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Chapter 19

Intellectual property rights and anti-competitive behaviour: Major deterrents to ecology and economic progress of SIDS

Introduction

Small Island Developing States (SIDS) increasingly rely on emerging new opportunities in the high-tech and information and technology sectors to overcome limitations of isolation and remoteness. As examples, the sunrise industries for SIDS have been enumerated as e-commerce, telecommunications and tele-medicines and distance learning. In this quest, geographic information systems (GIS) and other information systems are believed to play a significant role. As a result, significant emphasis has been placed on the development of national, regional and supra-national information and database centres. It is therefore not an overstatement that information and communication technologies (ICT) are a critical ingredient in the pursuit of sustainable development in many SIDS. It is important to note that insofar as these industries have relatively smaller ecological footprints than other more traditional fields of industrial production, they will contribute to the ecological sustainability of SIDS. In reviewing the economic performance of these states, the experience over the decade has been a mixed bag. Most states, except the least developed ones, registered positive economic growth since 1994. Especially, over the same period, most of these nations achieved very satisfactory human development indices mainly in literacy and health. Most of these social and economic successes have been attributed to appropriate economic diversification, tourism, and the development of niche markets in goods and especially services

Many of the success stories among SIDS relied heavily on the high-tech sectors and on financial services as in the case of The Bahamas, Barbados and Mauritius. As an example, the contribution of the financial services sector to the gross domestic product of Mauritius increased from 10.1 per cent in 1992 to over 20 per cent by 2005. The emergence of high-tech sectors must be viewed against the steady decline in the terms of trade of primary products in which these countries specialised before. It is also important to note that the increase in the costs of exporting bulk products is largely due to energy price shocks. Because of these twin factors, one has come to realise that the knowledge sector and management of this sector may well be key drivers for the future prosperity of these nations. As a simple observation to support this point, between 1980 and 2000 the share of SIDS in global merchandise trade dropped by 50 per cent while their share in global trade of services stayed unchanged due mainly to telecommunications and high-tech service sectors.

The sticking point is that, because of intellectual property rights issues, high-tech sectors do not offer a level playing field and instead have given rise to a digital divide between developed countries and those nations belonging to the SIDS. It is widely argued that the presence of intellectual property rights promotes innovation that drives economic growth and economic prosperity (see Demestz, 1966; Boldrin and Levine, 2002). Strong property rights are therefore regarded as a collective good, based on a simplistic notion that they provide appropriate incentives for the production of any goods and services. If this perception is correct, then one is left to conclude that strong and well-defined property rights are a pre-requisite for the production of ideas as well. Unfortunately, this perception is at best a *howler*, since ideas and knowledge are typically considered means of production – inputs for the production of other goods and services.

The problem is that the presence of strong intellectual property rights takes away from the purchaser the freedom to utilise this input as he/she sees fit. This gives rise to what is known as 'intellectual monopoly'. We highlight a vertical market model to argue a case against strong intellectual property rights. We call for an appropriate regulatory framework to control royalties by international players like the United Nations. Thus strong intellectual property rights can lead to serious anti-competitive behaviour in industries that rely on knowledge.

The Chapter is organised as follows:

This chapter begins with a review of intellectual property rights (IPR). The next section develops a game-theoretic model that is appropriate for examining IPR in a vertically-related industry. The section following examines the need for regulation in the light of the proposed game. Finally, some conclusions are drawn.

Intellectual property rights and global forums

The World Trade Organization (WTO) is a recent development in the context of intellectual property rights (IPR) agreements. The World Intellectual Property Organization (WIPO) has been a relevant forum since its creation in 1967, through the Stockholm Convention. The WIPO, which is based in Geneva, administers more than 20 international IPR treaties. The WTO has an interesting IPR agreement, known as the agreement on Trade-related Intellectual Property Rights (TRIPs). When the agenda for the Uruguay Round was being set in the mid-1980s, serious opposition was mounted against the idea of TRIPs being included. Traditionally, two main arguments were advanced against such inclusion: first, it is widely held that IPR and international trade are unrelated. At a face value, this may seem to be true. But a proper analysis will show that this view is incorrect. If India exports computer software to Germany, one cannot argue that protection granted to software has nothing to do with trade. If German firms export computer hardware to India, one cannot argue that protection granted to hardware is a non sequitur for trade-related issues. The upshot is that trade is usually predicated on investments. So, if foreign direct investment (FDI) into a nation is hamstrung by a lack of IPR protection, one cannot convincingly argue that IPR and international trade are unrelated issues.

