



Information Technology Agreement of WTO: Call for a Revisit
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Executive summary

The Information Technology Agreement of WTO has been touted as a landmark agreement ever undertaken and a stepping stone to multilateralism through sectoral agreement route wherein developed and developing countries could work in a mutually beneficial manner. The basic premise of the agreement is that by liberalizing the trade in IT goods the members could harness the manifold benefits of ICT. Earlier studies have argued that ITA has been instrumental in augmenting the trade in IT products, facilitated faster diffusion of ICT and helped developing countries to participate in Global Production Network. Hence, a case has been made to expand the product coverage of ITA (called ITA-II) and the negotiations are on. Yet, majority of developing countries prefer to keep away from ITA. In this context, the present study analysed the outcomes of ITA in terms of its effect on trade in ITA goods, the country concentration therein and the trend in unit value indices. The major point of departure of the present study is that, while the previous studies were concerned only with the post ITA period, this study compared the performance during the post ITA period with the pre ITA period.

It is observed that, in contrast to the earlier findings, post ITA period witnessed a sharp deceleration in the exports and imports of ITA goods. The export growth for ITA goods was higher than merchandise exports during the pre ITA period. But during the post ITA period the recorded growth in the export of IT goods was lower than the merchandise leading to decline in the share of IT goods in merchandise exports. This tends to suggest that despite ITA the impact of exogenous shocks like Asian financial crisis, dotcom crisis and global financial crisis were more on IT goods as compared to merchandise exports in general. Hence the often made growth augmenting effect of ITA doesn't withstand to empirical verification.

While there is evidence to the effect that the share of Asia in global trade has increased significantly after ITA, once we keep away "the China factor", the emerging picture is not encouraging. There is hardly any empirical evidence of either incumbent in global production network (eg. Malaysia, Thailand, Indonesia) improving their position or the entry of new countries from Asia into the electronics production network.

Further, the study finds an increase in the 4-country concentration ratio in the export of ITA goods by about 15 per cent during the post ITA period in contrast to a decline in their share by about 10 per cent during the pre ITA period. Hence the present study makes the case for product level analysis to discern whether ITA has resulted in more competitive environment.

The preliminary evidence based on unit value indices, with all its limitations, suggests that ITA has enabled the MNCs, both from the west and the east, to behave like 'price makers'. During the pre ITA period, out of the seven product groups considered, rate of growth in the unit value index of only three was found positive and significant with others recording either negligible or negative growth rates. But during the post ITA period all the seven product groups, except one, recorded positive and statistically significant growth in prices. Here again the study underlines the need for more detailed analysis to explore whether ITA helped improving the affordability through price reduction or has it made the IT products dearer with its implications on ICT diffusion in developing countries.

On the whole, ITA seems to have not delivered what was expected of it. Therefore, the reasons for the hesitation of large number of developing countries to join it are not far to seek. To the extent that the ITA could not keep up its promises and perceived to be perilous to IT industry in countries like India, it is imperative for India to take a stand to revisit the outcomes of ITA-I before embarking on ITA-II.

The study attributes the 'ITA fiasco' to its scant attention to innovation and capacity building which is quintessential for promoting the production and use of ICT. In the context of frustration that resulted from ITA and given India's capabilities in ICT and commitment to developing countries, the study makes the case for an e-South Framework Agreement based on the twin foundations of trade liberalization and capacity building.

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Introduction

Considering the key role of Information Communication Technology (ICT) as a General Purpose Technology (GPT) in bringing about socio-economic transformation, there have been various initiatives by the Governments - both national and sub-national- the Multilateral Organizations and NGOs towards harnessing this technology for development. While there is hardly any country without an explicit ICT policy – indicative of national commitment to ICT- at the multilateral level the Information Technology Agreement (ITA) of WTO, initiated by the private sector, aimed at liberalizing trade in IT products as a means of promoting the use and production of IT products. Since the demand for IT products is known to be price elastic, ITA has been expected to enhance its access by reduced prices *inter alia* through getting rid of their tariffs (also other duties and charges) and heightened competition induced by trade liberalization. Given the link between trade and investment in assembly based industries like IT products, it was also expected to strengthen and widen the Global Production Network (GPN) in IT products with an increased participation by developing countries.

ITA, which came into force in 1997, required elimination of tariffs on goods coming under its ambit in maximal four stages until 2000. However, developing countries could opt for extending their staging until 2005¹. Participating countries are required to abide by the Most Favoured Nation (MFN) principle. Hence, the benefits of zero tariffs are

¹ The exact text of the ITA, including the product coverage, can be found at http://www.wto.org/english/tratop_e/inftec_e/inftec_e.htm

extended to those WTO members who did not sign the ITA without having to provide similar access to their own markets in return. Even today ITA is mainly a tariff reduction mechanism as the review of non-tariff barriers (NTBs) has not yet come to any definite conclusion. Moreover, while mass communication tools like radio and television could be important in addressing the information needs of the poor, such products are not covered by the ITA and the negotiations on expanding the product coverage have not been concluded. Though IT hardware without software are simply light emitting devices for unknown reasons software was not a part of the Agreement, despite software was included in the broad language of the ITA.

Products covered under the ITA are listed in two annexes to the Declaration, commonly referred to as attachments A and B. Attachment A is a positive list of items at the 6-digit Harmonized Schedule (HS) level, separated into two sections (A1 and A2). Attachment B includes product descriptions but not corresponding to HS code, whether or not they are included in Attachment A. The descriptive approach in the Attachment B list is designed to cover products regardless of specific HS codes and to address divergent national positions in coverage of complex, multifunction products (Dreyer and Hindley 2008).

By now ITA has been in existence for over 15 years. The moot question is on the extent to which the Agreement has been able to accomplish its objectives. This issue becomes important at least for two reasons. While the original signatories in 1997 were only 29, the total number of ITA member countries more than doubled to 74 in 2013. Yet, even today more than half of the 159 WTO members are out of ITA. Though the ITA is open to non-WTO members, so far hardly any of them have signed it. Hence it may not be without valid reason that the large majority of developing countries, despite being wedded to ICT, are not with ITA. Secondly, today there is a call for expanding the product coverage of ITA (so called ITA II) and countries are divided on this issue. Therefore, to understand the hesitation of countries to join ITA and reluctance of those joined to move towards ITA II, there is an express need for a systematic analysis of the outcomes of ITA. While the issue is of immense relevance for theory and policy, it has

not so far received the scholarly attention that it deserves. Nonetheless, there are a few studies that deserve attention.

The most notable study is WTO (2012) that examined the performance of ITA during the 15 years of its existence. Against the backdrop of a detailed discussion on the wide-ranging negotiations that culminated in ITA, and especially the role of private sector therein, the study observed that participants in ITA have significantly liberalized the trade by reducing both the bound and most favoured nation tariff. As a result, there has been a three-fold increase in the export of IT products since 1997 to reach a level of \$1.4 trillion in 2010 accounting for 9.5% of global merchandise exports. Further, in 2010 ITA participants accounted for 96% of global exports and 90% of global imports of IT products. Along with high export growth the study also observed that developing countries, lead by China, have consistently increased their participation in global trade in IT goods. The share of developing countries in exports more than doubled from 31% in 1996 to 64% in 2010. When it comes to imports the corresponding increase was from 27% to 51%. Since the demand for IT products is highly responsive to changes in income and price, the study attributed the increased diffusion and use of these products with the growth -price effects associated with opening up trade and reducing tariff. Moreover, it has been argued that ITA helped the expansion of GPN in IT goods with respective increase of trade in intermediate goods and the de-location of production that considerably increased trade flows between developed and developing countries.

Similar were the conclusions by Ezell (2012) who argued that the ITA has been one of the most successful trade agreements ever undertaken as it played an important role in expanding global trade in ICT products leading to innovation, enhanced productivity, increased employment, and accelerated economic growth. Hence the study made a case for the expansion of the product coverage under ITA as it would bring immediate and significant benefits to both ICT producers and consumers in the developed and developing world.

Anderson and Mohs (2010), on the basis of their analysis of the performance of IT trade during 12 years after the inception of ITA, highlighted the changing composition of trade by leading exporting and importing nations and the profiles of ITA trade by different product segments. The study observed that ITA, primarily the domain of developed countries at its inception, greatly helped expanding the number of developing countries participating and in turn enhanced the trade by these countries.

Studies also noted that ITA is beset with constitutional problems like the product average and the absence of a mechanism to rationally and constructively deal with classification concerns. Dreyer and Hindley (2010) observed that the fundamental problem in the ITA is its product coverage, especially the exclusion of some of the important consumer electronic goods. In the current context of technological convergence among ICT product this exclusion has the potential to progressively erode ITA coverage. Yet another related problem is based on a rigid positive listing of products that created problems with multifunctional goods. Further, NTBs in the ITA sector were not included in the ITA negotiation but remained a central problem to trade in technology goods. Hence, the study calls for a different approach to product coverage and incorporating provisions on NTBs.

While the findings of these studies are highly encouraging, their empirical base and the method of analysis certainly leave much scope for improvement. To begin, while a three fold increase in the trade in IT goods has been associated with ITA, one needs to reckon with the fact that association could not necessarily be construed as causation. Further, all these studies have dealt with the period since ITA by keeping in dark the developments prior to ITA. Hence, for an informed policy making, any analysis of performance of ITA and its attendant changes need to be seen in comparison with the trends observed during the pre ITA period. If a turnaround has been observed since ITA, the precise role that ITA played therein also needs to be located.

Moreover, while most of these studies have indicated that there has been a decline in the price of IT goods after ITA, there is hardly any empirical evidence other than anecdotal

illustration by taking select goods like computing equipment. WTO (2012) for example states “import price level of June 2011 for computers, peripherals and semiconductors to be around 65 per cent below the respective level of June 1996, while the average import prices for all commodities were 40 per cent above the level of 1996”. Though the reliable price data on different IT goods is difficult to obtain, the unit value index which could be derived from the trade data and often used in the trade literature, with all its limitations could be of some relevance to explore the issue empirically.

