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GLOBALIZATION AND URBAN GROWTH: EVIDENCE FOR BANGALORE (INDIA)

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This paper aims at economic analysis of globalization and urban growth of Bangalore (capital of Karnataka State, and globally known as Silicon Valley of India, IT Hub of Asia, and IT Capital of India) in South India. It offers new insights and evidence for information and communication technology (ICT) sector as a major source for selective globalization and urban growth. Estimated combined contribution of ICT manufacturing and services to Bangalore's economic growth is compared with regional, national and international (OECD average) levels. Empirical results support for a remarkable performance of Bangalore at all levels, mainly driven by ICT sector. In addition, Bangalore's valuable contributions to regional and national economic growth are singled out. Available and new evidence are put together to explain select factors behind Bangalore's phenomenal economic growth under globalization.

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GLOBALIZATION AND URBAN GROWTH: EVIDENCE FOR BANGALORE (INDIA)

1. INTRODUCTION

India's urban centres (comprising cities and towns) are a part of a State in which they are located. Accordingly, they are a part of Indian federation with mixed and open economic system. International trade and foreign investment belong to the Central List of the Indian Constitution. All foreign trade and investment policies are formulated and implemented at the national level. State and urban local governments can complement the foreign trade and investment policies by way of providing producers and investors with additional fiscal and financial incentives and by creating congenial local environment with amenities and infrastructure. Since 1991, India's economic reforms in (a) foreign trade in goods and services and (b) manufacturing and infrastructure privatization with foreign investment have contributed to increasing degree of openness to trade and internationalization of capital. In addition, India's founder-membership to World Trade Organization (WTO) lead to commitments by honouring disciplines under different agreements for freer trade in goods, services, and intellectual properties, and trade-related investment measures. Implementation of these commitments along with external sector reforms has intensified the pace of country's economic globalization.

Economic globalization is a process of deep and powerful integration of domestic markets or economy with the global markets or economy. Globalization is important for urban growth because it affects spatial allocation of resources and creates spatial impacts. Factors which affect allocation of resource include overall population growth and distribution, population distribution among large and small cities, communication and other technologies, scale economies and diseconomies of cities, industrial composition, changing comparative advantages of cities, demographic factors, and income growth and distribution [Lim (2007)].

A preliminary link between India's globalization and broad changes in cities and city-related policies is described by Mathur (2005). Lack of international trade data at sub-national levels limits the measurement of globalization for 15 States and 6 cities only by the amount of inflow of foreign direct investment. Post globalization urban growth is described by changes and growth in urban population and changes in share of employment in manufacturing and service sectors.

Absence of primacy is distinguished as an important characteristic of India's urban system. Changes in spatial structure is identified with transformation of urban space in use and form, such as, commercial spaces for shopping and office space for MNCs and financial institutions, and mushrooming of high quality residential and office space bordering major cities. This is observed to have affected land and housing markets in major cities, such as, Mumbai, Bangalore, and Delhi. Absence of appropriate reform in policies that govern urban land markets is considered a key constraint in the globalization period. In addition, globalization period underlines a paradigm shift in city-level policies for provisioning of municipal services and infrastructure in terms of debt financing, public-private partnerships, and cost-recovery based pricing.

Kundu (2006) explored the unequal economic base between Class I cities (million plus cities) and medium towns (50000 to one million population) and small towns (less than 50000 population) in terms of employment, consumption, and poverty. These inequalities are considered as consequences of large cities' capacity to attract national and global investors and link with national and world markets, and decline in public investment in infrastructure and basic amenities for small towns. Thus, a case is made for providing special capita support to the less developed states that are not in a position to allocate requisite funds to medium and small towns for improvements in their infrastructure and amenities and for enhancement of their attractiveness for private investments and business.

Available studies on globalization at city level are limited to specific cities and non-economic in approach.¹ These studies include Dittrich (2007 and 2005), Kalra (2006), and Madon and Sahay (2001) for Bangalore. Dittrich studies focused on negative impact of globalization on social map of Bangalore with multiple divides between winners and losers. The winners are upper-class people (2 percent) with annual household income (AHHI) of more than one million Indian rupee (INR); and upper middle class (5 percent) with AHHI of more than 0.5 million INR but less than one million INR. The losers are the deprived (50 percent) and poor (30 percent). The AHHI of the poor is about 370 times smaller than that of upper class AHHI. The winners

¹ Select summary of many unpublished studies on Bangalore is included in Kalra (2006).

are also the beneficiaries of up market service complexes, self-contained apartment-complexes, and Euro-American gated residential enclaves both close to the modern city centre and in the newly developed high-income residential areas; and urban fringe luxurious club-houses with swimming pools surrounded by discotheques, tennis clubs and golf courses. The globally integrated economic sector plays a prominent part in rearranging the utilization of land, capital, and public investments, such as, construction of fly-overs, ring roads, fiber-optic services in high value industrial areas, and international airport with the ultimate aim of making Bangalore globally competitive. However, “all these investments are exclusive responses to the demands of the modern industrial sector but have, little value in the common resident’s daily life” (p.51). Sudhira et al (2007) notes that “the escalating cost of land prices coupled with rise in cost of living has pushed the urban poor to reside in squatter settlements with inadequate amenities and services”(p.385).

Madon and Sahay (2001) highlight the links between globalization and localization in Bangalore city and explain how such links are forged and contributory for Bangalore’s development under globalization. Localization is related to local environment in terms of standards of civil amenities and local infrastructure created by local agents, such as, urban local bodies, policy makers and planners. Globalization impacts on localization by forcing the local agents to create civil amenities and infrastructure (e.g. IT parks) at global quality and standards through participation of public and/or private (Indian and foreign) investors. Networking between the Government and professionals through public policy forums is another major step in connecting globalization and localization in Bangalore. In addition, Madon and Sahay appreciate the role of non-governmental organization as a missing link between the local urban poor and policy makers as well as international lobby groups trying to facilitate purposeful negotiations between them.

In general, no sub-national (e.g. State or urban level) empirical evidence exists on the nature, extent and impact of economic globalization in India, mainly due to lack of published data on indicators and variables of economic globalization and urban economic growth. This is in contrast with other countries, such as China and Philippines. For instance, Zhao et al (2003) determine the impact of globalization on urban growth by estimation of empirical models using cross-section data on 236 cities in 2000. First, city level gross domestic product (GDP) is

regressed on foreign direct investment (FDI) and foreign industrial output (FIO). Second, city population is regressed on FIO and FDI. In both the estimations, the coefficients were positive and significant. These results supported for positive impact of globalization on urban growth in China. Pernia and Quising (2005) estimated, among others, the impact of globalization (measured by degree of openness to export trade) on regional development (measured by regional GDP), and the impact of regional development on wellbeing of poor (measured by per capita expenditure of poor), using five year panel data on 12 regions in Philippines. The empirical results offered evidence for the positive and direct (or indirect) impact of globalization on regional development (or wellbeing of the poor through regional development).

Recent databases on foreign trade in goods and services, and inflow of foreign investment in Karnataka State (and on Bangalore as its capital) is an exception in India. This paper is the first attempt to use this database for measurement of economic globalization, and relate globalization and urban growth for Bangalore in comparison with regional (or State level, throughout) economic growth of Karnataka State and national economic growth of India. This comparison brings out the valuable contributions of Bangalore to regional and national economic globalization and economic growth.

Bangalore has been in the global limelight for its remarkable growth of information and communication technology (ICT) sector. This performance raises many research questions in the context of globalization and urban growth, such as: Does ICT sector contribute to globalization of Bangalore? If so, how such globalization be measured and its growth impact can be empirically modeled and estimated? Can empirical estimates of Bangalore be comparable at the regional, national and international levels? If so, how does Bangalore perform and why? How much does Bangalore contribute to regional and national globalization and economic growth as they are related to ICT sector? This paper is an attempt to answer these questions by economic analysis of globalization and urban growth (changes in growth and composition of urban GDP) of Bangalore, as compared to the regional, national and international levels. In addition, the results of this paper have implications in offering empirical justifications for public policy for promotion of economic globalization. Subject to the comparability of economic structures, the empirical framework and policy implications of this study may have useful guidelines for future studies on cities elsewhere in India as well as in other developing countries.

Mid 1980's was the beginning of India's openness policies in trade. This had been intensified and broadened by the introduction of national economic reforms (in brief, the Reforms) since July 1991 under the external sector reforms comprising foreign trade, foreign and exchange. Thus, in this paper, analyses before 1991 refer to pre-globalization period and after 1991 refer to post-globalization period.

Rest of the paper is organized as follows. In section 2, an overview of Bangalore's economic growth is presented. Section 3 focuses on economic analysis of globalization and urban growth of Bangalore with reference to ICT sector. Major conclusions and implications are summarized in section 4.