The second argument against the inclusion of IPR in a trade agenda is more convincing.

One may argue that given that the WIPO already exists and that it has agreements on IPR, why does one need the WTO to safeguard IPR? It is important to highlight that the relevance of the WTO is predicated on the notion that the WIPO has not been effective for various reasons. To understand this point, note that, in terms of inclusiveness, the WTO has 145 members. In contrast, very few countries are signatories to various WIPO conventions or treaties. Thus, the WTO seems to provide a broader umbrella than the WIPO has done over the years. One may also argue that incorporating IPR into the WTO fold has several advantages. Not only are more countries members of the WTO, more importantly, the WTO provides an effective dispute resolution mechanism and this can be used against countries that fail to protect IPR. Following favourable judgment in a dispute, retaliatory action can be taken against a country that breaches IPR conventions. The WTO as a disciplinary mechanism is thus far more credible, which is why IPR was brought into the WTO.

The forms of IPR covered in the WTO are copyright and related rights, trademarks, geographical indications, industrial designs, patents, layout designs (topographies) of integrated circuits and undisclosed information. On transitional arrangements, nations are to gradually achieve higher norms. Developing countries had until 2005 for patents. In some sectors, some countries such as India only allowed process patents in food, chemicals and drugs. It is important that product patents should protect property rights in all sectors and not just for a select few. At the moment, the choice between a process patent and a product patent is usually left to the applicant.

At the conclusion of WTO's Fourth Ministerial Meeting in Doha in 2001, least developed countries (LDCs) were given until 2016 to implement higher norms. Other than the issue of product patents vis-à-vis process patents, the duration of patent protection has also to be uniformly implemented in the coming twenty years. Towards this end, compulsory licensing provisions have been tightened. These provisions are used when a patent is not workable. The government can then instruct that the patent-holder has to compulsorily execute a license in favour of another manufacturer.

There are three main issues about the TRIPs agreement that give rise to concern in South Asia. India and Brazil have asked for dilution of the Uruguay Round's TRIPs agreement. The Commission on Intellectual Property's document represents one of the best examples of the concerns. For integrating intellectual property rights into development policy, the Commission on Intellectual Property Rights was set up by the British government in 2002. On health issues, there are also various reports produced by the Global Forum for Health Research, WHO. The expression '10/90 gap' is now used, meaning that less than 10 per cent of global spending on health research is devoted to diseases or conditions that account for 90 per cent of the global disease burden.

There is a concern that patent protection in the pharmaceutical sector will result in monopolies, increase drug prices and prevent access to health care. Similar concerns are also expressed about monopolies in fertilisers and seeds. Given the spread of AIDS, countries in sub-Saharan Africa and South Asia have also been concerned about the cost of public health. This concern was reflected in a WTO Ministerial Declaration in Doha on TRIPs and access to public health. On public health issues, there are three kinds of concerns – price

controls, parallel imports and compulsory licensing. The major concerns with IPRs at the global level are that they:

1 promote monopolisation of an idea;
2 protect and promote monopoly power;
3 place at the discretion of the owner the power to decide how an idea can be utilised; and
4 require that every time an idea is used, a royalty has to be paid by the licensee to the owner, thus distorting competition.

The following section offers a game-theoretic model based on the issues (1), (2) and (4) to examine an anti-competitive element in the entire set-up.