Hence, in what follows we shall empirically examine the following specific issues;

- (i) Has there been a turnaround in trade (export and import) since ITA as compared to the pre ITA period?
- (ii) Has the global trade in ITA goods become more competitive after ITA as compared to the pre ITA period with significant change in the role of developed vis a vis developing countries and strengthening of global production network by increased participation of developing countries?
- (iii) Has there been a significant increase in the affordability of IT goods resulting from a decline in price during the post-ITA period as compared to the pre-ITA period?

The remainder of this paper is organized as follows; the second section presents an analytical framework by critically examining the role of trade liberalization as a means of promoting production and diffusion of IT. The third section presents a brief discussion on the database made use of in the study. Empirical evidence on the core issues explored in the study are presented in section four followed by the last section that summarizes the major findings and presents a perspective for the future.

2. Trade, an engine or lubricant for growth? Towards an analytical framework

Given the generality of purpose and innovational complementarities, ICT qualifies itself as yet another GPT². On comparing ICT with earlier GPTs, David (1990, 1991) found remarkable parallels in terms of their contribution towards augmenting economic growth

²For a detailed discussion on General Purpose Technology, see Bresnahan and Trajtenberg (1995) who coined this term.

and human welfare. In general, it has been argued that ICTs are key inputs for competitiveness, economic growth and development. It offers opportunity for global integration, increasing economic and social well being of the poor and enhances the effectiveness, efficiency and transparency of the public sector, including the delivery of public services (World Bank, 2002). Thus viewed, there is hardly any field of human activity wherein ICT could not have its profound influence *inter alia* by revolutionizing the process of information exchange and thereby reducing the transaction cost (Joseph 2007). Hence to appreciate the economic rationale for ITA there is the need for a precise understanding of the contribution of ICT towards development and welfare and the role of trade liberalization as manifested in ITA in accomplishing this.

The contribution of a general purpose technology like ICT, could be understood in terms of its *use* and *production*. While the former refers to ICT diffusion induced development through enhanced productivity, competitiveness, growth and human welfare the latter is on account of its contribution in output, employment, export earnings from the production of ICT related goods and services (Kraemer and Dedrick 2001).

Returns to Production of ICT Goods and services

Ezel (2012) has shown that ICT industry accounted for six per cent of global GDP in 2010 and the global value-added by ICT industries more than doubled from \$1.2 trillion in 1995 to \$2.8 trillion in 2010. ICT industries also account for a notable share in employment. For example, in 2010, ICT industries employed 5.8 per cent of workers in OECD economies, a 13 per cent increase since 1995.

Studies have also shown that in the US, wherein the macroeconomic benefits of ICT revolution are apparent, ICT industries accounted for about 8.3 per cent of the GDP and nearly a third of GDP growth between 1995 and 1999 (US Department of Commerce 2000). ICT production also contributed to lower inflation since a growing proportion of economic output has been in sectors marked by rapidly falling prices (US Department of

Commerce 2000)³. Recent evidence suggests that ICT was responsible for 75 per cent of US productivity growth from 1995 to 2002, and 44 per cent from 2000 to 2006 (Brynjolfsson and Adam Saunders 2010). According to Japan's Ministry of Internal Affairs and Communications, Japan's ICT industry contributed 34 per cent of the country's economic growth from 2005 to 2010 (quoted in Ezel 2012).

Developed countries are not the only beneficiaries from the production of IT goods. Production of IT goods has been a major source of economic output, exports and job creation even in developing countries like South Korea, Singapore, Thailand, Malaysia and others. This has been facilitated by their participation in global production network of IT goods which has a longer history than ITA.

However, it has been argued that production of IT goods need not necessarily be an easy proposition for the developing countries because industrial structure of IT goods is highly concentrated with high entry barriers. Industry segments like microprocessors are almost closed because standards are set by the leading US based IT players like Intel. Most of the segments of IT industry are highly capital intensive and scale intensive and require specialized skills that only a few countries can hope to achieve (Kraemer and Dedrick 2001). Moreover, early entrants such as Singapore, Hong Kong, South Korea, Taiwan, Ireland and Israel have preempted many of these opportunities to a great extent.

While there is some merit in the above argument, a closer look at the characteristics of IT industry would reveal that the doors are not that firmly closed for the new comers. IT industry is a multi-product industry and the products may be broadly divided into two categories; IT goods and IT services⁴. In each of these broad categories there are a large number of products that vary in terms of technological intensity, dynamism, investment and skill requirements (Joseph 1997). This has made possible the segmentation of the

³The report argues that actual inflation fell by 0.5 per cent points a year from 1994 to 1998 due the effect of declining prices of IT goods. Also IT industry, including telecommunications, employed 7.4 million workers in 1998 and this accounted for 6.1 per cent of the total employment with an annual wage rate more than 1.5 times that for all private employees.

⁴ See Joseph (1997) for a detailed analysis of the product structure of electronics industry and the implication of product structure for the growth performance.

industry into separate, yet closely interacting horizontal layers with greater opportunities for outsourcing and thus transforming a vertically integrated industry into horizontally disintegrated but closely interacting market segments. Moreover, as argued by Ernst (2002) under global production network that characterize IT goods production today, geographical dispersion becomes more concentrated in case of high precision design intensive goods whereas in case of lower end products there is high regional dispersion. Therefore, it is possible that the new comers in developing world could enter profitably into some of these product lines depending on their technological capability, human capital availability and the ability to mobilize capital. What is more, in the near future, the demand for ICT goods and services is likely to increase as the rate of ICT diffusion increases both in the developing and developed countries.

When it comes to IT services, economists have long since noted that the services in general are cheaper in developing countries as compared to the developed countries⁵. Yet, these countries have been unable to take benefit of this advantage mainly because the export of most of the services called for the cross border movement of labour. But the movement of labour, unlike capital, was subjected to series of restrictions. Though the process of globalization, which *inter alia* implied the free movement of products and factors, achieved momentum during the last two decades, there have been hardly any relaxations in the restrictions on labour mobility. However, the advances in ICT has made possible, to a great extent, the “splintering off” of many of the services from its providers which in turn led to what is often called global division of labour and the outsourcing of services.

No wonder, as noted by a number studies India, with its large pool of skilled manpower along with supporting policy environment and proactive private sector, has emerged as a preferred location in the international division of labor in knowledge intensive industries as well as in Business Process Outsourcing (BPO) and a leading player in the export of

⁵This has been attributed mainly to the fact that labour is the major input in the production of services and the abundant supply of labour in less developed countries translate into low wages. Since the technology of producing services does not differ significantly across countries, lower wages results in low cost of production of services in less developed countries (Bhagwati 1984).

software services (Heeks 1996, Joseph 2002, Kumar and Joseph 2005, Joseph 2012 among others). India is not the only country being benefited from opportunities offered by BPOs. Countries like China, Philippines and others are also emerging as providers of BPO services to the developed countries.

Returns to ICT Use

While there were apprehensions about the return to productivity enhancement on account of ICT use, the evidence from the recent cross-country studies shows that the returns to investments in ICT in terms of productivity and growth are substantial⁶. Pohjola (2001) found the output elasticity of ICT capital as high as 0.31 for the full sample of 39 countries and 0.23 in the OECD sub sample. Another cross-country study by IMF (2001) also has similar conclusions to offer. Country specific studies like the one for Singapore (Wong 2001) finds that the net return to ICT capital (37.9 per cent) is about two and a half times higher than that for non-ICT capital (14.6 per cent). These studies also show that ICT induced productivity and growth still remains a phenomenon of developed OECD countries and that the developing countries are yet to catch up.

However, there are also numerous cases to show that developing countries could benefit from increased access to IT as much as their counterparts in the developed world to address various development issues like empowering people, improving social service provision and poverty alleviation.

In the literature on IT and development, the focus of attention has been essentially on IT use and only limited attempts have been made towards integrating the policy towards electronics production and diffusion of IT. As argued by Mytelka and Ohiorhenuan (2000) the often suggested strategies place the developing countries in a situation of perpetual *attente* – waiting for the transfers of technology from the North and focusing their attention on the need to attract transnational corporations to their shore. The studies on technology diffusion, however, have shown that along with demand side factors, supply side factors are also important determinants of diffusion. Hence, greater domestic

⁶ For a review of studies the readers are referred to Indjikian and Siegel (2005)

availability of electronics goods acts as a catalyst in the process of diffusion. To the extent that the present levels of income are important determinants of IT use, there is no reason why the developing countries should forgo the income earning opportunities offered by the production of IT goods which could also be instrumental in their industrial transformation. If the available empirical evidence on technological capability in the developing world is any indication, the lopsided approach in terms of promoting IT use while neglecting IT production capabilities, has the potential danger of perpetuating technological dependence on the one hand and foregoing opportunities for income and employment generation on the other (UNCTAD 2012; Joseph and Parayil 2008).

Promoting production and use of IT: Role of trade and investment

The key issue of relevance here pertains to the factors that help developing countries to leapfrog in the field of information technology by promoting its production and use and the bearing of trade and investment therein.

The virtues of trade liberalization, the underlying economic rationale for the ITA, resulting from the removal of tariff and non-tariff barriers have been well articulated in the literature (Dornbusch 1992, Kruger 1997, Srinivasan and Bhagwati 1999). With the removal of tariff barriers, there will be a corresponding reduction in the price of imported goods. The removal of non-tariff barriers could also lead to enhanced supply and increased access to imported goods and services. The implications of the reduction in price and increased access may vary from country to country and also between sectors within an economy. Yet, in the case of a developing country the following generalizations may be in order. The decline in domestic prices is likely to make the goods and services more affordable and therefore could act as a catalyst in the process of diffusion/use of IT into other sectors of the economy. If the available empirical evidence is any indication, the increased use/diffusion of IT could help in increasing the efficiency, productivity and competitiveness of the IT using sectors. The resultant higher output growth could lead to higher income and employment generation in the domestic economy as a whole. This impact is likely to be strong in the case of less developed countries

wherein the affordability, on account of low per capita income and higher price, is a major constraint in promoting IT use.