2. ECONOMIC GROWTH OF BANGALORE

Bangalore is the capital of Karnataka State in South India. It has a long history from its birth as a small village in 1537 to a vibrant and 5th biggest urban agglomeration area in India in 2001.² For administrative purposes, Bangalore is divided into Bangalore Urban and Bangalore Rural districts since 1986. Greater Bangalore City Corporation is the urban local body of Bangalore. For census purposes, Bangalore Corporation area is called Bangalore City and is distinguished from the Bangalore Urban Agglomeration Area.³ Urban planning distinguishes Bangalore Metropolitan Area (or non-greenbelt area) and Planning Area (or planning districts for land use regulations through zoning laws) within the Bangalore Urban District. Bangalore Metropolitan Region includes both Bangalore urban and rural districts for regional planning purposes.

² No attempt is made below to describe the historical aspects of growth of Bangalore as they are well documented, for instance, in: Nair (2005), Heitzman (2004), and Government of India (2001a). A recent profile of Bangalore is given in Sudhira et al (2007).

³ According to the Census of India 2001 [Government of India (2001a)], an urban agglomeration is a continuous urban spread constituting a town and its adjoining urban outgrowths or two or more physically contiguous towns together and any adjoining urban outgrowths of such towns. It is delineated by following criteria (a) Core town or at least one of the constituent towns is a statutory town. (b) Total population of all the constituents (i.e., towns and outgrowths) is not less than 20,000. If these two criteria are met, an urban agglomeration is a city or town with one or more contiguous outgrowths; or two or more adjoining towns with their outgrowths; or a city and one or more adjoining towns with their outgrowths all of which form a continuous spread.

Growth of Bangalore Urban Agglomeration Area (UAA)

Total population of Bangalore UAA increased from 2.92 million in 1981 to 4.13 million in 1991 and to 5.69 million in 2001, as a result of population growth by 75.56 percent (or 1.76 times) between 1971 and 1981, 41.36 percent (or 1.41 times) between 1981 and 1991, and 37.69 percent (or 1.38 times) between 1991 and 2001 (**Table 1**). Share of Bangalore UAA in total urban population of Karnataka (or urban India) increased from 27.23 (or 1.83) percent in 1981 to 29.70 (or 1.90) percent in 1991 and to 31.73 (or 1.99) percent in 2001. Bangalore UAA recorded 5.79 percent annual growth rate of population during 1971-81, 3.52 percent during 1981-91, and 3.25 percent during 1991-01. Throughout, the annual growth rates of Bangalore UAA had been higher than that of urban Karnataka and urban India.

Total area of Bangalore UAA increased from 365.65 sq.kms in 1971 to 445.91 sq.kms in 1981 and to 531 sq.kms in 2001 due to (a) increase in urbanization of surrounding areas and (b) incorporation of surrounding areas into the City on a continuous basis. This increase is about 2.06 times during 1971-1981, 1.22 times during 1981-1991, and 1.19 times during 1991-2001. Pressure of population size on land is evident in increasing density (per square kilometer) from 7991 persons in 1981 to 9263 persons in 1991 and to 10710 persons in 2001.

Share of Bangalore UAA in the total population of Class I cities (0.1 million and above population) in Karnataka State marginally increased from about 46 percent in 1981 to 47 percent in 2001. Excluding Bangalore UAA from the Class I cities in the State, the average size of Class I cities is smaller than the population size of Bangalore UAA by about 14 times in 1981, 17 times smaller in 1991 and 21 times smaller in 2001. At the all India level, the share of Bangalore UAA in total population of Class I cities (or Million plus cities) varied from 3.04 (or 6.94) percent in 1981, 2.91 (or 5.85) percent in 1991, and 2.90 (or 5.27) percent in 2001.

Total population of Bangalore city is equal to 4.29 million in 2001. This accounted for 75.48 percent of total population of Bangalore UAA, 65.80 percent of total population of urban Bangalore district, 23.95 percent of total population of urban Karnataka, and 1.50 percent of total population of urban India (**Table 2**). Density of population in Bangalore city is 1.78 times bigger than in Bangalore UAA and about 6 times bigger than in Bangalore Urban district. In

addition, literacy rates (for total population and by male and female population) in Bangalore city are higher than in Bangalore UAA, Bangalore Urban district, urban Karnataka, and urban India.

Internal migration is a major source for changes in net increase in inter-census population of Bangalore. For instance, net increase in population is equal to 1.21 million during 1981-91 and 1.56 million during 1991-2001. In-migration contributed to this increase by about 45 percent 1981-91 and about 49 percent during 1991-2001 (**Table 3**). Next to immigration, jurisdictional changes contributed about 33 percent and rest by natural increase.

Bangalore UAA joined with other mega cities (5 million and above population) of India in 2001, viz., Mumbai; Kolkata, Delhi, Chennai, and Hyderabad. Bangalore is the 5th biggest UAA in India in 2001 (**Table 4**). It attracted third highest number of migrants (=0.76 million). Migrants comprised 6.2 percent of total population, which is the lowest among the mega cities. During 1991-2001, its annual growth rate of population is second highest (3.25 percent) among the mega cities. Unlike other mega cities, Bangalore's population growth rate during 1991-2001 is higher by its city plus outgrowth than by its urban agglomeration. Literacy rates in Bangalore UAA are higher than in other mega cities except in Mumbai.

Economic growth of Bangalore

Gross District Income or GDI (at factor cost and at constant or 1993-94 prices) of Bangalore (used interchangeably with Bangalore Urban district) increased from Rs.36.58 billion in 1980-81 to Rs.71.72 billion in 1993-94, Rs.146.96 billion in 1999-00 and to Rs.250.42 billion in 2004-05 (**Table 5**). Annual growth rate of GDI recorded 5.32 percent during 1980-81 to 1993-94, 10.79 percent during 1993-94 to 1999-00, 9.29 percent during 1999-00 to 2004-05, and 10.98 percent during 1993-94 to 2004-05. At the same time, Bangalore's per capita income increased from Rs.7472 in 1980-81 to Rs.14127 in 1993-94, Rs.22970 in 1999-00 and to Rs.36592. Annual growth rate of per capita GDI recorded 5.02 percent during 1980-81 to 1993-94, 7.19 percent during 1993-94 to 1999-00, 8.07 percent during 1999-00 to 2004-05, and 8.25 percent during 1993-94 to 2004-05. During this period, Bangalore's share in the State income (or India's National Income) showed an increase from 19.11 (or 0.91) percent in 1980-81, 17.46 (or 0.92)

percent in 1993-94, 23.02 (or 1.28) percent in 1999-00, and 29.21 (or 1.64) percent in 2004-05. At the same time, gap in per capita income between the district and the State (or nation) widened from 1.62 (or 1.61) times in 1993-94 to 2.36 (or 2.65) times in 2004-05. Mostly importantly, throughout globalization period, growth rates and levels of GDI and per capita GDI of Bangalore remained higher than for Karnataka State, all India and urban India.⁴

Economic growth of Bangalore has been contributed by secondary (includes manufacturing) and tertiary (includes service) sectors (**Table 5**). Throughout 1980-81 to 2004-05, the share of these sectors in GDI is higher than in State income and national income. In post reform years, share of secondary (or tertiary) sector in the GDI declined (or increased) from 48.92 (or 47.96) percent in 1993-94 to 39.23 (or 56.72) percent in 1999-00 and to 35.41 (or 62.91) in 2004-05. In terms of relative share, the following sectors are identifiable as key contributors for remarkable economic growth of Bangalore during globalization period (**Table 6**). (a) Registered manufacturing; (b) trade, hotels, and restaurants; and (c) real estate, ownership of dwellings, and business services. In terms of annual growth rates, all the secondary and tertiary sectors recorded positive growth except public administration during 1999-00 to 2004-05. The highest growth is evident for the sector: real estate, ownership of dwellings, and business services. The importance of business services will be highlighted later as it includes information technology services.

Changes in the structure of labourforce and sources of employment generation are important in the process of economic growth of Bangalore. According to the latest national sample survey of employment and unemployment in cities and town in India in 2004-05 (NSSO (2007)], about 53 percent of Bangalore's population is in the labour force, which is comparable with the millions cities and for urban India (**Table 7**). Bangalore's labourforce constitutes about 1.53 (or 5.79) percent total urban labour force (or total labour force in million plus cities). Of the total labour force, about 96 percent are employed. Share of labour force is higher in regular

⁴ India's national income is estimated by rural and urban areas only for the base years of National Accounts series, as the detailed data for this estimation comes from the benchmark enterprise surveys which are done once about every 5 years. Up to 2007, Net Domestic Product at factor cost and current prices (NDP) is estimated by rural and urban areas for four points in time: 1970-71, 1980-81, 1993-94, and 1999-00. In order to express urban GDP at constant prices, the NDP industry/sector shares were applied to the GDP at factor cost and constant (1993-94) prices for the respective years. This GDP data is used here and in Table 5 for comparison purposes.

wage/salaried employment (48 percent) than in self-employment (32 percent) and casual labour (16 percent). Importance of casual labour is attributable for expanding construction sector in Bangalore.