Formalisation of the model

Ecological footprints of economic progress: The relevance of knowledge assets

Environmental economics, economic development and sustainability have triggered one of the most interesting debates of the modern civilisation. One strand of thought by leading natural scientists is that the current interrelationship between human beings and nature is vitiated by a deep 'malaise' as the current standard of living of an average human is not ecologically sustainable. This negative opinion comes to us as a prediction of doomsday awaiting humanity when the ecological system will collapse and fail to sustain our future. The other strand of thought, mainly posited by economists and business specialists, is that the standard of living of an average human being today is better in many ways than humans have ever enjoyed. Some, therefore, tend to argue that there is no impending crisis and the foundation of the doomsday prediction is an overreaction.

It is early days for anyone to make a clear and definitive judgment about the empirical tenability of either of these opposing views. Yet what is at stake is a fragile ecological system that can suffer irreversible damage from unbridled economic development and population growth. If over time the first strand of thought prevails many states, especially the SIDS, will need to quickly adopt a pattern of sustainable development program in order to rapidly rectify ecological damages. If the existing ecological damage has been serious enough, the potential survival for such SIDS will be already in question. So a critical question for SIDS is how to contain ecological damage that typically accompanies economic development within some reasonable and acceptable bounds. In this chapter, we call this damage rather euphemistically the 'ecological footprints of economic progress', or simply ecological footprints.

In what follows, we constructively argue two important drawbacks of economic development in the context of ecological sustainability:

- First, we will argue that through an appropriate economic development strategy SIDS can achieve ecological sustainability by promoting industries that intensively use 'knowledge assets' in their production. One may call these industries 'knowledge-specific industries'. These industries, we will establish, have relatively smaller ecological footprints.

- Secondly, we will argue that the nature of knowledge-specific industries is such that SIDS cannot rely on global market mechanisms to achieve ecologically sustainable economic progress. It is, therefore, essential that SIDS collectively engage in a multilateral negotiation/bargaining with the advanced nations on regulating and controlling royalties on knowledge assets.

Let us take a quick glimpse at the implication of ecological footprints of economic development/progress. Economic activities directly, or indirectly, utilise natural resources. Natural resources are directly used in consumption and indirectly as inputs in the production system. The main natural ingredients in the production process are oil, coal and natural gas, which generate adverse environment impacts such as water and air pollution. In modern work natural resources are considered those natural assets that create a complex ecosystem on which life is based. These natural assets provide a complex set of services to all living organisms of a specific ecosystem. The main pillar of our argument is that economic activities leave irreversible impacts on the ecosystem and different industries have different impacts on the ecology. In other words, the production process of an industry releases pollutants that adversely impact on the ecosystem. In most cases the concomitance of economic development and pollutants is a degradation of ecosystems. Economic development also causes a deterioration of various environmental assets (like water and air quality). The environment is the proverbial 'sink' and pollution is an unintended consequence of economic development on the quality of environmental goods. For us, one of the important quests of economic sustainability is to minimise the deterioration of environmental assets.

In support of our argument that SIDS can significantly arrest environmental degradation by choosing an optimal development strategy that focuses on knowledge-intensive industries, we offer the consumption, or utilisation, of energy by an industry as a proxy for the measure of its ecological footprint. The measures give an estimate of the pollution that is directly caused by production in each industry. We examine the energy consumption of 22 industrial sectors from the United States of America in 2002. The industry classification codes (NAICS) and their names and various measures of energy consumption are presented in Table 19.1. The details are given at the bottom of the table. For our argument it is important to note two of the measures CPE and CPV as proxies for ecological footprints. The index CPE is the consumption of energy per employee and CPV is the consumption of energy per value added. For our reference, Industries 334, 335, and 336 are the knowledge-intensive industries.

In Figure 19.1 we present the energy consumption, or CPE measure, of each industry. It is evident from the figure that the ecological footprint of Industries 334, 335, 336 are significantly lower than the other. These are the high-tech and knowledge-specific industries. In Figure 2 we present the CPV measure of energy use for 22 industries, which graphically describes how the ecological footprints of Industries 334, 335, and 336 are close to zero.