Second effect refers to the impact on domestic IT producing sector on account of increased competition and greater access to needed inputs for production that in turn underscore the link between trade and investment. Increased competition, apart from inducing firms to cut cost of production, leads to the exit of inefficient firms and the absorption of their market share by more efficient ones leading to economies of scale and industry level efficiency.

The link between trade and investment, however, is conditioned by the product characteristics and organization of production. This link is likely to be stronger in assembly-oriented industries as compared to process industries. In an assembly-oriented industry like IT goods, production essentially involves assembling a number of components and sub assemblies based on a design. The production of needed components and subassemblies may be highly skill, capital and/or scale intensive that no country could afford to have the capacity to produce all the needed components and other accessories. Hence there is the need for rationalizing their production across different locations. This is what led to the global production networks (Ernst and Kim 2002) and the international division of labour in IT production. Thus in the global production network, production of each of the component or sub assembly is made across different countries according to their comparative advantage such that the overall cost of production is minimized. This essentially means that the production in any country will call for significant imports and bulk of the output will have to be exported to other countries rather than sold in the domestic market. Hence if the production, and therefore investment, in IT is to take place in any country the trade regime needs to be the one wherein the free flow of inputs into and outputs out of the economy is ensured. Thus viewed, there is an inexorable link between trade and investment, which is apparently much stronger in IT goods as compared to most other industries.

Limits to Trade liberalization

While the theoretical case for trade and investment liberalization is elegant, when it comes to the experience of developing countries that resorted to trade liberalization as a short cut to prosperity we have a mixed picture. Here it may be apt to quote Stiglitz

“Globalization itself is neither good nor bad. It has the power to do enormous good, and for the countries of East Asia who have embraced globalization under their own terms, at their own pace, it has been an enormous benefit.....But in much of the world it has not brought comparable benefits. For many it seems closer to an unmitigated disaster” (Stiglitz 2002 p.20).

After analyzing the trade reform policies in developing countries Rodrik (1992) convincingly concludes that

“trade policy plays a rather asymmetric role in development: an abysmal trade regime can perhaps drive a country into economic ruin; but good trade policy alone cannot make a poor country rich” (p 103).

Trade policy, at best, provides an enabling environment for development. Perhaps most emphatic was Arthur Lewis who stated as early as in 1978. To quote

“the engine of growth should be technological change with international trade serving as lubricating oil and not as fuel”. He continued “...international trade cannot substitute for technological change, so those who depend on it as their major hope are doomed to frustration” (Lewis 1978; p 74).

In case of IT production, the link between trade and investment notwithstanding, it has been shown that local capabilities are critical for attracting investment and promoting production and trade. In a context wherein low labour cost is taken for granted by the MNCs, the ability of the developing countries to participate in global production network is governed by their ability to provide certain specialized capabilities that the MNCs need in order to complement their own core competence (Lall 2001, Ernst and Lundvall 2000). Countries that cannot provide such capabilities are kept out of the circuit of international production network despite their liberal trade regime. Also as argued by Cantwell (1995), Dunning (1996), Makino et al (2002) and Pearce (1999) the MNCs have been following the knowledge-based asset-seeking strategies along with natural resource-seeking, market-seeking and efficiency-seeking strategies to reinforce their competitive strengths.

More importantly to get rid of the risk of getting locked up at the low end of the value chain and to facilitate movement along the continuum of Original Equipment Manufacturer (OEM) to Original Brand Manufacturer (OBM) and finally to Original Design Manufacturer (ODM) (Hobday 1994) there is the need for building up an innovation system while resorting to a liberal trade and investment regime. In a similar vein, along with numerous studies, a survey by Saggi (2002) concludes that the absorptive capacity of the host country is crucial for obtaining significant benefits from FDI. Without adequate human capital or investment in R&D, spillovers from FDI are infeasible.

When it comes to IT use, lower prices resulting from trade liberalization need not necessarily promote IT demand and its diffusion unless the developing countries have the capability to use it. Hence trade liberalization has to be accompanied by capacity building such that needed local content is developed and capabilities are created to facilitate its effective use. This calls for complementing the liberalized trade and FDI policies with appropriate policy measures and institutional interventions with respect to education, R&D and human capital such that learning capabilities are enhanced in all parts of the economy – the central concern of studies on innovation system.

In the similar vein, The World Bank (2000) underlined the role of following factors; an educated and skilled population that can create and use knowledge, a dynamic national Information Infrastructure (NII) that consists of telecommunication networks, strategic information systems and the policy and legal frameworks affecting their deployment, an interlinked system of research centers, universities, firms and other organizations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs and create new knowledge. All these can be grouped into what is now referred to in the literature as an innovation system.

Drawing from the above discussion it may be inferred the liberalized trade could at best be construed as a necessary condition for promoting IT production and use and the necessary condition being a vibrant innovation system at the national, regional and the sectoral level.

3. On the data base

As acknowledged by the earlier studies, since ITA covers a large number products there are serious issues with the definition of IT goods as well as their classification into different subgroups. For example, on account of technological changes, the distinction between the traditionally considered categories like electronic consumer goods and the electronic capital goods like computers and communication equipment is increasingly getting blurred. To complicate the issue further, COMTRADE, the only data base at the country level trade in IT goods, has undergone nomenclature revisions in 2002 and more significantly in 2007, complicating the construction of a consistent times series for ITA product trade. Quantifying trade in Attachment B products is additionally challenging because most countries provided their own list of tariff codes, usually at the national line level (i.e. the 8- or 10-digit level), where these products may be classified, and some countries have not provided a list. Here it needs to be noted that most of the previous studies have made use of HS 1996 as they dealt only with the post ITA period. While HS 1992 provides data from 1988 to 2011 data from HS 1996 refers to 1997-2011 only. Thus for the period since 1997 we have two series of data one by HS 1992 and the other by HS 1996. To make our analysis comparable to that of previous studies, we make use of HS 1996 and HS 1992 for the post ITA period while the analysis of pre ITA period is based on HS 1992. However, it needs to be noted that on account of the differences in HS definition of IT goods, trade data with HS 1996 is not strictly comparable to HS 1992. As is evident from table 1, total exports and imports are lower as per HS1992 when compared to HS 1996.

To illustrate, as per HS 1992, the total export of ITA products by the member countries in 1988 amounted to \$ 35.6 billion and by 1996 it recorded more than eight fold increase to reach \$ 277.5 billion and further increased to \$ 930.8 billion (over three fold increase) by 2011. This turns out to be an under estimate when compared to HS 1996. According to HS 1996 total exports in 1997 was as high as \$456.5 billion which increased to \$ 1540.5 billion in 2011 (around threefold increase same as that we have seen with respect to HS 1992). Thus, HS 1992 and HS 1996 vary in terms of level the growth rate observed

appears to be comparable regardless of HS 1992 or HS 1996. Here it is important to note that the data that we have recorded using HS 1996 are in tune with the data compiled by and made use of in WTO (2012). In the analysis that follows we shall make use of both of these datasets to present a comparative picture between the pre and post ITA periods. To the extent that ITA member countries accounts for more than 95% of global trade in IT goods, in our analysis we focus only on the ITA member countries.

Table 1: Trend in global trade in ITA goods as per HS 1992 and HS 1996 – All countries (in US \$ in Billion)

Year	HS 1992		HS 1996	
	Export	Import	Export	Import
1988	35.59	22.97		
1989	52.34	45.68		
1990	61.44	57.22		
1991	97.71	88.86		
1992	121.97	114.40		
1993	153.12	147.64		
1994	204.41	204.65		
1995	265.74	269.49		
1996	277.48	287.55	456.48	482.26
1997	308.43	320.92	594.53	606.96
1998	320.20	336.38	602.49	631.51
1999	362.73	382.35	693.86	727.76
2000	466.42	484.57	886.59	923.7
2001	413.21	436.90	769.92	813.32
2002	429.56	453.07	775.82	810.53
2003	485.47	515.13	881.51	929.14
2004	599.85	637.79	1075.69	1147.35
2005	695.00	721.44	1204.68	1290.18
2006	812.90	827.85	1380.31	1463.27
2007	816.83	891.74	1340.23	1463.79
2008	849.93	937.12	1374.33	1510.06
2009	714.33	796.60	1178.52	1295.7
2010	882.01	1014.19	1450.65	1645.82
2011	930.82	1062.53	1540.49	1750.26

Source: compiled from Comtrade

4. Empirical results

Tariff reduction, exports and imports

As already noted, ITA quintessentially is a tariff cutting mechanism and the estimates showed that simple average tariffs over all ITA products before the Agreement was 3.6 per cent for ITA members, compared to 11.2 per cent for non-members. According to the WTO, average bound tariff rates for ITA products for developed countries were reduced from 4.9 per cent to zero per cent (WTO 2008). Their initial rates ranged from one per cent to 12.1 per cent, as compared to 1.2 per cent to 66.4 per cent for developing countries. Since the developing countries had considerably higher bound rates before the Agreement, several developing countries implemented significant tariff liberalization to achieve duty free trade under the ITA. The largest concessions based on pre-ITA bound rates, had to be made by India (66.4 per cent) followed by Thailand (30.9 per cent) and Turkey (24.9 per cent). Similarly, for applied tariff rates, developing countries' pre-ITA tariffs were generally higher than the average 2.7 per cent for developed countries. Notable average applied-tariff reductions for developing countries included those of India (from 36.3 per cent) China (from 12.7 per cent) and Egypt (from 12.1 per cent) (Mann and Liu 2007).