Let us look into the changes in levels of urban employment, unemployment, types of employment (i.e. self-employed, regular wage/salaried, and casual workers) in 2004-05 as compared with two previous survey years (1993-94 and 1999-00). First, out of 1000 employed persons aged 15 years and above, over 75 percent of employment belongs to males in Bangalore as in case of Million plus cities and urban India (**Table 8**). Gender differential are insightful if types of employment are considered. For instance, female participation in employment is relatively higher in Bangalore than for all Million plus cities in India, especially in case of regular wage/salaried category. This is mainly contributed by high female literary and education, as well as by growing employment opportunities for females in tertiary sector (e.g. hospitality industries, information technology enabled services, secretarial and office works). Second, of the types of employment, regular wage/salaried is the highest in Bangalore, as in the Million plus cities rather than in urban India (includes medium and small towns). Third, female unemployment is remarkably higher in Bangalore than in Million Plus cities and in the entire urban India: 13.4 percent in 1993-94, 8 percent in 1999-00, and 13.7 percent in 2004-05. Unemployment indirectly increases poverty levels in small towns, because monthly per capita consumption expenditure is lower at higher unemployment rates.⁵ Fourth, by industry, urban employment is dominated by tertiary/services sector rather than by secondary sector. This is consistent with the distribution of Bangalore's GDI by secondary and tertiary sectors in Table 5. Within the tertiary sector, urban employment is concentrated in: trade, hotel, and restaurants, financing, insurance, real estate, business services, community, social and personal services. For instance, in 2004-05, these service sectors accounted for 66 percent total employment in Bangalore. This is higher than million plus cities (62 percent) and in urban India (57 percent), as already shows in Table 7.

⁵ This is clearly evident in Government of India (2002: p148) for 1999-00. For instance, two lowest and highest urban monthly per capita consumption expenditure class and unemployment rates (measured by Currently Daily Status), were as follows. Rs.0-300 = 9.61; Rs.300-350 = 9.67; Rs.1500-1925 = 4.67; and Rs. 1925 and above = 4.10.

The productive employment growth in Bangalore has implications for public revenues. For instance, the City Development Plan for Bangalore 2006 [Government of Karnataka (2006a)] acknowledged the contribution of Bangalore to Karnataka economy by its increasing share in tax revenues: 75 percent of the corporate tax collections, 80 percent of sales tax collections, and 90 percent of luxury tax collections in the State. Further, “the city has seen a five-fold growth of state tax revenues during the period (1990-2003), which is unparalleled in the country. While tax revenues, as a ratio to GDP of most States have remained constant, there has been an increase in Karnataka, primarily because of Bangalore” (p.17).

3. GLOBALISATION OF BANGALORE

Business services include software development and IT services. Bangalore is globally known for location and growth of information and communication technology (ICT) manufacturing and services. Manufacturing includes computer hardware (i.e. personal computers, notebooks, servers, printers and other peripherals), and telecommunication equipment and networks materials. Services include development of software; training of persons for manufacture and operations of computer equipment; use of computers in government, health, education and research, and financial services; use of computer technology for IT (information technology)-enabled services (e.g. call centres and medical transcription services); and telecom services (i.e. basic and value added services on narrow and broad bandwidth by fixed and mobile telephony). Further, ICT and electronics sectors are mutually complementary. Thus, ICT sector is broadly inclusive of IT, communication and electronics in manufacturing and/or service activities.

Contribution of ICT sector (comprising both manufacturing and services) is important to explain and predict for economic growth of Bangalore in post globalization period. This calls for two analyses. First, impact of economic globalization on ICT sector. Second, impact of ICT sector on economic growth. From these analyses, globalization and economic growth of Bangalore can be connected through the ICT sector.

Globalization and ICT sector in Bangalore

Globalization is measured by two indicators: internationalization of trade and internationalization of capital.⁶ Internationalization of trade is measured by degree of openness to export trade (for lack of data on import of goods and services, however) and expressed by export trade as a percent of GDI of Bangalore. Internationalization of capital is measured by FDI inflow as a percent of GDI of Bangalore.

Internationalization of trade

Karnataka is a pioneer among the States in India in establishing a continuous database on exports. Since 1993-94, annual export data is compiled for 19 commodities at the State level. District level estimates of exports within the State are available only for 2002-03. Bangalore Urban district accounts for about 69 percent of total exports and 97 percent of ICT exports from the State. This share is used to generate exports data for Bangalore in 1993-94, 1999-00, and 2004-05. Other important exports of Bangalore include readymade garments, silk products, processed food products, and engineering goods.

Total exports from Bangalore increased from Rs.20.87 billion in 1993-94 to Rs.88.69 billion in 1999-00 and to Rs.432.21 billion in 2004-05 (**Table 9**). This resulted in remarkable increase in the degree of openness to export trade from 29.10 percent in 1993-94 to 40.58 percent in 1999-00 and to 99.62 percent in 2004-05, as compared to the degree of openness to export trade of Karnataka (or India): 7.36 (or 11.03) percent in 1993-94, 13.53 (or 12.07) percent in 1999-00, and 42.17 (or 17.07) percent in 2004-05.⁷ Bangalore contributed to this globalization of export trade at the national level by its increasing share in national total exports: 2.42 percent in 1993-94 to 4.17 percent in 1999-00, and 8.50 percent in 2004-05. Bangalore's export trade is mainly contributed by the ICT sector. For instance, of the total exports from Bangalore, ICT sector contributed 10.92 percent in 1993-94, 70.83 percent in 1999-00, and 70.67 percent in 2004-05.

⁶ These measures are widely applied at international level as well. This is evident, for instance, in Table 6.1 on indicators of integration with global economy in World Bank (2007).

⁷ Exports from Bangalore included software and IT service. To bring in comparability in exports between Bangalore and at all India level, export of software and IT services from India have been added to the total merchandise exports from India.

Of the total ICT exports from India, contribution of Bangalore was about 21 percent in 1993-94, 32 percent in 1999-00, and 36 percent in 2004-05. Throughout 1993-94 to 2004-05, annual growth rates of total exports and ICT exports of Bangalore remained higher than at the national levels. These indicators shows Bangalore's remarkable globalization, as it is related to internationalization of ICT trade.

Internalization of capital

Availability of foreign investment data is limited to inflow of foreign direct investment (FDI) at the state level.⁸ Inflow of FDI into Bangalore is computed at 86 percent of FDI inflows into Karnataka State.⁹ Thus, the following analysis of internationalization of capital is restricted for inflow of FDI.¹⁰

With the introduction of national economic reforms for liberalization of foreign investment into the country in 1991, Bangalore benefited by cumulative FDI inflow of Rs.221 billion during 1993-94 to 2004-05 and the highest annual inflow of Rs.257 million in 1996-97 (**Table 10**). Share of FDI inflows into Bangalore as a percentage of nation's total FDI inflows varied from about 5 percent in 1993-94, 25 percent in 1995-96, 44 percent in 1998-99 and 5.25 percent in 2004-05. Annual variation in FDI inflows into Bangalore is lower than into India and Karnataka State, because the standard deviation of its annual inflow is equal to 1527 as compared to all

⁸ Attraction of FDI inflows is guided by many policy objectives. First, FDI is a source of financial and non-financial (e.g. transfer of state-of-art technology and managerial skills) capital for production of goods and services. Second, private FDI is a source of financing investment through non-public debt instrument as well as through public-private partnership programmes. Third, FDI is a source of accessing global markets and earning precious foreign exchange, especially if the globally established multi-national corporations make the productive investments.

⁹ This computation is based on the records of FDI approvals from April 1995 to December 2005 by 2700 individual projects with details on amount of FDI and districts' location code, obtained from the Karnataka Udyog Mitra – an investment promotion body - in the Government of Karnataka.

¹⁰ At the national level, this restricted focus underestimates the degree of internationalization of capital. For instance, net (inflows minus outflows) foreign investment in India increased from Rs.1.74 billion in 1990-91 to Rs.72.16 billion in 1995-96, Rs.93.96 billion in 1999-00, and to Rs.251.59 billion in 2004-05. Share of FDI in this total foreign investment ranged from 94.57 percent in 1990-91 to 44.24 in 1995-96, 41.76 percent in 1999-00, and 38.84 percent in 2004-05. As a percentage of GDP (at factor cost and current prices), total foreign investment was equal to 0.04 percent in 1990-91, 1.52 percent in 1995-96, 1.28 percent in 1999-00, and 2.27 in 2004-05.

India (9166) and Karnataka (1776). Before 1993-94, share of FDI inflows was less than one percent in district income for Bangalore. In the post-globalization period, this share remained higher but varied from about 1.16 percent in 1993-94, 44 percent in 1998-99 and 3 percent in 2004-05. Further, for all the years during 1993-94 to 2003-04, Bangalore recorded a higher internationalization of capital than at the State and national levels.

During 1999-00 to 2004-05, Bangalore attracted Rs.102.10 billion worth of total FDI. This is contributed by different countries: USA (32 percent), Germany (9 percent), Mauritius (7 percent), UK (7 percent), Japan (6 percent), Singapore (5 percent), and by non-resident Indians (7 percent). Most importantly, electronics and computer (hardware/software) including software parks accounted for 58.20 percent. Other key attractors of FDI included engineering sector (9.73 percent), automobiles (7.63 percent) and textiles (2.64 percent). These four sectors together accounted for 78.19 percent of FDI inflows during the period. Thus, internationalization of capital in Bangalore is largely driven by the FDI inflow into ICT sector with top IT companies in the country and world located in Bangalore¹¹. Consequently, Bangalore has emerged the 4th largest technological cluster in the world. It has the largest share of membership (22.6%) in the India's National Association of Software Companies (NASSCOM) in 2005-06. In view of these achievements in ICT sector, Bangalore is called *Silicon Valley of India*, *IT Hub of Asia*, and *IT Capital of India*.