Thus, our main argument is that knowledge-specific industries and their development in SIDS can play an important role in ensuring economic development without compromising their ecological sustainability. What we argue in the next section is that we cannot

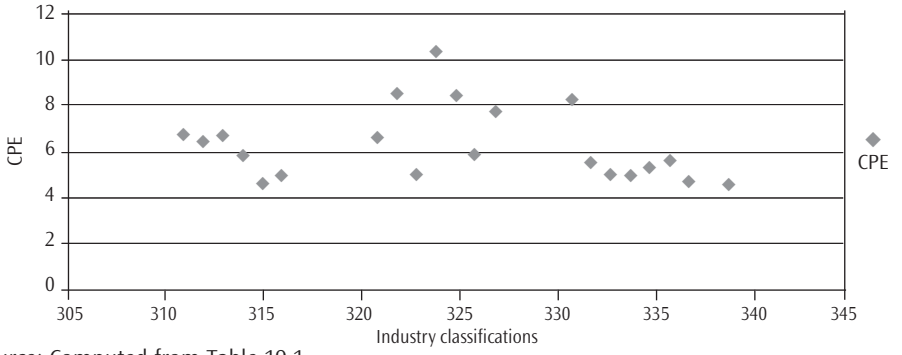
leave the development of these important industries to the vagaries of the global market mechanism which can significantly marginalise SIDS and compromise their future development.

Table 19.1. Price and consumption of energy by the American manufacturing industries in 2002

NAICS	Sectors	POE	CPE	CPV	CPVS
311	Food	6.42	6.766	6.0	2.6
312	Beverage and tobacco products	7.53	6.508	1.6	1.0
313	Textile mills	7.73	6.683	11.2	4.3
314	Textile product mills	7.38	5.844	4.7	1.6
315	Apparel	11.16	4.622	1.8	0.9
316	Leather and allied products	9.66	5.025	2.4	1.1
321	Wood products	3.95	6.609	10.6	4.2
322	Paper	4.78	8.525	31.1	15.2
323	Printing and related support	12.54	5.028	1.8	1.1
324	Petroleum and coal products	3.97	10.354	91.3	15.0
325	Chemicals	5.03	8.481	15.3	8.5
326	Plastics and rubber products	10.90	5.928	2.9	2.1
327	Non-metallic mineral products	4.66	7.798	20.7	11.7
331	Primary metals	4.94	8.336	34.6	14.2
332	Fabricated metal products	10.39	5.555	3.0	1.7
333	Machinery	11.38	5.059	1.4	0.7
334	Computer and electronic products	9.24	4.949	0.9	0.5
335	Elec equip., appliances, components	6.84	5.353	1.9	1.0
336	Transportation equipment	8.65	6.30	1.8	0.7
337	Furniture and related products	8.82	4.734	1.6	0.9
339	Miscellaneous	13.26	4.620	0.9	0.6

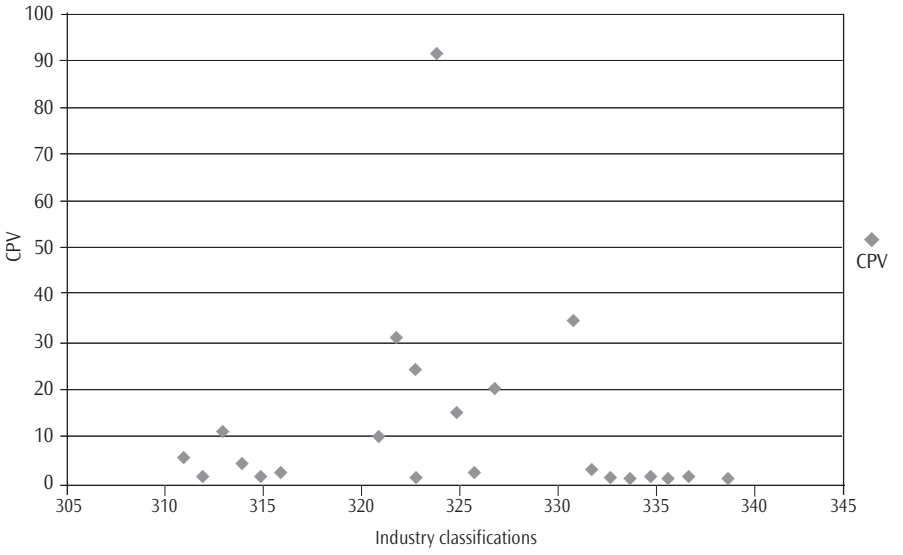
Notes: NAICS: North American Industry Classification System, POE: Average Price of Purchased Energy, CPE: Consumption of Energy Per Employee, CPV: Consumption of Energy per Value Added, CPVS: Consumption Per Dollar Value Shipment.
Source: Energy Information Administration, U.S. DOE (2002 index), Department of Energy survey data on energy intensity in industrial sectors.