While analyzing the trend in export and imports during the post ITA period in comparison with the pre ITA period an issue of concern might be the low base during the pre ITA period. With a view to address this issue we have estimated the trend (log) growth rates along with the annual growth rates. Table 2 presents the annual growth rates as well as the trend (log) growth rates in the exports for the two sub periods - pre ITA (1988-1996) and post ITA (1997-2011). Let us begin by analyzing the trend growth in total exports. As per HS 1992 the recorded trend growth rate in total export of IT goods during the pre-ITA period was 30 per cent. When it comes to post ITA period, the recorded growth rate in total exports using HS 1992 declined to 8.4 per cent which is found comparable to the recorded trend growth rates (7%) using HS 1996. Thus it is evident that post ITA period was marked by a deceleration in exports. The observed deceleration in exports since 1997 despite ITA also needs to be seen in the context of

Asian financial crisis of late 1990s, dotcom crisis of early 1990s and the global financial crisis since 2007.

It is interesting to note that during pre ITA period exports of all the product groups were growing in a balanced manner without much variation across different product groups in terms of the recorded trend growth rates. With plausible exception of ITA 6 (data storage media and software) with 20 per cent growth rate, all the other products have recorded trend growth rates above 25 per cent during the pre ITA period. When it comes to post-ITA period, we get a different picture regardless of the data (HS 1992 or HS1996) set that we use. Let us

Table 2: Trend growth rates and annual growth rates in the export of different IT goods

Year/Period		Annual average growth rates							Total
		ITA1	ITA2	ITA3	ITA4	ITA5	ITA6	ITA7	
HS1992	1989	43.56	71.24	75.22	114.47	36.44	12.46	66.88	61.35
	1990	-9.31	11.56	14.55	71.48	7.73	15.53	18.37	16.16
	1991	111.30	79.45	60.26	50.34	170.18	88.10	106.96	96.26
	1992	23.25	30.47	10.53	10.20	13.58	19.94	26.52	22.33
	1993	38.00	42.85	31.15	8.07	17.03	11.94	25.79	26.28
	1994	10.56	51.63	38.90	33.96	27.77	10.71	32.93	33.47
	1995	-0.18	37.97	42.55	62.62	19.57	11.63	25.80	28.67
	1996	62.29	6.62	-3.25	9.56	6.21	8.83	5.99	4.58
	Trend GR Pre ITA	26.1 (10.99)*	34.4 (21.41)*	27.4 (16.04)*	31.0 (9.57)*	28.8 (9.08)*	20.3 (8.97)*	31.3 (12.81)*	29.9 (13.99)*
HS1996	1998	-0.88	18.17	-3.40	-9.52	-0.70	-0.70	2.23	0.91
	1999	7.47	23.21	20.08	31.01	5.93	5.32	18.93	16.13
	2000	10.56	34.04	39.64	79.13	9.11	-7.87	29.81	27.48
	2001	-6.88	-6.46	-22.30	-32.96	7.59	-11.41	-12.49	-13.59
	2002	-0.86	5.11	6.91	-6.41	-1.73	-4.12	-2.94	1.15
	2003	18.09	6.86	16.17	8.95	14.78	14.08	12.28	14.02
	2004	21.39	31.10	18.80	78.44	16.57	14.02	21.78	22.28
	2005	11.90	27.12	6.22	-3.05	10.38	17.44	12.47	12.20
	2006	10.48	23.26	14.13	26.75	13.42	5.03	13.92	14.55
	2007	1.85	-4.08	8.92	-56.00	11.96	1.61	-13.88	-2.67
	2008	1.23	6.53	-2.28	-16.38	10.35	-2.35	5.27	2.11
	2009	-15.06	-12.21	-10.21	-46.55	-12.94	-14.11	-19.04	-14.42
2010	20.90	14.66	32.41	96.62	16.02	0.04	20.74	23.08	
2011	6.83	18.54	2.35	15.10	17.58	4.15	2.41	6.29	

	Trend GR Post ITA	6.2 (10.07)*	11.3 (13.19)*	7.8 (11.92)*	0.4 (0.13)^{ns}	8.3 (18.65)*	2.1 (2.86)**	5.4 (6.37)*	7.0 (10.52)*
	Trend GR HS92 Post ITA	-18.0 (-6.56)*	10.6 (6.60)*	11.3 (15.35)*	10.0 (6.92)*	8.2 (17.65)*	7.8 (6.30)*	6.8 (10.69)*	8.4 (12.22)*

Note: ITA -1: Computers and calculating machines; ITA-2: Telecommunication equipment; ITA-3: Semiconductors; ITA-4: Semiconductor manufacturing equipment; ITA-5: Instrument and apparatus
ITA-6: data storage media and software; ITA-7: Parts and accessories

*, ** - Growth rates are statistically significant at 1 per cent and 5 per cent levels respectively
ns: statistically not significant

Figures in parenthesis indicate corresponding t-values

Pre-ITA period: 1988 – 1996; Post-ITA period: 1997-2011

begin with HS 1996 database. As per this data during post 1997, along with a lower growth rate in total exports (7.0%) there has been wide variation in the recorded growth rate across different product groups that ranged from 0.4 per cent in the case of ITA 4 semiconductor manufacturing equipment (ITA4) to as high as 11.3 per cent in the case of Telecommunication equipment (ITA2). When it comes to growth rates in different product categories based on HS 1992 the observed growth rates ranged from -18 per cent in case of Computers and calculating machines (ITA1) to 11.3 per cent in case of semiconductors (ITA3) product group.

Further interesting observations could be made from the annual growth rates presented in the table. During the pre ITA period there was hardly any year in which recorded growth rate in total export was negative indicating a more stable growth pattern. The stability in growth was confined not only with respect to total exports but also in different product categories. During the pre ITA period, out of the seven product groups, negative growth rate was observed only in the case of ITA-1 (Computers and calculating machines) and that too was confined to only two years (1990 and 1995)

The picture changes in its entirety as we move to the post ITA period as the recorded growth of total exports was negative in three years with the negative growth rates in 2001 and 2009 being as high as -13.6 and -14.4 respectively. Further, it is also evident that there has been only six years during the post ITA period wherein no product groups recorded negative growth rate. It appears that while pre ITA period was characterized by

more stable export performance, it became more volatile during the post ITA period which could be attributed to different external shocks as indicated above. A definite conclusion is not warranted without more systematic analysis.

From the above discussion it could be inferred that regardless of the HS classification used, there has not been any marked increase in growth of ITA goods exports during the post ITA period as compared to the pre ITA period. Instead, there has been drastic decline in export growth during the post-ITA period. This has not attracted the attention of previous studies because of their exclusive concern with the post ITA period. This in turn has led these studies to infer that ITA has been associated with high export performance. Our analysis of growth during the post ITA period in comparison with the pre ITA period tend to suggest that there is hardly any empirical evidence for the growth augmenting effect of ITA highlighted by the earlier studies.

Trend in imports

In analyzing the growth in imports we have followed the same method as in case of exports. The results of the estimated trend (log) growth rates for the two sub-periods as well as the annual growth rates are reported in table 3.

The broad pattern that emerges from the table is in tune with what we have observed in case of exports. As per the trend growth rates in total imports based on HS1992, we find a drastic decline in growth rates from over 35 per cent during to pre ITA period to 8.8 per cent during the post ITA period. The extent of decline in growth rates higher as per HS 1996 as the estimated growth rate is only 7.4 per cent. Thus the deceleration in growth stands regardless of the database used.

As in case of exports, the estimated annual growth rates in different product groups tends to suggest that the variability in growth across different product groups increased during the post ITA period as compared to the pre ITA period. To be more specific during the pre ITA period, while total exports recorded a growth rate of 35 per cent per annum, the highest growth was in case of communication equipment (47.6) and the lowest being

25.6% in case of computers. When it comes to the post ITA period, the growth rates in imports declined to 7.4 percent (as per HS 1996) with highest growth in case of semiconductors (9.7) and the lowest was in case of semiconductor manufacturing equipment (1.1%). in per cent. The variability in the imports growth across different product groups increases if we look at the growth rates based on HS 1992. The table also suggests that growth pattern became more unstable during the post ITA period as compared to the pre ITA period. Yet the import behavior in general has been more stable as compared to exports. We have seen that during the post ITA period exports recorded negative growth rates in three years where as in imports only two years recorded negative growth rates.

Table 3: Trend growth rates and annual growth rates in the import of different IT goods

HS classification	Year	ITA -1	ITA -2	ITA -3	ITA -4	ITA -5	ITA -6	ITA -7	All products
HS1992	1989	40.89	211.72	122.21	89.69	96.60	184.82	162.38	145.24
	1990	-3.82	34.05	27.35	35.21	12.33	16.50	21.31	22.14
	1991	115.88	159.75	58.45	145.49	95.07	143.00	107.87	97.84
	1992	19.27	31.91	21.33	19.16	18.73	24.60	29.02	26.48
	1993	18.04	61.67	31.49	1.72	15.77	25.12	27.51	29.09
	1994	19.23	46.47	41.85	56.72	36.72	17.00	38.77	38.53
	1995	14.62	37.56	42.49	49.33	18.98	12.00	29.26	31.16
	1996	41.08	1.53	2.32	21.45	4.89	6.82	6.67	5.40
	Trend GR	25.6 (12.18)*	47.6 (10.57)*	32.3 (13.56)*	37.3 (12.28)*	28.2 (10.29)*	33.6 (6.85)*	36.3 (10.24)*	35.1 (10.10)*
HS1996	1998	4.56	14.13	-3.59	-7.47	-2.06	0.89	7.63	3.55
	1999	11.46	30.22	21.24	32.98	8.00	5.27	16.93	17.24
	2000	10.47	39.32	42.88	66.50	13.98	-10.17	25.29	26.62
	2001	-8.96	-4.63	-20.18	-23.63	5.68	-9.70	-11.54	-12.62
	2002	0.27	-0.97	7.83	-20.11	-0.75	-2.66	-4.31	0.51
	2003	13.02	12.32	18.14	15.39	11.57	15.39	13.64	14.68
	2004	17.22	32.31	25.03	60.61	17.59	19.08	21.57	22.99
	2005	8.92	22.90	9.78	3.33	8.55	21.60	12.52	12.07
	2006	6.48	14.20	15.41	29.50	12.82	11.17	13.99	12.87
	2007	-5.20	10.27	10.98	-49.28	8.35	0.24	-9.34	0.58
	2008	2.02	6.81	-0.95	-13.55	9.67	-3.06	1.17	1.44
	2009	-15.27	-9.63	-11.42	-50.72	-14.11	-8.37	-18.18	-13.89
	2010	24.08	20.01	35.30	101.12	18.23	5.28	22.22	26.56
	2011	10.74	19.26	2.09	19.94	16.05	8.39	-0.65	6.20
Trend GR Post ITA	4.6 (8.56)*	12.5 (16.63)*	9.7 (13.76)*	1.1 (0.47) ^{ns}	7.8 (19.20)*	4.3 (5.16)*	5.5 (6.68)*	7.4 (11.59)*	