¹¹ These companies include Integrated Chip Designers [*Texas Instruments, Siemens, Synopsis, Philips, Analog Devices, and National Semiconductors*], Communication Software [*Lucent Technologies, Nortel, Siemens, Motorola, Cisco Systems, Erickson, and Sony*], and System Software [*Oracle, Novell, Sun Microsystems, Digital/Compaq, Hewlett Packard, and Network Associates*]. Global IT Major Companies, operational in 2004-05, include: *Textron Global Technology Center, Unisys Global Services, AMD India Engineering Technology, Cap Gemini Consulting, LG CNS Global, Amazon Software Development, Target Technology Services, Volvo India, Ingersoll -Rand International, ELCOTEQ Electronics, Cisco Systems Asia Services BV, Daksh eServices (IBM), and Google Online India*. Major software exporting companies include *Infosys Technologies, Wipro, IBM Global Services India, Tata Consultancy Services, Digital Global Soft, Texas Instruments (India), I-flex Solutions, Accenture Services, Dell International Services, and Oracle India*. Major electronic hardware exporting companies include *American Power Conversion, GE Medical Systems X-Ray, Wipro-GE Medical Systems, H P India, Precision Interconnect India (P), Tyco Electronics Corporation, Hical Magnetics, TVS Electronics, Solectron Centum Electronic, V X L Instruments, and Elcotech India*. Major MNCs having R & D Centres in Bangalore include *Texas Instruments, Motorola, Daimler Chrysler, General Motors, GE, SAP, Astra Zeneca, Microsoft, Intel, Phillips, Oracle, AMD*.

ICT sector and economic growth of Bangalore

Growth and share of ICT manufacturing and services in the district income of Bangalore are important indicators for the sector's aggregate contribution to Bangalore's economic growth. In the context of official income accounting, communication services include provisioning of postal (e.g. telephones, telegrams, and overseas communication services) and telecommunication services. IT services are related to data processing, software development and computer consultancy services. IT services are called software development and related services under the business services.¹²

Data for growth indicators by ICT manufacturing and services must be combined from different sources. In particular, the contribution is explicitly (or implicitly) accounted for communication (or IT) services under the tertiary sector.¹³ This contribution is estimated at the national level and allocated to States (under supra-regional sectors) by the Central Statistical Organization (CSO).¹⁴ The respective states in turn allocate the value added from communication services to their district using the same criteria. On the other hand, the contribution is not explicitly accounted for manufacturing ICT sector as a whole, or separately by communication and IT sectors. This calls for approximations in determining the sector's contribution for Bangalore, using the national and State level data in the Annual Survey of Industries.

Framework for estimation

Jalava and Pohjola (2002) provides with an excellent framework to accounting for ICT's contribution to aggregate economic growth. This framework is useful, among others, to determine the direct contribution of ICT output to economic growth. This can be briefly

¹² Other business services include services provided on fee or contract basis such as accounting, auditing, bookkeeping, data processing and tabulation, engineering, advertising, commercial art-work and market research activities. In particular, IT services are classified under NIC-892.

¹³ Methodological details of communication and IT services in national accounts are outlined Chapter 31 in Government of India (2007).

¹⁴ Estimation of national income from ICT sector is based on income method. Allocation for states' is based on proportion of workforce in the State to the nation's total.

explained as follows. Let the aggregate value added (Y), at any given time (t), consists of ICT goods and services ($Y_{ICT,t}$) and non-ICT goods and services ($Y_{NICT,t}$). Hence, from the production side, national income is equal to gross value added by the ICT and non-ICT goods and services. It is straightforward to show that $Y_t^* = (S_{ICT,t} \cdot Y_{ICT,t}^*) + (S_{NICT,t} \cdot Y_{NICT,t}^*)$, where $*$ indicates the rate of change or proportional growth rate, and $\{S_{ICT,t}, S_{NICT,t}\}$ are weights and equal to nominal output share of ICT and non-ICT goods and services. Thus, production of ICT goods and services contributes directly to total value added generated in the economy. This contribution is equal to the product of $S_{ICT,t}$ and $Y_{ICT,t}^*$.¹⁵

Value added by ICT manufacturing and services are essential for estimation of $S_{ICT,t}$ and $Y_{ICT,t}^*$. The framework for determining the value added by ICT manufacturing and services for Bangalore are as follows.

For the first time under business services, India's National Accounts Statistics published data on GDP from the IT services in 2006. This data is available from 1999-00 to 2004-05. For the Karnataka State (and Bangalore Urban district), value added from the IT services is available since 2000-01 (and for 2004-05) from the Directorate of Economics and Statistics. Using the share of Bangalore in the State's total for 2004-05 as given (i.e. 86 percent), value added from the IT services are estimated from 2001-02 through 2004-05.

Contribution of ICT manufacturing is related to production of electronics, communication equipments, and IT hardware. The Annual Survey of Industries, conducted by the Central Statistical Organization, provides with data, among others, on gross value added at 3-digit level (NIC-1998) at the national and state levels. Using this information, the gross value added of 8 industry groups [i.e. Reproduction of recorded media (223), Manufacture of office, accounting and computer machinery (300), Manufacture of electricity distribution and control apparatus (312), Manufacture of insulated wire and cable (313), Manufacture of accumulators, primary cells and primary batteries (319), Manufacture of electronic valves and tubes and other electronic

¹⁵ Other important uses of this framework is to determine growth contributions of inputs by ICT capital services, non-ICT capital services, labour services and multi-factor productivity (assumed to be Hicks neutral or output augmenting). Assuming constant returns to scale in production and competitive factor and product markets, growth accounting gives the share weighted growth of output as the sum of share weighted inputs and growth in technical progress. Accordingly, growth contributions of (a) ICT capital used as an input in production of other goods and services, and (b) ICT technology via its impact on multifactor productivity can be distinguished.

components (321), Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy (322), and Manufacture of television and radio receivers, sound and video recording or reproducing apparatus, and associated goods (323)] are computed. Sum of the gross value added by these 8 industries is considered for contribution of registered manufacturing ICT sector to gross national and State income in 2000-01 and 2004-05. For lack of district level estimates from the Annual Survey of Industries, annual contribution of ICT manufacturing for district income of Bangalore is approximated by the district's share in the State's gross valued added from the IT services in 2004-05 (i.e. 86 percent).¹⁶

Results

Bangalore's GDI from ICT sector increased from about Rs.33 billion in 2000-01 to Rs.47 billion in 2002-03 and to Rs.103 billion in 2004-05 (**Table 11**). Within the ICT sector, share of ICT services increased from about 75 percent in 2000-01 to 87 percent in 2004-05. This signifies for the contribution of ICT services to economic growth of Bangalore.

Share of ICT manufacturing in Bangalore's GDI from registered manufacturing is remarkably higher than in Karnataka's GSDP and India's GDP. For instance, share of ICT manufacturing in Bangalore's GDI from registered manufacturing is about 4 times higher than in India's GDP. In the same way, ICT services constituted an increasing share in the Bangalore's GDI from business services: about 78 percent in 2000-01, 82 percent in 2002-03, and 87 percent in 2004-05. This share is higher than at all India level.

Bangalore contributed to national and State level GDP/GSDP from ICT manufacturing and services. For instance, contribution of Bangalore's ICT services to Karnataka's GSDP (or India's GDP) from ICT services increased from about 56 (or 4) percent in 2000-01 to 65 (or 5) percent in 2002-03, and to 71 (or 7) percent in 2004-05. Bangalore's share in ICT manufacturing is evident in India's GDP by about 10 percent in 2000-01 to 13 percent in 2002-03, and to 12 percent in 2004-05.

¹⁶ An alternative approximation could be to take the district's share in State's total exports from ICT manufacturing goods. This share is about 97 percent for Bangalore. Thus, the approximation used is a lower limit for share of ICT manufacturing in Bangalore's gross district income.

Most importantly, contribution of ICT services (or manufacturing) to the GDI of Bangalore shows a remarkable increase (or marginal variations) from 11.35 (or 3.79) percent in 2000-01 to 13.05 (or 3.59) percent in 2002-03 and to 20.62 (or 3.04) percent in 2004-05. Thus, the contribution of ICT sector to economic growth of Bangalore increased from about 15 percent in 2000-01 to 17 percent in 2002-03 and to 24 percent in 2004-05. In essence, these contributions of ICT sector to Bangalore's economic growth are higher than to the economic growth at the State and national levels.