Figure 19.1. Specific industries and their ecological footprints (CPE measure)



Source: Computed from Table 19.1.

Figure 19.2. Industrial sectors and their ecological footprints (CPE measure)



Source: Computed from Table 19.1

Knowledge assets and vertical structure: Basic intuition

We argue that a strict enforcement of IPR of global firms by the WTP can cause problems of vertical foreclosure in relevant markets. As an example, suppose there is a global player in the pharmaceutical industry that invests significant resources to develop a drug to prevent the dreaded bird flu. Once the global giant is successful in developing the vaccination/drug, it has effectively established (intellectual) property rights over this drug. If this drug is subsequently produced in India by a local firm for the Indian and other regional markets, then this local firm combines two types of inputs to produce this drug: first and foremost, it pays a royalty to the global firm to acquire the formula that one may call a 'knowledge asset'. Secondly, upon acquiring this knowledge asset as a key input, the local firm uses necessary ingredients and inputs to manufacture this drug. For each unit produced, the local firm pays a royalty to the global firm. The local firm competes with the global firm in the downstream drug market to sell the drug. Thus, the industry has a vertical structure since this key input, knowledge asset, is monopolised by a global firm that sells this input to a local firm and both these firms compete in the downstream market of the final good. In the subsequent discussion we call the global firm an integrated firm and the local firm a non-integrated firm.

The optimal royalty

We postulate an industry that supplies a single final product. Each unit of it is produced by combining necessary input, called a knowledge asset, from the upstream industry with labour and other inputs from competitive markets. The upstream firm is an integrated firm which has monopolistic control over the supply of the knowledge asset and competes with

the downstream firm in the market for the final product[1]. The downstream firm is competitive in the input market as it takes the input price as a datum. We postulate Cournot type quantity competition in the downstream duopoly market while the integrated firm has naturally monopolistic power in the upstream market (see Ordover, Saloner and Salop, 1990 for relevant details). It is natural that the degree of (actual) competition in the downstream market is determined by the royalty/price of the knowledge asset of the upstream market. We assume a highly stylised sequential game that is played out over two time periods. The integrated firm faces a duopoly in the downstream (final product) market while it wields naturally monopolistic power in the upstream market (knowledge asset).

During the first time period, or Stage I, the integrated firm announces the royalty at which it will sell the knowledge asset in the second period, or Stage II, to the rivals in the downstream market. During the second period, or Stage II, both the integrated and non-integrated firms will compete as Cournot duopolists in the downstream market to sell the final product. If the information is complete, in the relevant rational expectations equilibrium, both the firms correctly predict the Cournot-Nash equilibrium of the second period, or Stage II, competition and both the firms will seek to maximise their profits in Stage II given the royalty as determined in Stage I. When the integrated firm chooses the royalty in Stage I, it seeks to maximise the overall profits in Stage I and Stage II[2]. Thus, in order to solve the game we will apply the logic of backward induction: we start with Stage II and characterise the Cournot-Nash equilibrium of the duopoly game. Rationality and complete information dictate that both firms and the regulatory body will form their expectations by looking ahead and foreseeing the duopoly outcome. If agents behave this way, they are said to have rational expectations. In Stage I, relevant agents adopt their optimum, actions based on their rational expectations. The resultant outcome is the solution to the sequential game, which is called the perfect Nash equilibrium.