	Post ITA HS1992	-15.9 (-6.486)*	13.3 (10.295)*	11.2 (18.458)*	9.7 (7.056)*	7.6 (17.879)	9.5 (9.396)*	6.9 (11.092)*	8.8 (14.872)*
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Note: ITA -1: Computers and calculating machines; ITA-2: Telecommunication equipment; ITA-3: Semiconductors; ITA-4: Semiconductor manufacturing equipment; ITA-5: Instrument and apparatus
ITA-6: data storage media and software; ITA-7: Parts and accessories

The first period (pre – ITA) data is based on UN-Comtrade classification (H0) HS1992, and the second period (post ITA) data is based on classification HS1996 (H1).

*, ** - Growth rates are statistically significant at 1 per cent and 5 per cent levels respectively

ns: statistically not significant

Figures in parenthesis indicate corresponding t-values

Pre-ITA period: 1988 – 1996; Post-ITA period: 1997-2011

IT exports in global merchandise

Given the decelerating trend in IT trade it may be of interest to situate the exports of IT goods in against the global merchandise export. Such an exercise assumes importance because, the observed deceleration in trade (exports and imports) could be attributed to various exogenous shocks like the Asian financial crisis, dotcom crisis and the global financial crisis that coincided with the post ITA period. It could be argued that these exogenous shocks would have affected the global merchandise in general and because of ITA its impact on IT trade would have been lower. This in turn would have led to an increase in the share of IT goods in merchandise exports.

Hailing the performance of IT trade under the Agreement, WTO (2012) has shown that world exports of IT products almost tripled in value between 1996 and 2010. Further with an annual average growth rate of 7 per cent over this period, global exports of IT products reached US\$ 1.4 trillion in 2010, becoming one of the most important product categories in world trade. Exports of IT products accounted for 9.5 per cent of global merchandise exports in 2010, exceeding the share of both agricultural (9.2 per cent) and automotive products (7.4 per cent).

Our analysis of the growth of IT exports by the ITA countries while confirming the above findings observed the picture presented by WTO (2012) is at best partial. The estimated growth rates in the export of IT goods and merchandise exports tend to suggest that the former was higher during the pre ITA period. But when it comes to the post ITA period, recorded growth in the exports of ITA goods was lower than the merchandise exports

(see table 4). As a result, as per HS1992 the share of IT products in merchandise exports showed a steadily increasing trend up to 2000 and declined thereafter. The declining trend after 2000 is confirmed by the data based on HS 1996 as well. To be more specific the share of IT products in global merchandise increased from 10 per cent in 1996 to over 14 per cent in 2000 and thereafter declined to 8.8 per cent in 2011 which is lower than the 1996 level (10.1%). In general, despite ITA, export performance of IT goods could not keep pace with global merchandise trade.

Table 4: Share of ITA exports by ITA countries in global merchandise exports

Year	Global Merchandise Export (Billion US\$)		IT exports (Billion US\$)		Share of IT (%)	
	HS1992	HS1996	HS1992	HS1996	HS1992	HS1996
1988	785.24		26.35		3.36	
1989	1200.87		42.51		3.54	
1990	1378.18		49.38		3.58	
1991	1917.71		96.91		5.05	
1992	2457.66		118.56		4.82	
1993	2832.13		149.72		5.29	
1994	3758.70		199.83		5.32	
1995	4683.01		257.12		5.49	
1996	4997.00	4353.28	268.88	441.16	5.38	10.13
1997	5180.40	4921.23	297.76	574.83	5.75	11.68
1998	5156.75	4969.24	308.21	580.05	5.98	11.67
1999	5347.40	5261.46	352.06	673.59	6.58	12.80
2000	6113.09	6044.79	450.43	858.66	7.37	14.20
2001	5912.29	5867.94	398.61	742.00	6.74	12.64
2002	6217.16	6191.21	417.17	750.57	6.71	12.12
2003	7267.52	7239.33	472.57	855.81	6.50	11.82
2004	8818.74	8780.21	584.70	1046.45	6.63	11.92
2005	9951.21	9939.45	676.85	1174.16	6.80	11.81
2006	11621.74	11606.82	789.90	1345.05	6.80	11.59
2007	13261.27	13243.35	796.21	1309.14	6.00	9.89
2008	15341.98	15340.23	822.67	1336.74	5.36	8.71
2009	11943.43	11943.43	690.57	1143.98	5.78	9.58
2010	14495.03	14495.03	855.77	1408.04	5.90	9.71
2011	16963.48	16963.48	906.77	1496.65	5.35	8.82

Source: Estimated based on Comtrade data

Developing Asian countries and global production network

It has been argued that the liberalized trade regime under ITA has been instrumental in widening the scope of global production network that characterized electronics production which in turn has been beneficial to the developing countries in general and Asian countries in particular.

GPN is not a new phenomenon and many scholars have already studied the participation of South East Asian countries in electronics GPN which has a longer history. Based on a detailed analysis of the electronics industries in South East Asia, Ernst (2001) argued that export-oriented production can no longer guarantee sustained growth and welfare improvement on account of sticky specialization of exportable 'commodities'. Moreover, a narrow domestic knowledge base has been leading to limited industrial upgrading and limited backward and forward linkages. Evidence also suggests that IT induced prosperity in general and electronics production in particular has been confined to few locations leading to an enclave type development and contributing towards widening regional and personal inequalities (Joseph 2006).

It has also been argued that most of these countries have specialized in the mass production of a few products mainly for the export market. This has led to a kind of sticky specialization with limited backward and forward linkages especially for materials and production equipment that gave rise to very high level of import dependence and limited value addition. In the case of Thailand, Mephokee (2003) noted that Thai IT firms play a small subcontracting role by supplying minor components for foreign firms in the IT industry. There are four main reasons for the firms to import these components from foreign suppliers: First, the production technology belongs to foreign parent companies. Secondly, there are no domestic components because the production technology is not available in Thailand. Thirdly, the quality of domestic components cannot meet the foreign company's requirements. Finally, it is easier to deal with foreign suppliers with whom long-term relationship has already been established. Thus the study concludes that Thai firms have small room to play in the Thai IT industry.

A striking feature, which could partly be attributed to the strategy being adopted, is the mismatch between local production and consumption both at the component and equipment level. To illustrate, in the case of telecommunication equipment, Thailand exports almost 70 per cent of its production and at the same time imports more than 70 per cent of its domestic demand (Joseph 2006). The case with semiconductor devices also appears not different. The narrow production base with export orientation also has the effect of making the industry highly susceptible to international market fluctuations. In such a context the need for upgrading of East Asia's electronic industry has been underlined. While the issue of industrial upgrading is most pertinent in case for some countries that remain at the low end of global production network, for a large number of countries, for whom development of an electronics production base and IT based development still remain a distant dream, the key is how to make an entry into the global production network. The moot question in the context of present study is to explore the extent to which ITA has been enabling new countries to participate in the production network and upgrading the position of those already been into the network.

With a view to explore this issue we have analysed the share of Asian countries in the global export and import of IT goods (see **table 5**). The table confirms the remarkable increase in the share of China in the global export of IT goods noted by the earlier studies. It is also evident that, as per HS 1996, the share of ITA members from Asia also increased from 41 per cent in 1997 to 67 per cent 2011. This increase, as evident from the table, is mostly on account of the more than 10 fold increase in China's share from 2.5 per cent in 1997 to over 28 per cent in 2011. To the extent that China has done exceedingly well in the merchandise export in general, its performance in IT goods cannot be attributed entirely to ITA alone.

As already noted the issue of importance is the influence of ITA on countries like Thailand, Malaysia, Indonesia and Philippines that entered the Global electronics production network even before ITA. The table tends to suggest that the share of these countries in the global export of IT goods while increased during the pre ITA period

recorded a decline after ITA. This especially holds in case of Malaysia, Indonesia and Philippines regardless of HS 1992 or HS1996. Moreover, with plausible exception of Vietnam, there has been hardly any new country that managed to increase their share in Global trade in 2011 as compared to 1997. Hence the argument that ITA has been instrumental in strengthening global production network does not have the required empirical basis.

