21.5				
R &D Expenditure (% of GDP)	0.37								
University-industry collaboration in R&D									3.3
Patent applications, residents				2					
Patent applications, non-residents				22					
Intellectual property protection									3.8
Software piracy rate, % of software installed									57
Venture capital availability									2.8
E-participation index									0.08

3D: Human Resource Development

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
School enrolment, Secondary (% gross)	83.8								
School enrollment, tertiary (% gross)	21.6	23.0	23.1	24.9	29.0	30.58	32.45		
Labor force with secondary education (% of total)	39.1	45.8	39.8						
Labor force with tertiary education (% of total)	10.2	9.4	11.2						
Public spending on education, total (% of government expenditure)	14.3	12.7	12.6	12.7	11.6	13.7			
Researchers in R&D (per million people)									
Technicians in R&D (per million people)									
Quality of Management Schools									4.1
Quality of math & science education									4.3
Knowledge-intensive jobs, % workforce									15.8

Table 4: KBE Indicators for Bangladesh

4A: Business Environment

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
FDI/GDP ratio		1.31	0.97	1.37	0.79	0.92	1.07	0.90	1.0
Openness (Total Trade as % of GDP)	43.8	49.2	49.0	53.6	45.1	51.3	61.1	56.5	
Trade in Goods (Merchandise) as % of GDP	38.5	45.0	45.4	49.3	41.3	46.8	54.2	51.2	
Exports of high technology products as % of (manufactured) exports	0.3	0.2	1.2						
Trade in services as % of GDP				7.2	6.0	6.8	6.9	7.0	
GDP per capita growth (annual %)			6.4	6.2	5.7	6.1	6.7	6.3	
Intensity of local competition (rating)									4.7

4B: ICT Infrastructure

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mobile Subscribers (per 100)	6	13	24	31	35	46	56	64	
No. of telephone mainlines per 1000 population	1	1	1	1	1	1	1	1	
Households with personal computers (%)									3.1
Internet Users (per 100)	0.2	1.0	1.8	2.5	3.1	3.7	5.0	6.3	
Broadband Subscriptions (per 100)	0		0.03	0.03	0.21	0.28	0.31	0.34	
Mobile Cellular tariffs, PPP $/min									0.03
ICT goods exports (% of total goods exports)	0.1	0.6							
ICT goods imports (% of total goods imports)	6.2	6.7	5.1						
ICT use & gov't efficiency									3.7

2C: Innovation System

Indicator	2005	2006	2007	2008	2009	2010	2011	2012	2013
Scientific & Technical Journal Articles	195	219	235	237	260				
R &D Expenditure (% of GDP)									
University-industry collaboration in R&D									
Patent applications, residents	294	288	270	278	275	276	274		
Patent applications, non-residents	50	22	29	60	55	66	32		
Intellectual property protection									2.4

Software piracy rate, % of software installed									90
Venture capital availability									2
E-participation index									0.08

2D: Human Resource Development

Indicator	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
School enrolment, Secondary (% gross)	46	46	47	45	49	51	52		
School enrollment, tertiary (% gross)	6	7	8	9	11		14		
Labor force with secondary education (% of total)									
Labor force with tertiary education (% of total)									
Public spending on education, total (% of government expenditure)		14.2	15.8	14.0	14.1				
Researchers in R&D (per million people)									
Technicians in R&D (per million people)									
Quality of Management Schools									4.1
Quality of math & science education									4.3
Knowledge-intensive jobs, % workforce									7.3

Appendix 3: Choice of Indicators

Indicator	Description	Significance for KBE	Data Source
Business environment			
FDI/GDP ratio	Inward FDI financial flows expressed as a per cent of GDP	Indicates investor confidence in economy. Also indicates openness to outside influence (and knowledge).	UNCTAD Statistical Database
Openness (Total Trade as % of GDP)	Sum of exports and imports as a percentage of GDP	Openness to outside goods and services indicates openness to outside ideas	UNCTAD Statistical Database
Trade in Goods (Merchandise) as % of GDP	The sum of merchandise exports and imports divided by the value of GDP	Higer volumes indicate more openness to outside goods and hence outside ideas	WB, World Development Indicators
Exports of high technology products as % of (manufactured) exports	High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery.	Indicator of knowledge intensity of manufacturing.	WB, World Development Indicators
Trade in services as % of GDP	The sum of service exports and imports divided by the value of GDP	Indicator of knowledge-intensity and size of service sector. (Exportable services tend to be knowledge-intensive; Most Developed Economies tend to have higher proportion of services)	WB, World Development Indicators
GDP per capita growth (annual %)	Annual percentage growth rate of GDP at market prices based on constant local currency divided by mid-year population	Indicator of a country's level of development and thus status in moving to a KBE	WB, World Development Indicators
Intensity of local competition (rating)	The intensity of competition in local markets	Competition encourages innovation	WEF, Global Information Technology Report
ICT infrastructure			
Mobile Subscribers (per 100)	Subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network. Post-paid and prepaid subscriptions are included.	Indicator of new technology take-up.	WB, World Development Indicators
No. of telephone mainlines per 1000 population	fixed telephone lines that connect a subscriber's terminal equipment to the public switched telephone network and that have a port on a telephone exchange. Integrated services digital network channels ands fixed wireless subscribers are included.	Indicator of ICT infrastructure and penetration rates	WB, World Development Indicators
Household with personal computers (%)	Percentage of households equipped with a personal computer	Indicates take-up of new ICT by business and broader community	WEF, Global Information Technology Report
Internet Users (per 100)	people with access to the worldwide network	Indicates take-up of new ICT by business and broader community. Indicative of	WB, World Development Indicators