In order to derive the perfect Nash equilibrium, we need the following details:

Definition 1: The profit of the integrated firm (Π^m) is given as:

$$\Pi m = (A - w)q_n + (P(Q) - c - w)q_m \tag{1a}$$

where Q (= $q_m + q_n$) is the market output of the final product while q_m is the output of the integrated firm and q_n is the output of the non-integrated firm and A is the royalty for each unit of final output produced by the non-integrated firm, w is the cost of producing the essential input, c is the cost of producing the final good for both firms, and P(Q) is the inverse demand function.

Definition 2: The profit accruing to the non-integrated firm from the downstream market is:

$$\Pi n = (P(Q) - c - A)q_n \tag{1b}$$

Assumption 1: We assume the inverse demand function to be linear:

$$P(Q) = a - bQ \tag{1c}$$

Based on the above, we derive the Cournot-Nash equilibrium of the duopoly at Stage II.

Stage II: Cournot-Nash equilibrium of the duopoly in the downstream market

In Stage II, the integrated firm earns Π^{m1} from the sales of final product:

$$\Pi^{m1} = (P(Q) - c - w)q_m \tag{2a}$$

Substituting (1c) in (1a) and simplification would yield:

$$\Pi^{m1} = (a\text{-}c\text{-}w)q_m - bq_nq_m - bq_m^2 \tag{2b}$$

The Cournot-Nash equilibrium of the downstream market is given as:

$$\begin{aligned} q_n^* &= [(a - c - 2A + w)/(3b)],\ q_m^* = [(a - c + A - 2w)/(3b)], \\ Q^* &= [(2(a - c) - (A + w)]/(3b)], \\ P^* &= [(a + 2c + A + w)/(3)] \end{aligned} \tag{2c}$$

In an unregulated industry, the integrated firm fully controls the royalty A. It also has the full knowledge about the Cournot-Nash equilibrium of Stage II and expects the rival to respond by equation (2a). In Stage I, the integrated firm thus sets A to maximise (1) subject to the Cournot-Nash equilibrium of Stage II as given by equations (2a). This outcome is the perfect Nash equilibrium of the two-stage game.

Theorem 1: In the perfect Nash equilibrium of the proposed sequential game the optimal royalty, A^E, as set by the integrated firm in Stage I, is given by equation (2b). This optimal royalty, in turn, determines the equilibrium output response of the non-integrated firm, q_n^E, equilibrium output of the integrated firm, q_m^E, and the equilibrium market price, P^E, at Stage II as[3]:

$$\begin{aligned} P^E &= [(a + 2c + A^E + w)/3],\ A^E = [(a - c + w)/2],\ q_m^E = [(a - c - w + A^E)/(3b)], \\ q_n^E &= [(a\text{-}c\text{+}w\text{-}2A^E)/(3b)] \end{aligned} \tag{2d}$$

The optimum, A^E, is derived as:

$$\Pi^m = [\frac{(a - c - 2w + A)^2}{9b} + A\frac{(a - c + 3w)}{3b} - \frac{2}{3b}A^2 - \frac{w\,(a - c + w)}{3b}] \tag{2e}$$

The first order condition to maximise (2e) with respect to A yields:

$$A^E = \frac{(a - c + w)}{2} \tag{3a}$$

Theorem 2: In the perfect Nash equilibrium of the sequential game, the optimal royalty, A^E, of the integrated firm will drive the profit of the rival (non-integrated firm) to zero. Hence the non-integrated firm will leave the downstream market if the industry is unregulated.

Proof: Simple maximisation yields the result. QED.