Table 12 presents the output contribution of ICT sector (= average share weighted, annual growth rate) for Bangalore from 2001-02 through 2004-05. The results show that ICT sector contributed to the growth of GDI to the extent of 4.04 percent in 2001-02, 2.60 percent in 2002-03, 5.55 percent in 2003-04, and 16.11 percent in 2004-05. In terms of percentage points, output contribution from ICT sector varied from 0.62 in 2001-02, 0.36 in 2002-03, 0.96 in 2003-04 and 5.01 in 2004-05. Further output contribution from the ICT sector in Bangalore is remarkably higher as compared to the national and Karnataka State levels.

Select international comparisons

Contribution of ICT sector to Bangalore's economic growth is comparable with advanced countries.¹⁷ These comparisons are merely indicative, because the comparisons are for the nearest year rather than for the same year. For instance, Jalava and Pohjola (2002) notes that the ICT goods and services typically constitute between 3 and 5 percent of total GDP (at current prices) in OECD countries.¹⁸ As compared to these estimates, Bangalore's (and, hence,

¹⁷ At the international level, ICT sector include manufacturing ICT, telecommunications, and other ICT services. The manufacturing ICT includes the following according to the International Standard Industry Classification (ISIC) Revision 3: 3000 (Office, accounting and computing machinery), 3130 (Insulated wire and cable), 3210 (Electronic valves and tubes and other electronic components), 3220 (Television and radio transmitters and apparatus for line telephony and line telegraphy), 3230 (Television and radio receivers, sound or video recording or reproducing apparatus, and associated goods), 3312 (Instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment), and 3313 (Industrial process equipment). ICT services include 5150 (Wholesale of machinery, equipment and supplies), 7123 (Renting of office machinery and equipment including computers), 6420 (Telecommunications), and 7200 (Computer and related activities). For details, see for instance, OECD [(2002): .226-227].

¹⁸ These estimates are quoted from OECD (2000). The following is the latest year for which individual country's estimate is reported. Australia, 1995-96 (3 percent); Canada 1997 (5.9 percent); Denmark 1996 (4 percent); France

Karnataka State) performance of ICT sector to economic growth is found to be higher than the average for the OECD countries.

The OECD Information Technology Outlook 2002 [OECD (2002)] reported select performance indicators of ICT manufacturing and services for OECD countries. First, the share of ICT manufacturing in total manufacturing value added in 1999 is above 15 percent in Finland, Ireland and South Korea; and more than 10 percent in USA and Japan. Bangalore's (or Karnataka's and India's) performance is comparable (or lower) by this international indicator because its (or Karnataka's and India's) share is equal to 16.82 (or 8.63 and 3.68) in 2000-01. Second, maximum share of ICT services in total business services valued added in 1999 ranged between 10 percent to 15 percent in Ireland, Sweden, Hungary, U.K, France and USA. As shown in *Table 11*, the performance of Bangalore as well as that of India by this indicator is comparable with the top performing OECD countries.

Jalava and Pohjola (2002) reported the latest output contribution of ICT sector for Finland during 1995-99 at 2 percentage points per year when annual output growth rate is 6 percent. As compared to this global performance, Bangalore's output contribution of ICT sector remained lower than Finland except in 2004-05.

4. CONTRIBUTORY FACTORS

Impact of concentration of people and activities on economic growth is often measured by estimating the impact of urban agglomeration economies (or increasing returns to scale) on productivity. For instance, Mitra (2000) estimates the impact of two alternative measures of agglomeration [percent of urban population, and share of non-household employment in total urban employment] on total factor productivity of manufacturing industries at two-digit level and using state level data. The cross-section regression estimates showed that, out of 17 industries, 11 industries benefited from the agglomeration economies. However, this study was not focused on ICT sector and impact of urban agglomeration economies on total factor productivity in urban

1997 (3.8 percent); Italy 1995-96 (less than one percent); Japan 1997 (7.3 percent); Norway 1995 (less than one percent); Sweden 1996 (less than one percent); UK 1997 (6.8 percent); and USA 1998, Real GDP (one percent).

areas. In fact, no evidence seems to be available on impact of urban agglomeration economies on productivity of ICT sector in general, and for Bangalore in particular. Rather, the available evidence is limited to identifying the Bangalore's comparative advantages for attraction of investment and location of ICT companies based on survey techniques. This evidence is elaborated below.

Available evidence

Historically, Karnataka (especially Bangalore) has been a natural cluster of electronics and electrical industries in both the public and private sectors. This cluster has been a source of low cost supply of components to the major industries and, hence, a major comparative and competitive advantage for the ICT manufacturing in the State (Heitzman).

Bangalore's location in global digital geography is reported in UNDP global Human Development Report 2001 [UNDP (2001)]. First, Bangalore is selected as one of 46 technological hubs in the world. Second, each hub was rated from 1 to 4 in the following areas: (a) ability of area universities and research facilities to train skilled workers or develop new technologies; (b) presence of established companies and multinational corporations to provide expertise and economic stability; (c) population's entrepreneurial drive to start new ventures; and (d) availability of venture capital to ensure that the ideas make it to market. Bangalore score was 13, the third highest in the global hubs of technological innovation. The other hubs which equaled Bangalore's score were Austin (USA), San Francisco (USA), and Taipei (Taiwan).

Basant (2006) compared the advantages for Bangalore, as a cluster of electronics and IT industry, with other IT and electronic clusters (i.e. Pune and National Capital Region) and non-clusters. Using a sample of 166 firms from Bangalore, 141 from other clusters, and 105 firms from non-clusters in 2005, Basant finds the following perceived advantages for Bangalore cluster over other clusters: (a) proximity to customers; (b) access to information from and about competitors; (c) access to skilled labour; (d) presence of hardware and software suppliers; (e) better access to support services, training facilities, R&D institutions, information on fairs and exhibitions; and (f) availability of maintenance/repair services. At the same time, Bangalore

cluster was perceived relatively better in terms of availability of following infrastructure: consultancy and support services, and presence of industry associations. In addition, productivity of labour (=ratio of sales to number of employees) was highest for both electronic firms (=Rs.9.34 million) and IT firms (Rs.5.39 million) as compared other clusters and non-cluster firms.

In essence, Bangalore is advantageous for agglomeration of IT companies because their activities are knowledge-intensive. This experience of Bangalore coincides with the impact of globalization of Japanese multinational firms in electronics. For instance, Fujita et al (2004) find increasing concentration of knowledge intensive activities (e.g. research and development) of these companies in Tokyo and Osaka and explain it “ due partly to the convenience of face-to-face communications and more generally to enjoy the agglomeration economies which are generated by accumulated knowledge and information there” (p.2951).

Further evidence

Post globalization policy initiatives by the State Government

Karnataka was the first state in India to announce a separate policy for promotion and development of information technology in the State (i.e. Information Technology Policy-1997) with objectives to increase domestic and export earnings. Subsequently, the State announced the Millennium IT Policy in 2000.¹⁹ At present, more than 12 States have separate IT policies in India. These policies encourage for use of information technology in educational institutions, government, industry and infrastructure sectors. In addition, incentives and concessions and special assistance are provided.²⁰

¹⁹ Details of evolution of State policies and programmes for ICT sector is available on: <http://www.bangaloreit.com>

²⁰ This includes exemptions from entry tax, purchase tax, electricity tax, sales tax, and work contact tax; concessions in regard to cost of land, power tariff, and stamp and registration duties; relaxations from labour laws, pollution control, power supply, zonal regulations, and floor area ratio; and support services including single window clearance and escort services. In addition,, companies registered under the Software Technology Park (STP) scheme in Bangalore are eligible from the Government of India for: Single window government clearance; 100 percent foreign equity permitted; Complete duty free import; Corporate income tax exempted up to 90%; Dedicated data communication links; and export certification provided at single point.

In addition, the State Government implemented the general industrial policy, complementary policies for the general industrial policy, and sector-specific policies for promotion and development of industries and investments, such as, the New Industrial Policy 2001-06; complementary policies include Export Promotion Policy 2002-07, Tourism Policy 2002-07, Industries (Facilitation) Act, 2002, Infrastructure Policy 1997, and Power Sector Policy 1997; and sector-specific policies include Agro-Food Processing Policy 2003, Millennium BPO Policy 2002, Industrial Promotion Policy for the Automobile Industry 2000, and Textiles Policy 2004-2009. Specialized institutions for promotion of international trade (i.e. Visvesvaraya Industrial Trade Centre) and foreign investment (i.e. Karnataka Udyog Mitra) are established.

The Bangalore Development Authority was established in 1976 as a planning and development authority for the Bangalore Metropolitan Area (BMA). In the context of globalizing Bangalore, BDA has a major role in managing the supply of and demand for land for different activities, especially for residential purposes.²¹ It prepares a Comprehensive Development Plan (CDP) once in ten year. At present, the CDP 2006-2015 (in brief, CDP 2015) is ready. The BMA covers a total area of 1306 sq. kms with 60.18 percent of conurbation (non-green belt) area and the remaining for the projected total population of 8.84 million in 2015. It aims to promote Hi-tech development by earmarking land for 375000 new jobs related to IT, software, electronics, telecommunications and other emerging knowledge-based industries by the year 2015. This should be welcome given the remarkable contribution made by the ICT sector to Bangalore's growth so far, and much larger contribution expected of it in future.