Table 5: Share of Asian countries [in the world exports of ITA goods]

Country	HS1992					HS1996			
	1991	1997	2001	2007	2011	1997	2001	2007	2011
Bahrain			0.00	0.00	0.00			0	0.01
China		2.57	5.75	18.41	25.55	2.53	5.3	21.67	28.13
China, Hong Kong SAR		6.39	6.99	10.67	14.00	4.73	5.55	9.1	12.02
China, Macao SAR	0.04	0.01	0.00	0.01		0	0	0.01	
India	0.11	0.07	0.12	0.12	0.61	0.06	0.08	0.11	0.42
Indonesia	0.06	0.36	0.45	0.22	0.27	0.27	0.42	0.26	0.22
Japan	26.03	14.26	10.93	8.24	6.21	14.2	10.18	6.85	5.21
Kuwait			0.00	0.01				0.01	
Malaysia	4.48	4.62	5.30	3.87	3.39	4.9	5.1	4.93	3.93
Oman	0.00	0.00	0.01	0.01	0.01		0	0	0
Philippines		1.32	1.43	0.75	0.66		2.74	2.19	0.84
Rep. of Korea	6.95	2.27	4.57	6.52	5.95	4.81	4.94	6.79	6.39
Saudi Arabia	0.01		0.01	0.01	0.03		0	0.01	0.02
Singapore	7.34	8.77	7.46	11.34	8.12	10.11	8.16	7.82	7.86
Thailand	2.78	2.76	2.41	1.34	1.48		1.9	2.17	1.96
United Arab Emirates				0.38				0.27	
Viet Nam			0.13	0.10			0.07	0.14	
Total	47.81	43.41	45.56	62.01	66.27	41.61	44.46	62.34	67.02

Source: Estimates based on Comtrade data.

Trend in country concentration in exports

As noted by ITC (1999) Transnational Corporations (TNCs) hold a large share of the markets, production and investment in this knowledge-intensive sector. On the eve of

ITA (1997), out of the leading 100 TNCs, 22 were in the electronics sector⁷. Among these, eight originated in the United States and EU respectively, and six in Japan. Companies based in the United States dominated the sectors for high-end computers, semiconductors, telecommunications, computer software, and semiconductor manufacturing equipment. As is evident from WTO (2012), the initiative for ITA was taken by these leading multinational companies and it is of interest to examine, to what extent ITA has been able to bring about a more competitive environment with a more globally distributed production of ITA goods.

To analyse the extent of competition ideally we need to examine the share of leading firms in the export of IT goods. Since such data is hard to obtain for the large number of products that we examine, as a next best alternative we have analyzed the share of leading countries in ITA goods exports. As in the previous section, analysis of the pre-ITA period is based on HS 1992 and that of post-ITA is based on HS 1996 of COMTRADE.

Table 6: Trend in the share top 4 countries in the export of IT goods (%)

Period	ITA -1	ITA-2	ITA-3	ITA-4	ITA-5	ITA-6	ITA-7	Total
1989	75.29	75.11	82.65	97.10	87.39	95.20	82.61	83.47
1990	70.71	72.28	81.90	98.48	85.80	93.04	80.03	81.38
1991	76.60	78.10	75.73	97.94	86.08	91.59	78.74	79.55
1992	70.60	70.88	69.93	94.14	75.84	72.98	64.56	67.22
1993	69.01	63.37	62.12	95.77	67.53	63.51	57.47	59.78
1994	69.92	55.84	57.90	89.39	55.68	58.65	53.72	55.16
1995	65.37	53.90	59.68	87.42	53.46	56.60	50.81	53.38
1996	63.42	56.65	63.28	84.95	53.77	60.80	48.72	53.08
1997	67.80	56.81	61.48	84.90	55.36	59.92	48.52	52.71
1998	63.33	53.21	60.85	83.08	55.47	60.33	45.79	50.55
1999	61.47	47.43	64.76	81.33	57.39	57.39	43.16	48.85
2000	58.19	40.14	64.78	81.73	58.06	56.78	42.80	47.63
2001	59.72	44.78	62.80	81.81	56.53	53.36	41.21	46.56
2002	61.57	48.92	62.08	78.24	53.88	52.77	43.25	48.71
2003	61.99	46.36	60.90	77.97	53.04	50.98	47.07	50.24

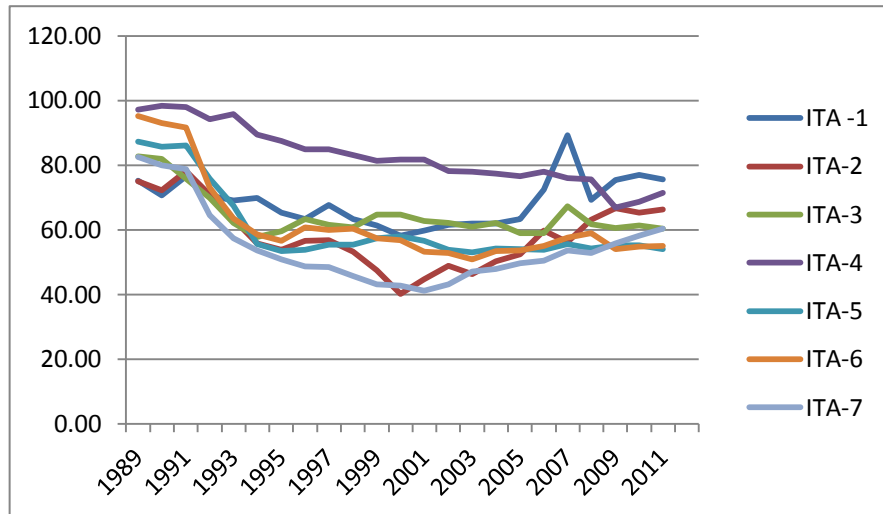
⁷ In 2011, only 7 of the top 100 TNCs were in the electronics sector. Of these, 3 were US, 3 European and 1 Japanese. Among the top 100 TNCs among developing and transition economies, 12 were in this sector -- all from East Asia. I am Thankful to Torbjorn Frederickson for this information.

2004	62.01	50.23	62.17	77.47	54.27	53.43	48.01	51.76
2005	63.35	52.57	58.98	76.57	54.09	53.64	49.71	52.49
2006	72.46	59.79	59.05	77.90	53.79	55.00	50.44	54.60
2007	89.20	56.16	67.38	76.01	55.57	57.66	53.74	57.88
2008	69.31	63.15	61.75	75.64	54.27	59.07	52.86	56.84
2009	75.36	66.75	60.63	66.86	55.16	54.01	55.77	58.63
2010	76.95	65.43	61.46	68.78	55.18	54.82	58.18	59.93
2011	75.61	66.28	60.30	71.53	54.13	55.09	60.39	60.93

Note: Note: ITA -1: Computers and calculating machines; ITA-2: Telecommunication equipment; ITA-3: Semiconductors; ITA-4: Semiconductor manufacturing equipment; ITA-5: Instrument and apparatus
ITA-6: data storage media and software; ITA-7: Parts and accessories

It is evident from **Table 6** that in 1989 top four ITA member countries accounted for over 83 per cent of global trade in IT goods. The table further reveals that their share has been declining steadily since 1989. The trend seems to have reversed after ITA and upward trend in the share of four countries became more pronounced since 2001. To be more precise, the share of top 4 countries declined from 83 per cent in 1989 to 46 per cent in 2001. From 2001 there has been an upward trend to reach 61 per cent 2011 – an increase of 15 per cent! The trend in concentration that comes out at different product group level is also in tune with that of the total exports. Out of the seven four product groups, four of them (ITA 1, ITA2, ITA6 and ITA 7) showed a downward trend in the share of top four exporting countries up to around 2000 and showed an increase since then in their share by about 15 per cent. The increase in the share to top four countries is further evident from fig 1.

Fig 1: Trend in the global share of top 4 IT exporting countries



Note: ITA -1: Computers and calculating machines; ITA-2: Telecommunication equipment; ITA-3: Semiconductors; ITA-4: Semiconductor manufacturing equipment; ITA-5: Instrument and apparatus ITA-6: data storage media and software; ITA-7: Parts and accessories

While our analysis, based on country level concentration ratios, is only indicative, there is enough evidence to suggest that the market power of MNCs has been increasing over time. Let us take the case of personal computers. According Gartner, five large MNCs (Compaq 13.1%, IBM 8.6%, Dell 5.5% HP 5.3% and NEC 5.1%) together accounted for only 37.5 per cent of the global market in 1997. By 2012 the share of five top multinationals increased to 58.8% (HP 16% Lenovo 14.8%, Dell 10.7% Acer 10.4% and Asus 6.9%)⁸.

If we take the case of semiconductors the situation is not different. Based on KPMG report top five MNCs accounted for 35 per cent of the global market in 2010. Further during 2009-10 Intel improved its revenue by 24%, Samsung by 60%, Texas instruments by 34%. What is more, among the top 10 MNCs, five of them recorded more than 30 per cent increase in their revenue⁹. In case of mobile phones, share of top five firms (Samsung 22.7%, Nokia 18%, Apple 9.2% ZTE 3.4% and LG 3.2%) accounted for 56.5 % of the global market in 2011(Gartner). As is evident from table 7 one of the MNCs holds leading position in seven products with more than 18% market share in each of

⁸ See for details http://en.wikipedia.org/wiki/Market_share_of_personal_computer_vendors

⁹ See for more details http://en.wikipedia.org/wiki/Semiconductor_sales_leaders_by_year

them. The table further indicates that out of the 11 products considered the top two firms accounts more than 30 per cent of the global share and in the remaining products the share is over 29 per cent. Such examples could be multiplied.

Table 7: Global market share of Samsung and its nearest competitor in select products

Product	Samsung world market share (%)	Leading competitor	Market share (%)	Year
DRAM	40.4	SK Hynix	19.8	Q3 2010
NAND flash	40.4	Toshiba	33.1	Q3 2010
Large-size LCD panels (revenue)	26.0	LG Display	25.9	Q3 2010
Active-Matrix OLEDs	97.0	LG Display	1.3	2010
Lithium-ion batteries	18.7	Sanyo	19.4	Q1010
LCD monitors	18.0	Dell	12.8	2009
Hard-disk drives	9.0	Western Digital	31.3	Q12010
Televisions (LCD, PDP, CRT, LED)	17.2	LG Electronics	14.8	Q32009
Mobile Phones	25.0	Nokia	23.0	Q12012
Digital cameras	11.8	Sony	17.4	2010
Application processors	12.0	Texas Instruments	17.0	Q3, 4 2011

Source: downloaded from http://en.wikipedia.org/wiki/Samsung_Electronics

The observed trend tends to suggest that being an Agreement initiated at the instance of leading MNCs, their ultimate objective would have been to arrest the decline in their market power to retain their profitability. Moreover, in contrast to the often made claim that ITA has been instrumental in spreading IT production across developing countries, especially Asia has hardly any empirical base. To the extent that our analysis has been preliminary, instead of drawing definite conclusions we underline the need for more systematic analysis to explore whether ITA has been helpful in fostering a more competitive trading environment.