In an unregulated and vertically-integrated industry, as captured by the above sequential game, the resulting equilibrium is one in which the integrated firm chooses A^E in Stage I to maximise its overall profits. At this pre-committed price A^E, the non-integrated rival will make zero profits and, hence, will quit the industry leaving the vertically integrated

firm to enjoy the monopoly profits. Thus, if the royalty for knowledge asset is not subject to regulation, such an industry will be characterised by significant market distortions. The integrated firm will have anti-competitive incentives and the ability to choose a royalty rate for the knowledge asset, which will eventually evict its rivals from the downstream sector. In order to protect the non-integrated firms, the regulator must therefore introduce caps on the royalty to avoid A^E. From the profit functions, it is evident that both the firms cannot simultaneously gain from an increase in the input price.

From these results we make the following remark: It is evident that

$$\text{for } A < A^E, \frac{\delta \Pi^m}{\delta A} > 0 \text{ and that for } A > A^E \frac{\delta \Pi^m}{\delta A} < 0$$

The above results show that the regulator must introduce restrictive measures in the upstream market to protect the non-integrated firm, otherwise the integrated firm can use its power in the upstream market to 'leverage'[4] into a position of power in the downstream market. It is interesting to note that the optimal royalty of the integrated firm may not be too high or too low: it is the price of knowledge asset that raises the cost and lowers the market share of the non-integrated firm in order to drive the non-integrated firm's profit to zero. At this optimal royalty the integrated firm maximises its profit and, hence, this anti-competitive behaviour appears as an equilibrium phenomenon. To prevent this equilibrium vertical foreclosure, it is necessary to regulate royalties in such markets.

Concluding comments

One of the major characteristics of SIDS is their isolated nature. More often than not, the transport network and communication networks in SIDS are poorly developed, maintained and managed. Poor long-term planning is partly responsible for this. It is of utmost importance that the fragmented nature of these nations and their linkage problems with the rest of the world must be redressed in order to lend economic and social stability in SIDS. The impact of geographical distance, in conjunction with high fuel costs, will further isolate these nations. These challenges are substantial and will determine the fate of these small and fragmented economies as the forces of globalisation take different turns with the energy price shocks of 2007–2008. There is increasing reliance by these nations, their economic advisors and also among experts from the United Nations, on the rapid development of ICT for establishing the requisite networks with the regional and global markets. In an ever-increasing appetite for economic progress these nations are gaining access to and implementing technologies to modernise their relevant sectors, which will also ensure reduced ecological footprints as the high-tech sectors are more energy efficient. Unfortunately, the global market for high-tech goods and services is dominated by a few firms and intellectual property rights are a major characteristic of these technology-intensive sectors. In this chapter, we have highlighted how intellectual property rights can pose a threat to sustainable economic development of SIDS and thereby compromise their ecological sustainability.

References

Boldrin, M. and Levine, D. (2002). 'The Case against Intellectual Property', *American Economic Review*, May, pp. 209–212.

Demestz, H. (1966). 'Some Aspects of Property Rights', *Journal of Law and Economics*, October, **9**, pp. 61–70.

Ordover, J.A., Saloner, G. and S. Salop (1990). 'Equilibrium Vertical Disclosure', *American Economic Review*, **80**, pp. 127–42.

Notes

1 In order to simplify the analysis we assume that there is a single non-integrated firm in the downstream market and, hence, this market is postulated to be a duopoly. The conclusions will extend to the case with a finite number of firms.

2 Profits accrue to the integrated firm from two sources: first, it receives profits from the sales of knowledge assets; secondly, it receives profits from the sales of the final product.

3 Here what we mean by an equilibrium is the perfect Nash equilibrium of the proposed sequential game.

4 This argument is similar in spirit to the equilibrium vertical foreclosure as propounded by Ordover, Saloner and Salop (1990) who consider a market in which supply of inputs is competitive. After the merger, the upstream division of the now-integrated firm refuses to supply necessary inputs to the rivals in the downstream market. Thus, the input-supply to the rivals is foreclosed which leads to increased input price as well as increased output prices. The integrated firms benefit from reduction in competition resulting in price hikes. Ordover, Saloner and Salop (1990) provided a coherent model to argue that anti-competitive foreclosure arises as an equilibrium phenomenon in a four-stage game.