Within the State, however, Bangalore is preferred to other locations for better facilities and conducive environment for competitiveness. This is evident in a sample survey of 376 manufacturing enterprises in Karnataka State, conducted during October-December 2002 for the study in Narayana (2005), which assessed the adequacy of State Government's infrastructure facilities and business environment through a structured questionnaire, canvassed by direct and personal interviews with the proprietors. Sample enterprises comprised engineering, electronics,

²¹ In general, higher price for land results in higher cost of construction of houses for owning and renting purposes. Thus, regulation of land prices is one of the main objectives of land use regulation in the BMA. In addition, the BDA has a policy for distribution of developed residential sites according to the social categories of applicants. The price of such sites is lower than in the open real estate market. Thus, a measure of implicit subsidy is received by recipients of the BDA sites. The fact that the number of applicant exceeds by several hundred times the number of sites to be allotted is an indication of the enormous demand for subsidized land for residential purposes.

electrical, handicrafts, chemicals, drugs and pharmaceuticals, food products, plastics, textiles and garments, tiles, leather and others industries. The survey results offered two evidences. First, Bangalore had lower infrastructure constraints, and lesser impact of the constraints on competitiveness, as compared to the State as a whole (**Table 13**). Second, as compared to other parts of the State, Bangalore had better business environment (measured by one or more years of delay in obtaining official permissions and clearances at the State level for starting and continuing the manufacturing activities) (**Table 14**).²²

Public subsidy and low cost higher education

Over the years, Bangalore accumulated with large infrastructure for human resources development: 7 universities, 250 general education colleges, 580 pre-university colleges, 32 medical colleges, 58 engineering colleges, 57 polytechnics, 1573 secondary schools, and 3994 primary schools, and several premier institutes/ centres of research in pure and applied science, social sciences and humanities, management, information technology, bio-technology, fashion technology, legal education, manufacturing technology and foundry technology. In addition to this infrastructure, low cost, highly skilled, and communicative higher educated manpower have been positive factors for growth of Bangalore.

Higher education comprises general, technical, medical, and agricultural education. Using the system of Common Entrance Examination (CET) since 1993, the State government provided with access to non-agricultural higher education in all colleges and to all sections by its reservation-cum-merit policy.²³ Affordability was ensured by the Government's fixation of differential fee structures (also implied cross-subsidization) for students. In addition to this system of regulation on admission and fee fixation for students, the State Government funded its

²² More recently, Dollar et al (2006) have reported the investment climate by 7 indicators for Bangalore along with two Indian cities (Kolkata and Chennai) and 13 other cities in the world, based on the sample firms and responses of its managers. Investment climate (= institutional policy and regulatory environment in which firms operate) in Bangalore is relatively better among the Indian cities by two indicators: (a) loss due to power outage (% of total sales), and (b) index of inefficiency of government services.

²³ In a way, the Common Entrance Examination became a signaling of qualifications in labour market. As Arora and Athreya (2002) wrote: "The Indian education system is such that competition for an engineering education is intense, and as a result, an engineering degree is synonymous of such qualities as intelligence and the willingness to work hard. Software firms may value these qualities more than specific substantive engineering knowledge" (p.264).

own institutions and aided private institutions by way of grants-in-aid. This policy intervention implicitly subsidized the institutional cost of higher education for students because the students' fees were always kept below the cost recovery levels.

Following the empirical framework in Narayana (2001), the implicit budgetary subsidy of the State Government to higher education is estimated for 1990-91, 1994-95, 1998-99 and 2002-03 (**Table 15**). Subsidy is estimated by aggregate cost recovery in higher education. Estimated cost recovery indicates that the extent of budgetary subsidy had been up to 96 percent in the post-globalization period (i.e. since 1994-95). The size of subsidy increased from Rs.2.06 billion in 1990-01 to Rs.2.89 billion in 1994-95, Rs.4.61 billion in 1998-99 and to Rs.7.45 billion in 2002-02. Annual growth rate of aggregate subsidy increased from 6.96 percent from 1990-91 to 1994-95, 9.84 percent from 1994-95 to 1998-99, and 20.87 percent from 1998-99 to 2002-03. Over the entire post-globalization period, annual growth rate of subsidy equaled to about 10 percent. Of the types of higher education, subsidy was highest for general education. Share of subsidy to private sector varied from about 80 percent in 1990-91 to 76 percent in 1994-95, 71 percent in 1998-99, and 73 percent in 2002-03.

The biggest beneficiaries of the public subsidy are the graduates of the higher technical education system (e.g. higher and quicker returns to investment in education) and employers of these graduates (e.g. less investment on training), especially in the IT sector. This is partly evident, in a recent book by Friedman (2005), which has an excellent narration of global features of Bangalore IT and ITES sector: "Most of the young people I interviewed give all or part of their salary to their parents. In fact, many of them had starting salaries that are higher than their parent's retiring salaries. For entry-level jobs into the global economy, these are about as good as it gets" (p.22). Thus, the Task Force on Higher Education of the Government of Karnataka in 2004 recommended, among others, for (a) a tax on employers of those who employ graduates of the system based on the nature of the degree and the basic salary; (b) a small tax, even as low as 4 per cent, on IT and other knowledge based industries as they maximally employ graduates of the system. If implemented, these recommendations would indirectly improve the cost recovery from higher education to the State Government as a consequence of globalization, provided the new taxes would be dedicated to higher education.

Bangalore's phenomenal increase in the internationalization of trade and capital of ICT sector may be recognized as a case for increasing non-orientation of demand and capital towards domestic market. With most of the output exported, implies little backward linkage. With the possibility of capital inputs to be importable implies less forward linkage. At the same time, with most of labour (higher educated, skillful and employable) coming from local/domestic markets implies greater forward linkage. This explains for enormous demand for and growth of higher education, and underlines an element of interdependency between growth of globalization and higher education, in globalizing Bangalore.

4. CONCLUSIONS AND IMPLICATIONS

This paper has provided with a detailed analysis of globalization and urban economic growth of Bangalore with a framework and new estimates of the contributions of ICT sector. These descriptions and analyses lead to the following major conclusions and policy implications.

Bangalore emerged as India's 5th biggest metropolitan area and world's 4th biggest technological hub in 2001. About 31 percent of urban population of the Karnataka State lives in Bangalore. Its economic growth is contributed by both manufacturing and service sectors.

Bangalore's globalization is contributed by remarkable growth of ICT sector. In fact, a study of globalization and urban growth of Bangalore is a study of globalization of its ICT sector, and ICT sector's contribution to economic growth. In terms of internationalization of trade and capital, Bangalore showed a higher degree of globalization than India. Contribution of ICT sector to economic growth of Bangalore is higher than at the State and national levels. This contribution is found to be higher than the OECD averages.

ICT lead economic globalization of Bangalore has the greatest forward linkage with labour inputs and, hence, with higher education. This is contributory for growth of higher education from the demand side, while higher education is contributory for globalization from the supply side. This implies an element of interdependency between economic globalization and higher education in Bangalore.

Bangalore's experience demonstrates how best globalization can be contributory for urban economic growth, and urban growth to regional and national economic growth, in a developing country like India. These results offer empirical justification for continuing with and strengthening of public policies for promotion of growth-oriented ICT sector and economic globalization at the urban, regional and national levels.

Bangalore's globalization is driven by the historical growth and cluster of electrical and electronics industries; availability of highly skilled, communicative and low cost technical manpower by subsidized higher education; enormous growth of external demand; generous public policy incentives and concessions; and by its competitive locational advantages in business environment and investment climate, both within the State and country. Nevertheless, Bangalore's high and speedy economic growth has been demanding in terms of high quality and low cost infrastructure facilities, and further improvements in business environment and investment climate, at globally competitive levels. If persists, this insufficiency may prove to be fatal for the sustainability of globalization for Bangalore. In this regard, efforts by all levels of the government (i.e. Central, State, and urban local governments) for sustainability of Bangalore's globalization should be most welcome.

Given the comparability of economic structure and availability of data, the framework in this paper can be used to generate new empirical evidence (either supporting or confronting) on the impact of ICT globalization on urban growth in other cities in India and elsewhere in developing countries. In addition, policy lessons from the experience of Bangalore's economic growth are considerable in regard to (a) promotional factors for growth of ICT sector, (b) competitive public policies and programmes for globalization, provision of infrastructure, and creation of business environment and investment climate, and (c) investment on human capital to generate high quality and low cost technical manpower.

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Table 1: Select demographic growth indicators of Bangalore UAA: 1981 to 2001

Indicators	1981	1991	2001
Bangalore UAA			
• Total population (million persons)	2.92	4.13	5.69
• Total area (sq.km)	365.65	445.91	531.00
• Decadal growth of population (%)	75.56	41.36	37.69
• Annual growth rate (%)	5.79	3.52	3.25
• Density of population (persons)	7991	9263	10710
Urban Karnataka			
• Annual growth rate (%)	4.18	2.63	2.57
• Share of Bangalore UAA (%)	27.23	29.70	31.73
Urban India			
• Annual growth rate (%)	3.87	3.14	2.77
• Share of Bangalore UAA (%)	1.83	1.90	1.99
Size class of cities			
• Share of Bangalore UAA in Class I cities in Karnataka	46.42	45.90	47.22
• Share of Bangalore UAA in Class I cities in India	3.04	2.91	2.90
• Share of Bangalore UAA in Million plus cities in India	6.94	5.85	5.27

Notes: Annual growth rate refers to compound average annual growth during 1971-1981, 1981-1991, and 1991-2001. UAA refers to urban agglomeration area.