Trend in prices

Market power is bound to have its influence on price. Trends in the price of electronics products, especially semiconductors and computing equipment are known to be governed by the famous Moore's law - an observation that the number of components in integrated circuits had doubled every year from the invention of the integrated circuit in 1958 until

1965 and predicted that the trend would continue. With geometric progression in the power of computing equipment their prices have been moving in the opposite direction. Such trends have been attributed mainly to the technological dynamism resulting from the high technological opportunity resulting from the scientific base of this industry along with significant R&D investments by the large MNCs engaged in the sector. However, along with higher technological base of IT products, increased competition resulting from ITA is expected to have further accelerated the downward trend in prices on account of heightened competition resulting from trade liberalisation.

Earlier studies (WTO 2012, for example) have argued that such a trend has indeed been in operation since ITA. To quote from WTO (2012) “import price level of June 2011 for computers, peripherals and semiconductors to be around 65 per cent below the respective level of June 1996, while the average import prices for all commodities were 40 per cent above the level of 1996”. The study further argued that “as a result of significant price reductions and increased performance, consumers have benefited from an unprecedented reduction in the price paid for computational power. The cost of a gigaFLOPS a unit of computational power, fell to \$ 1.80 in March 2011 from \$ 30,000 in 1997 – 0.006 per cent of the initial cost”.

In case of IT industry with numerous products having varying characteristics, such anecdotal evidence could conceal more than what is revealed. Hence, for informed policy making there is hardly any option other than to analyze the issue at hand empirically at as disaggregated a level as possible. However, such an analysis is made difficult because of the non availability of credible product wise data on prices.

Perhaps, the only option left with is to make use of the unit value derived from trade data, keeping indeed in mind all its limitations. Strictly speaking unit value indices are not price indices since their changes may be due to changes in price, composition of commodities and quality of the product. However, to the extent that the compositional change and change product characteristics were prevalent even before the introduction of ITA, an examination of the trend in estimated indices could provide some broad

indications regarding the change in their prices. In what follows we shall try to analyse this issue by using the unit value indices, of all the seven ITA products derived from the trade data obtained from COMTRADE. Here again, our analysis shall compare the trends observed in the post-ITA period with that of the pre-ITA period.

We have estimated the trend growth rate in the unit value index of all the ITA products for the two time periods and tested the statistical significance of the observed growth rate in two time periods (table 8). In general, as per HS 1992, the growth in the price of IT goods has been at a very low level both during the pre and post ITA period. However, it is evident from table 8 that during the pre ITA period growth in price, in accordance with the Moore's law, was negative for two products (ITA1 and ITA6) groups and negligible in case of others with highest growth rate being in ITA 4 (6.9%). But when it comes to the second period, the while negative growth rate continued in ITA1 (as observed by WTO 2012) all the other product groups, except ITA3 and ITA4, recorded an increase in the growth rate in prices. The emerging picture with respect to growth in price during post ITA period as per HS 1996 is broadly in tune with HS 1992 except for the fact that ITA3 recorded a negative growth rate.

Table 8: Estimated trend growth rates in the export price of ITA goods

HS	Period	ITA-1	ITA-2	ITA-3	ITA-4	ITA-5	ITA-6	ITA-7
HS1992	Pre-ITA	-0.80 (-0.525)	0.80 (0.521)	3.5 (2.441)**	6.90 (2.640)**	2.40 (2.993)**	-0.40 (-0.476)	0.10 (0.102)
	Post ITA	-2.80 (-1.546)	6.20 (11.210)*	2.40 (6.581)*	4.50 (2.727)**	5.50 (9.268)*	2.36 (4.399)*	1.70 (5.180)*
HS1996	Post ITA	1.70 (2.579)**	4.10 (1.851)	-3.0 (-5.265)*	3.70 (5.707)*	5.40 (9.122)*	8.40 (3.024)**	1.0 (3.113)*

Note: ITA -1: Computers and calculating machines; ITA-2: Telecommunication equipment; ITA-3: Semiconductors; ITA-4: Semiconductor manufacturing equipment; ITA-5: Instrument and apparatus ITA-6: data storage media and software; ITA-7: Parts and accessories

*, ** - Growth rates are statistically significant at 1 percent and 5 percent levels respectively
 Figures in parenthesis indicate corresponding t-values
 Pre-ITA period: 1988 – 1996; Post-ITA period: 1997-2011

If we piece together the findings on price trend with market concentration, the following hypothesis could be advanced. As the ITA enabled the leading producers to consolidate

and significantly increase their market power they could behave like “price makers” instead of being “price takers”. The power to set the price backed by market power and control over core technologies and the power to set the global standards during the post ITA period to enhance profitability seems to have contributed towards an upward trend in prices in place of the downward or constant trend observed during the pre ITA period.

This, needless to say, would have adversely affected the access to IT goods and the diffusion of ICT in developing countries. Based on the literature on pricing behavior with market power, one could also expect ‘Pricing to Market behavior’ wherein price for developing countries being significantly higher than in the developed market. This is an issue that needs further exploration and reserved for future work.

5. Concluding observations

Information Technology Agreement of WTO, touted as one of the most successful trade agreements ever undertaken and a stepping stone to multilateralism through sectoral agree agreement route, aimed at enabling its member countries to harness the manifold benefits of ICT through liberalizing the trade in IT products. Ironically, while countries world over toady are wedded to ICT, majority of developing countries prefer to keep away from ITA. Hence, WTO has been enticing countries to ITA, *inter alia* by highlighting its varied benefits and a case has also been made to expand the coverage of products under the Agreement. In this context, the present study analysed the outcomes of ITA in terms of its declared objectives.

The points of departure of the present study from the previous ones are the following. While the previous studies were concerned only with the post ITA period, keeping us in dark with respect to the pre ITA period, this study compared the performance during the post ITA period with the pre ITA period. Secondly while the previous studies made tall claims about the positive outcomes of ITA without sufficient empirical base, the present study attempted to explore the issues of concern with much needed empirical evidence. The study has interesting preliminary empirical results which call for more detailed enquiries so as to contribute to informed policy making.

To begin with, it is found that in contrast to the observation made by WTO (2012) and other studies, post ITA period was marked by a sharp deceleration in the growth of trade (both exports and imports) in IT products. The deceleration was confined not only to total export and imports of IT products but also to almost all the seven product groups therein. As a result, the share of IT products in global merchandise exports did not record an increase after ITA. Instead, there has been a marked decline. This tend to suggest that despite significant liberalization in the trade in ITA goods, trade in IT goods could not withstand various exogenous shocks like the Asian financial crisis, dotcom crisis and the global financial crisis that coincided with the post ITA period. Therefore the growth augmenting effect of ITA as highlighted by WTO (2012) doesn't withstand to empirical verification.

While the present study confirms the finding that the share of Asia in global trade has increased significantly after ITA, once we keep away "the China effect", the emerging picture is rather dismal. There is hardly any empirical evidence of either incumbent in global production network (eg. Malaysia, Thailand, Indonesia) improving their position or the entry of new countries from Asia into the electronics production network. Here the only exception is Vietnam.

More importantly the study finds that the 4-country concentration ratio in the export of IT goods, while declined (about 10%) during the pre ITA period, post ITA period was marked by a significant increase in their share (about 15%). There is also evidence to indicate increased market power of MNCs in important IT products like personal computers, semiconductor devices and mobile phones that account for bulk of IT trade. The preliminary results underline the need for more detailed and systematic analysis to discern whether ITA has been helpful in fostering a more competitive trading environment.

The preliminary evidence also suggests that the increased market power appears to have enabled the MNCs to behave like price makers. During the pre ITA period, rate of growth in the price of IT goods was either negligible or negative indicative of the

operation of the Moore's law. Surprisingly, when it comes to the post ITA period, almost all the product groups recorded positive and statistically significant growth in prices as compared to the pre ITA period. Here again the study underscores the need for further enquiries to explore whether ITA helped improving the affordability or it made the IT products more costly with its obvious implications on ICT diffusion in the developing countries. Only further studies will tell us whether the digital world of today would have been more equitable had there been no ITA!

On the whole, ITA turns out to have not lived up to the expectations. Therefore, the reasons for the hesitation of large number of developing countries to join it are not far to seek. To the extent that the ITA could not keep up its promises, there is the need for revisiting ITA before considering the issue of expanding its product coverage.

Theoretically, the ITA fiasco has to be seen against its abiding faith in the virtues of trade liberalization and scant attention to innovation and capacity building. In a sense what we have observed is what Arthur Lewis predicted in 1978. To repeat

"the engine of growth should be technological change with international trade serving as lubricating oil and not as fuel". He continued "...international trade cannot substitute for technological change, so those who depend on it as their major hope are doomed to frustration" (Lewis 1978 p. 74).

In the context of frustration that resulted from ITA and given India's capabilities in the field of ICT and its commitment for the developing countries, it is an appropriate time to work towards an e-South Framework Agreement¹⁰. The scope for such an agreement is too obvious because of IT capabilities in some of the Southern countries to address the southern problems and the marked divergence in the IT interests of developing and developed countries. The proposed e-South Framework Agreement shall aim at bridging the digital divide through an integrated development of ICT sector within in the framework of south-south cooperation. Towards achieving this objective, the Agreement, in tune with the Information Technology Agreement of WTO should focus on liberalizing the trade in ICT goods and services. At the same time, drawing from the e-ASEAN

¹⁰ For a detailed discussion on the context and rationale for e-South Framework Agreement see Joseph (1996) Chapter 7.