		ability to engage in ecommerce and modern information collection and dissemination.	
Broadband Subscriptions (per 100)	The number of broadband subscribers with a digital subscriber line, cable modem, or other high-speed technology.	Indicates active participation by business in the digital economy	WB, World Development Indicators
Mobile Cellular tariffs, PPP $/min	Average per-minute cost of different types of mobile cellular calls (PPP $)	Indicator of affordability of ICT infrastructure	WEF, Global Information Technology Report
ICT goods exports (% of total goods exports)	ICT goods exports include telecommunications, audio and video, computer and related equipment; electronic components; and other information and communication technology goods. Software is excluded	Indicator of use of ICT in production processes	WB, World Development Indicators
ICT goods imports (% of total goods imports)	ICT goods imports include telecommunications, audio and video, computer and related equipment; electronic components; and other information and communication technology goods. Software is excluded	Indicator of openness to ICT-related goods and ideas	WB, World Development Indicators
ICT use & gov't efficiency	The extent to which the use of ICTs by the government improve the quality of government services to citizens (e.g., speeding-up of delivery time, reducing errors, introducing new online services, enhancing transparency)	Indicates take-up of new ICT by government. Indicative of ability to engage in ecommerce and modern information collection and dissemination	WEF, Global Information Technology Report
Innovation system			
Scientific & Technical Journal Articles	The number of scientific and engineering articles published in the following fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences.	Indicates research contribution to create new (technical) knowledge	WB, World Development Indicators
R &D Expenditure (% of GDP)	Current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development	Indicates current effort to create new (technical) knowledge	WB, World Development Indicators
University-industry collaboration in R&D	The extent to which businesses and universities collaborate on R&D	Partial indicator extent of knowledge networks	WEF, Global Competitiveness Report
Patent applications, residents	Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for	A patent provides protection for the invention to the owner of the patent, thereby encouraging innovation	WB, World Development Indicators
Patent			

applications, non-residents	exclusive rights for an invention--a product or process that provides a new way of doing something or offers a new technical solution to a problem.		
Intellectual property protection	Rating of intellectual property protection, including anti-counterfeiting measures in the country [1 = very weak; 7 = very strong]	safeguarding intellectual property (IP) is essential in spurring research and development	WEF, Global Information Technology Report
Software piracy rate, % of software installed	Unlicensed software units as a percentage of total software units installed	A basic proxy to gauge the relative strength of IP law enforcement	WEF, Global Information Technology Report
Venture capital availability	A rating of the ease for entrepreneurs with innovative but risky projects to find venture capital in the country [1 = very difficult; 7 = very easy]	Venture capital spurs innovation	WEF, Global Information Technology Report
E-participation index	Assessment, on a 0-to-1 (best) scale, of the quality, relevance, and usefulness of government websites in providing online information and participatory tools and services to their citizens	Indicator of government involvement in innovative activities	WEF, Global Information Technology Report
Human resource development			
School enrolment, Secondary (% gross)	Total enrollment in secondary education, regardless of age, expressed as a percentage of the population of official secondary education age.	Potential for skilled workforce in the future	WB, World Development Indicators
School enrollment, tertiary (% gross)	Total enrollment in tertiary education, regardless of age, expressed as a percentage of the population of official secondary education age.	Potential for knowledge-intensive skilled workforce in the future	WB, World Development Indicators
Labor force with secondary education (% of total)	The proportion of the labor force that has a secondary education, as a percentage of the total labor force.	Indicator of skill level of workforce	WB, World Development Indicators
Labor force with tertiary education (% of total)	The proportion of the labor force that has a tertiary education, as a percentage of the total labor force.	Indicator of skill level of workforce	WB, World Development Indicators
Public spending on education, total (% of government expenditure)	total public expenditure (current and capital) on education expressed as a percentage of the GDP	Indicator of the extent to which education is prioritized by the government	WB, World Development Indicators
Researchers in R&D (per million people)	Professionals engaged in the conception or creation of new knowledge, products, processes, methods, or systems and in the management of the projects concerned. Postgraduate PhD students (ISCED97 level 6) engaged in R&D are included.	Direct indicator of innovative capacity and potential	WB, World Development Indicators
Technicians in R&D (per million people)	people whose main tasks require technical knowledge and experience in engineering, physical and life sciences (technicians), or social sciences and humanities (equivalent staff).	They promote R&D by performing scientific and technical tasks involving the application of concepts and operational methods, normally under the supervision of researchers.	WB, World Development Indicators
Quality of	assessment of the quality of	Potential for flow of high-	WEF, Global

Management Schools	management or business schools in the country [1 = poor; 7 = excellent—among the best in the world]	level managerial skills into the economy	Information Technology Report
Quality of math & science education	Assessment of the quality of math and science education in a country's schools [1=poor; 7=excellent]	Potential for flow of high-level technical skills into the economy	WEF, Global Information Technology Report
Knowledge-intensive jobs, % workforce	Share of workforce employed in knowledge intensive activities	Indicates current status as a KBE	WEF, Global Information Technology Report

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