Source: Compiled and computed by using the basic data in Government of India (2001a, 2001b, 2001c and 2001d).

Table 2: Select comparative demographic indicators of Bangalore 2001

Indicators	Bangalore City	Bangalore UAA	Bangalore Urban District	Urban Karnataka	Urban India
1. Density of population (persons per sq.km)	19077	10710	2978	NA	NA
2. Literacy rate (%)					
2.1. Total	85.87	85.74	83.9	81.05	80.06
2.2. Male	89.93	89.56	88.4	86.85	86.42
2.3. Female	81.42	81.52	79.0	74.87	72.99

NA refers to not available.

Source: Same as in Table 1.

Table 3: Source of net increase in population in Bangalore UAA: 1981 – 2001

Sources of population growth	1981-1991 (million)	Percent to net increase	1991-2001 (million)	Percent to net increase
1. Natural increase	0.27	22.31	0.30	19.23
2. In-migration	0.54	44.63	0.76	48.72
3. Jurisdictional changes	0.40	33.06	0.50	32.05
• Net increase	1.21	100.00	1.56	100.00

Source: Government of Karnataka (2006)

Table 4: Select comparative growth indicators of Bangalore and other Mega Cities in India: 2001

Indicators	Bangalore	Mumbai	Kolkata	Delhi	Chennai	Hyderabad
1. Total population (million)	5.69	16.37	13.22	12.79	6.42	5.53
2. Percent of migrants in total population	6.2	15.1	6.6	16.4	13.4	8.7
3. Major sources of population growth						
• Annual growth rate of total population (%)						
➤ 1981-1991	3.52	4.24	1.81	3.85	2.34	5.34
➤ 1991-1981	3.25	2.62	1.82	4.18	1.69	2.41
• Annual growth rate of population in urban agglomeration (%)						
➤ 1981-1991	4.13	3.37	1.99	4.69	2.64	6.65
➤ 1991-1981	3.78	2.99	1.99	5.19	1.85	2.74
• Annual growth rate of population in city proper and its out-growth (%)						
➤ 1981-1991	0.74	2.04	0.66	4.32	2.89	3.92
➤ 1991-1981	6.13	2.00	0.41	3.62	0.97	1.28
4. Literacy rate (%)						
• Total	85.74	87.38	83.04	82.08	81.99	78.51
• Male	89.56	92.14	86.86	87.41	86.79	83.76
• Female	81.42	81.52	78.61	75.54	76.94	72.91

Source: Census of India – various years.

Table 5: Economic growth of Bangalore: 1980-81 to 2004-05

Growth indicators	Bangalore Urban District				Karnataka State				All India			
	1980-81	1993-94	1999-00	2004-05	1980-81	1993-94	1999-00	2004-05	1980-81	1993-94	1999-00	2004-05
1. Gross income (Rs. in billion)	36.58	71.72	146.96	250.42	191.37	410.79	638.51	857.24	4011.28 (1648.14)	7813.45 (3192.01)	11483.67 (5936.52)	15294.08 (NA)
2. Bangalore district's share in State and National income (%)					19.11	17.46	23.02	29.21	0.91 (2.22)	0.92 (2.25)	1.28 (2.48)	1.64 (NA)
3. Per capita income (Rs.)	7472	14127	22970	36592	5208	8706	12322	15527	5908 (10498)	8759 (13525)	11472 (21587)	13816 (NA)
4. Sectors' share												
• Secondary	42.44	48.92	39.23	35.41	22.65	26.15	27.39	28.86	24.37	26.26	26.68	27.3
• Tertiary	47.53	47.96	56.72	62.91	33.56	38.27	43.70	52.61	35.99	42.77	48.33	53.1
5. Growth rates	1980-81 to 1993-04	1993-94 to 1999-00	1999-00 to 2004-05	1993-94 to 2004-05	1980-81 to 1993-04	1993-94 to 1999-00	1999-00 to 2004-05	1993-94 to 2004-05	1980-81 to 1993-04	1993-94 to 1999-00	1999-00 to 2004-05	1993-94 to 2004-05
5.1. Gross income	5.32	10.79	9.29	10.98	6.05	6.50	5.03	6.32	5.26 (5.22)	5.66 (9.27)	4.89 (NA)	5.76 (NA)
5.2. Per capita income	5.02	7.19	8.07	8.25	4.03	5.09	3.93	4.94	3.08 (1.97)	3.93 (6.91)	3.15 (NA)	3.87 (NA)
5.3. Sectors												
• Secondary	6.47	7.35	7.44	8.03	7.23	7.21	5.95	7.20	5.87	5.89	5.30	6.10
• Tertiary	5.39	13.48	11.19	13.52	7.13	8.54	8.33	9.18	6.67	7.52	6.55	7.68

Note: (1) Gross income is measured by: Gross District Income for Bangalore Urban District; Gross State Domestic Product (GSDP) for Karnataka State; and Gross Domestic Product (GDP) for all India. Both gross income and per capita income are at factor cost and at constant prices (1993-94) prices. (2) Secondary sector includes manufacturing, electricity, gas and water supply, and construction. Tertiary sector includes rest of the sectors or all services. (3) Figures in the parentheses refer to urban India. (4) NA refers to not available. (5) Sectors' shares do not add up to 100 due to exclusion of primary sector (includes agriculture, and mining and quarrying).

Source: (a) National Accounts Statistics 2000 and 2006, Central Statistical Organization, Government of India (New Delhi), and (2) Directorate of Economics and Statistics, Government of Karnataka, Bangalore.

Table 6: Composition and growth of Gross District Income of Bangalore: 1999-00 to 2004-05

Industrial/sector classification	Share in Gross District Income(%)			Annual growth rate (%)		
	1993-94	1999-00	2004-05	1993-94 to 1999-00	1999-00 to 2004-05	1993-94 to 2004-05
1. Manufacturing	38.03	29.54	27.65	6.86	8.09	8.07
• Registered	34.69	25.66	23.22	6.12	7.48	7.33
• Unregistered	3.34	3.87	4.43	13.17	11.75	13.62
2. Electricity, gas & water supply	3.32	2.82	2.07	8.22	3.82	6.70
3 Construction	7.58	6.88	5.70	9.27	5.90	8.37
4. Trade, hotels & restaurants	14.62	15.29	19.72	11.50	14.03	13.78
• Trade	NA	NA	NA	NA	NA	NA
• Hotels & restaurants	NA	NA	NA	NA	NA	NA
5. Transport, storage & communication	6.36	6.20	6.05	10.38	8.85	10.52
• Railways	0.14	0.12	0.08	8.80	3.19	6.70
• Transport by other means	3.30	4.24	3.51	14.81	5.92	11.55
• Storage	0.02	0.02	0.03	8.33	19.32	14.45
• Communication	2.90	1.82	2.42	3.65	14.61	9.32
6. Financing, insurance, real estate & business services	13.81	23.86	31.37	19.80	14.39	18.84
• Banking & insurance	8.67	8.72	8.64	10.90	9.12	10.96
• Real estate, ownership of dwellings & business services	5.14	15.14	22.72	29.27	16.95	25.61
7. Community, social & personal services	13.17	11.37	5.77	8.49	-2.38	3.61
• Public administration	6.76	5.15	1.78	6.56	-8.41	-0.69
• Other services	6.40	6.22	3.99	10.32	1.50	6.69

Note: NA refers to not available/reported.

Source: Directorate of Economics and Statistics, Government of Karnataka, Bangalore.

Table 7: Distribution of urban persons by types of employment in Bangalore: 2004-05

Size class of cities	Distribution of labour force (%)					Share of employment by industry/sectors		Share of population in labour force (%)
	Share in all urban centres	Self-employed	Regular wage/salaried	Casual labour	Un-employed	Manufacturing sector	Service sector	
Bangalore	1.53	32.16	47.98	16.34	3.51	21.00	65.80	52.90
Million plus cities	26.49	37.72	49.71	8.90	3.68	28.40	61.60	51.70
All urban centres	100.00	43.21	37.92	14.34	4.53	24.30	57.40	53.00

Note: All employment and unemployment indicators are measured by Usual Status criterion.