Framework Agreement the e-South Framework Agreement should be instrumental in capacity building *inter alia* by harnessing the innovation capabilities in the South. Given the paramount importance of human capital in developing ICT production and promoting ICT use, special focus may be given to developing IT manpower base wherein there is the need for relaxing the restrictions on the mobility of skilled manpower across the developing world. In general, the Agreement should facilitate an integrated development of the ICT sector by promoting both production and use instead of the ongoing lop-sided approach wherein developing countries are often considered as passive adopters of technology. We may conclude by reiterating that South-south cooperation should not be construed as a substitute for the ongoing initiatives at promoting North-South cooperation.

Acknowledgement

This study has been undertaken with the support of WTO Center at IIFT for the Department of Electronics, Government of India. I have benefitted immensely from discussion with Prof Abhijit Das, Dr Nagesh Kumar and Dr Ajaya Kumar. My colleagues at CDS, Dr U S Mishra and Vinod Kumar patiently listened to my ideas and provided helpful comments on an earlier draft. Mr Rajesh Many provided excellent research assistance for analyzing the data. While I am thankful to all of them, the usual disclaimers follow.

References

- Anderson, Michael and Jacob, Mohs (2010), The Information Technology Agreement: An Assessment of World Trade in Information Technology Products, *Journal of International Commerce and Economics*, Web version January 2010, available at http://www.usitc.gov/publications/332/journals/info_tech_agreement.pdf
- Bhagwati, J. N. (1984) Why are Services Cheaper in Poor Countries? *Economic Journal*, 94: 279-285.
- Bresnahan, T. and M. Trajtenberg (1995) General Purpose Technologies: Engines of Growth, *Journal of Econometrics*, 65 (1): 83-108.
- Cantwell, J. A. (1995) The Globalization of Technology: What Remains of the Product Cycle Model? *Cambridge Journal of Economics*, 19(1): 155-174.

Carlos, A., P. Braga, J.A. Dally and B. Sareen (2003) The future of Information and Communication Technology for Development, paper presented in the ICT Development Forum, Petersberg, Germany.

David, P.A. (1990) The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox, *AEA Papers and Proceedings*, 1990; 355-361

David, P. A. (1991) Computer and Dynamo: the Modern Productivity Paradox in a Not-Too-Distant Mirror. In OECD, *Technology and Productivity: The Challenge for Economic Policy* (Paris: OECD): 315-348.

Dreyer Iana and Brian Hindley (2008), Trade in Information Technology goods: Adapting the ITA to 21st century technological change, ECIPE working paper No 6/2008, Brussels.

Dunning, J. H. (1996) The Geographic sources of the competitiveness of firms: some results of a new survey, *Transnational Corporations*, 5: 1-29.

Erik, Brynjolfsson and Adam Saunders (2010), *Wired for Innovation: How Information Technology is Reshaping the Economy*, Cambridge, MA: MIT Press.

Ernst, D. (2002) Global Production Networks and the Changing Geography of Innovation Systems: Implications for Developing Countries, *Economics of Innovation and New Technology*, 11 (6): 497-523.

Ernst, D. and B. A. Lundvall (2000) Information Technology in the Learning Economy: Challenges for Developing Countries, East-West Centre working paper No. 8, (Honolulu: East-West center).

Ernst, D. and L. Kim (2002) Global Production Networks, Knowledge Diffusion and Local Capability Formation, *Research Policy*, 31 (8-9): 1417-1429.

Ezell, Stephen J., (2012) *Boosting Exports, Jobs, and Economic Growth by Expanding the ITA*, The Information Technology & Innovation Foundation, Washington DC available at <http://www.itif.org/events/boosting-exports-jobs-and-economic-growth-expanding-information-technology-agreement>

Heeks R., (1996) *India's software industry, state policy, liberalization and industrial development*. New Delhi: Sage Publications.

Hobday, M. (1994) Export-led Technology Development in the Four Dragons: The Case of Electronics, *Development and Change*, 25 (2): 333–361.

Hobday, M. (1995) East Asian Latecomer Firms: Learning the Technology of Electronics, *World Development* 23 (7): 1171–1193.

Indjikian, R. and D. S. Siegel (2005) Impact of Investment in IT on Economic Performance: Implications for Developing Countries, *World Development*, 33 (5): 681-700.

IMF (2001) *World Economic Outlook: The Information Technology Revolution*, Washington DC, October.

Joseph, K. J. (1997) *Industry under Economic Liberalization: The Case of Indian Electronics* Sage Publications, New Delhi, Thousand Oaks, London.

Joseph, K. J. (2002) Growth of ICT and ICT for Development: Realities of the Myths of Indian Experience, Discussion paper No. 2002/78, Helsinki: UNU/ WIDER.

Joseph, K.J. (2004) Development of Enabling Policies for Trade and Investment in the IT Sector of the Greater Mekong Sub Region, UNESCAP, Bangkok, at <http://www.unescap.org/tid/projects/gms.asp>

Joseph, K. J., (2006) *Information Technology, Innovation System and Trade Regime in Developing Countries: India and the ASEAN*, Palgrave Macmillan, New York.

Joseph K J (2007) Electronics Industry, in Kumar N. and K J Joseph (eds) *International Competitiveness & Knowledge-based industries*, Oxford University Press New Delhi

Joseph K J (2012) India's Software Industry in Transition: Lessons for other developing countries and implications for South-South Cooperation, background paper for the *Information Economy Report 2012*, UNCTAD, Geneva.

Joseph K. J. and P. Intarakumnerd, P. (2004) GPTs and Innovation Systems in Developing Countries: A Comparative Analysis of ICT Experiences in India and Thailand, Paper Presented at the Second GLOBELICS Conference, Beijing, October.

Joseph K J and G Parayil (2008) Can Trade Liberalization Bridge Digital Divide: Assessing the Information Technology Agreement, *Economic and Political Weekly*, Vol. XLIII No.1, January 5 p 46-53.

Kraemer, K. L. and J. Dedrick (2001) Information Technology and Economic Development: Results and Policy Implications of Cross-Country Studies, in M. Pohjola (ed.), *Information Technology, Productivity and Economic Growth* (Oxford University Press).

Krueger, Ann O (1997) Trade and Economic Development: How we Learn'? *American Economic Review*, 87 (1): 1-22

Kumar N. (2001) Indian software industry development: International and national Perspective, *Economic and Political Weekly*, 36 (45): 4278-4290.

Kumar, N. and K. J. Joseph (2005) Export of Software and Business Process Outsourcing from Developing Countries: Lessons from India, *Asia Pacific Trade and Investment Review* 1(1): 91-108.

Lall, S. (2001) *Competitiveness, Technology and Skills* (Cheltenham: Edward Elgar).

Lewis, Arthur (1978) *The Evolution of the International Economic Order*, Princeton: Princeton University Press.

Makino, S., C. M. Lau and R. S. Yeh (2002) Asset exploitation versus asset seeking: implications for location choice of foreign direct investment from Newly Industrialized Economies, *Journal of International Business Studies*, 33: 403-421.

Mann Catherine L and Xuepeng Liu (2007) The Information Technology Agreement: Sui Generis or Model Stepping Stone? Paper prepared for the Prepared for WTO-HEI Conference 10-12 September, Geneva. Available at http://www.wto.org/english/tratop_e/region_e/con_sep07_e/mann_liu_e.pdf

Mephokee, C. (2003) Thai Labour Market in Transition Toward a Knowledge-Based Economy, in M. Makishima and Suksiriserkul, Somchai, (ed.), 2003, *Human Resource Development Toward a Knowledge-Based Economy: The Case of Thailand*, Institute of developing economies (Chiba: Japan: Japan External Trade Organization).

Mytelka, L. K. and John F.E. Ohiorhenuan, (2000) Knowledge-based Industrial Development and South-South Cooperation, *Cooperation South*, No.1 2000, pp 74-82.

Pearce, R. D. (1999) The Evolution of Technology in Multinational Enterprises: The Role of Creative Subsidiaries, *International Business Review*, 8: 125-148.

Pohjola, M. (2001) Information Technology and Economic Growth: A Cross country Analysis in M. Pohjola (ed.) *Information Technology, Productivity and Economic Growth*, Oxford University Press, New York.

Rodrik, D. (1992) The Limits of Trade Policy Reform in Developing Countries, *Journal of Economic Perspectives*, 6 (1) 87-105.

Rodrik, D. (2004) Rethinking Growth Policies in the Developing World, Lucad' Agliano Lecture in Development Economics, delivered on October 8, 2004, in Torino, Italy, available at <http://courses.umass.edu/econ804/rodrik2.pdf>

Saggi, K. (2002) Trade Foreign Direct Investment and International Technology Transfer: A Survey, *The World Bank Research Observer*, 17 (2):191-235.

Srinivasan, T. N. and J. N. Bhagwati (1999) Outward Orientation and Development: Are Revisionists Right? Discussion Paper No. 806, Economic Growth Center, Yale University, New Haven.

Stiglitz, J. E. (2002) *Globalization and its Discontents* (New York: Allen Lane).

UNCTAD (2012) *Information Technology Report 2012: The Software Industry and Developing Countries*, United Nations, New York and Geneva.

Wong, P. K. (2001) The Contribution of Information Technology to the Rapid Economic Growth of Singapore in M. Pohjola (ed.), *Information Technology, Productivity and Economic Growth* (New York: Oxford University Press).

World Bank (2000) *Korea and the Knowledge based Economy: Making a Transition* (World Bank: OECD).

World Bank (2002) *Information Communication Technology: A World Bank Group Strategy* (Washington DC: The World Bank).

WTO (2012) *15 years of the Information Technology Agreement: Trade, Innovation and Global Production Networks*, available at http://www.wto.org/english/res_e/publications_e/ita15years_2012_e.htm