Source: NSSO (2007)

Table 8: Urban employment by size-class of cities and towns in India: 1993-94 to 2004-05

Size class of cities and towns	Employment by gender			Self-employed			Regular wage/salaried		
	1993-94	1999-00	2004-05	1993-94	1999-00	2004-05	1993-94	1999-00	2004-05
• Bangalore									
Male	763	747	846	318	272	352	462	582	535
Female	162	232	202	296	250	239	623	586	672
• Million plus cities									
Male	767	745	762	353	368	395	540	510	512
Female	181	176	198	282	352	382	569	523	528
• All urban centres									
Male	768	752	763	415	415	449	425	418	407
Female	223	197	227	446	452	471	293	335	361
	Unemployment rate			Employment in secondary sector		Employment in tertiary sector			
	1993-94	1999-00	2004-05	1999-00	2004-05	1999-00	2004-05		
• Bangalore									
Male	38	29	12	NA	337	NA	651		
Female	134	80	137	NA	312	NA	688		
• Million plus cities									
Male	38	47	34	351	375	638	610		
Female	86	64	43	325	335	636	653		
• All urban centres									
Male	40	44	38	328	344	607	594		
Female	63	57	70	317	321	501	593		

Notes: (a) All employment and unemployment figures refer to number of usually employed persons per 1000 persons aged 15 years & above according to the Usual Status criterion. (b) Employment by gender does not add up to 1000 in all causes due to non-reported cases. (c) NA refers to not available. (d) Secondary sector includes manufacturing, electricity, gas and water supply, and construction. (e) Tertiary sector includes all services.

Source: NSSO (2007)

Table 9: Globalization and internationalization of trade of Bangalore: 1993-94 to 2004-05

Indicators of globalization of ICT trade	1993-94	1999-00	2004-05
1. Total exports (Rs. in billions)			
• Bangalore	20.87	88.69	432.21
• Karnataka	30.25	128.54	626.39
• India	863.97	2125.80	5081.88
2. Degree of openness to trade (exports)			
• Bangalore	29.10	40.58	99.62
• Karnataka	7.36	13.53	42.17
• India	11.06	12.07	17.79
3. Share in nation's total exports			
• Bangalore	2.42	4.17	8.50
• Karnataka	3.50	6.05	12.33
4. Share of ICT exports in total exports			
• Bangalore	10.92	70.83	70.67
• Karnataka/Bangalore	7.77	50.38	50.27
• India	2.43	9.36	16.79
5. Share in nation's ICT exports			
• Bangalore	10.87	31.57	35.81
• Karnataka	11.20	32.55	36.92
6. Growth rates	1993-94 to 1999-00	1999-00 to 2004-05	1993-94 to 2004-05
6.1. Total exports			
• Bangalore	22.96	30.21	28.73
• India	13.73	15.63	15.91
6.2. ICT exports			
• Bangalore	60.60	30.16	50.40
• India	37.90	27.45	36.17

Notes: (a) GSDP (or GDP) refers to Gross State Domestic Product (or Gross Domestic Product) at factor cost and current prices. .

Source: Processed data on export performance of Karnataka State, Visveswaraya Industrial and Trade Centre (VITC), Government of Karnataka, Bangalore: Various years; (b) Economic Survey 2005-06, Government of India (New Delhi). (c) Statistical Year Book 2005-06, Electronics and Computer Software Export Promotion Council, Government of India (New Delhi).

Table 10: Globalization and internationalization of capital of Bangalore: 1993-94 to 2003-04

Year	Amount FDI inflows into Bangalore (Rs. in millions at current prices)	Share of Bangalore in India's FDI in India (%)	Degree of internationalization of capital (%)		
			Bangalore	Karnataka State	India
1993-94	11.63	4.54	1.16	0.24	0.24
1994-95	33.40	7.08	3.34	0.46	0.72
1995-96	195.88	25.48	19.59	0.67	3.80
1996-97	258.08	24.11	25.81	0.81	4.34
1997-98	167.29	20.40	16.73	0.95	4.28
1998-99	257.39	44.49	25.74	0.65	6.12
1999-00	86.27	18.88	8.63	0.53	2.17
2000-01	183.77	21.48	18.38	0.97	4.40
2001-02	28.44	2.41	2.84	1.41	0.76
2002-03	69.59	8.05	6.96	1.08	1.93
2003-04	10.74	1.94	1.07	0.79	0.34
2004-05	30.45	5.25	3.04	0.88	1.03

Source: Computed by using the basic data in the (a) records and website of Karnataka Udyog Mitra: http://www.kumbangalore.com/kar_projects/projects.htm, (b) Economic Survey of Government of Karnataka – Various issues, and (c) Economic Survey of Government of India – Various issues.

Table 11: Contribution of ICT sector to economic growth of Bangalore: 2000-01 to 2004-05

Growth indicators	2000-01	2001-02	2002-03	2003-04	2004-05
1. Gross value added in Bangalore's Gross District Income (GDI) at current prices					
• ICT manufacturing (Rs. in billions)	8.16	10.03	10.13	11.84	13.20
• ICT services (Rs. In billions)	24.41	30.58	36.82	49.24	89.45
• ICT sector (Rs. In billions)	32.57	40.61	46.95	61.07	102.65
2. Share of ICT manufacturing					
• Bangalore's GDI from registered manufacturing	16.82	18.94	11.44	14.81	13.10
• Karnataka's Gross State Domestic Product (GSDP) from registered manufacturing	8.63	9.49	8.57	8.17	8.28
• India's Gross Domestic Product (GDP) from registered manufacturing	3.68	3.58	3.29	2.92	3.46
3. Share of IT services (%) in total business services					
• Bangalore's GDI	78.27	80.70	81.89	84.32	86.89
• India's GDP	61.90	65.45	67.96	71.38	73.95
4. Share of Bangalore's GDI from ICT services					
• Karnataka State's GSDP from ICT services	55.79	62.83	65.35	64.42	70.71
• India's GDP from ICT services	4.16	4.24	4.61	4.87	6.95
5. Share of Bangalore's GDI from ICT manufacturing					
• India's GDP from ICT manufacturing	10.40	12.09	13.05	15.27	12.21
6. Share of ICT services (%)					
• Bangalore's GDI	11.35	12.33	13.05	14.88	20.62
• Karnataka GSDP	4.19	4.49	4.75	5.87	8.52
• India's GDP	3.04	3.44	3.54	3.97	4.52
7. Share of ICT manufacturing (%)					
• Bangalore's GDI	3.79	4.05	3.59	3.58	3.04
• Karnataka State's GSDP	0.91	1.08	0.99	1.06	1.03
• India's GDP	0.41	0.40	0.34	0.30	0.38
8. Share of ICT sector (%)					
• Bangalore's GDI	15.14	16.38	16.63	18.45	23.66
• Karnataka State's GSDP	5.09	5.56	5.74	6.93	9.55
• India's GDP	3.45	3.84	3.88	4.28	4.90

Source: Author.

Table 12: Output contribution of ICT sector in Bangalore: 2001-02 to 2004-05

Growth indicators	2001-02	2002-03	2003-04	2004-05
Bangalore				
• Growth of output (= Gross District Income at current prices): %	15.29	13.83	17.26	31.08
• Contribution from ICT Sector (%)	4.04	2.60	5.55	16.11
• Contribution from ICT sector: Percentage points	0.62	0.36	0.96	5.01
Karnataka State				
• Growth of output (Gross State Domestic Product at current prices): %	10.08	3.75	9.35	9.72
• Contribution from ICT Sector (%)	1.16	0.51	1.67	2.70
• Contribution from ICT sector: Percentage points	0.12	0.02	0.16	0.26
India				
• Growth of output (Gross Domestic Product at current prices): %	8.67	7.54	12.76	11.81
• Contribution from ICT Sector (%)	0.80	0.34	1.03	1.39
• Contribution from ICT sector: Percentage points	0.07	0.03	0.13	0.16

Source: Author

Table 13: Infrastructure facilities and competitiveness in Bangalore 2002

Indicators	Bangalore	Karnataka
1. Transport facilities affect competitiveness due to:		
• High cost of transport	27.50	36.90
• Poor road conditions	23.90	24.90
2. Poor marketing facilities affect competitiveness	29.70	45.30
3. Poor credit facilities affect competitiveness due to high interest rate	51.40	71.50
• High interest rate		
• High transaction costs (i.e. application fee, bank credit not released in time, low repayment period, number of visits to banks etc.)	12.30	23.80
4. Major source of power used: Electricity	97.80	98.30
5. Reasons for lack of continuous power supply:		
• Voltage fluctuations	41.30	59.20
• Official power cuts	45.60	65.40
• No power due to natural calamity	14.40	17.10
• Lack of in-time fault repairs	13.00	14.70
6. Poor quality and high cost of power affect competitiveness	55.70	78.00
7. Major problems in official supply of water:		
• Non-supply everyday	16.60	28.90
• Poor quality	5.00	7.70
• Lack of in-time fault repairs	7.20	3.40
• Periodic rise in water charges	18.10	21.10
• Irregular supply caused by electricity problems	5.70	24.30
8. Poor quality and high cost of water facilities affect competitiveness	21.00	35.30
9. Present low technology affect competitiveness	68.10	83.90

Notes: (a) All figures refer to percent to total sample SSEs. (b) Sample size in Bangalore Urban District is 138 SSEs and in Karnataka State is 376 SSEs.

Source: Narayana (2005).

Table 14: Business environment in Bangalore Urban District: 2002

Nature of permission or clearance required	Percent of proprietors who experienced delay in obtaining permissions and clearances for one year or more		
	Bangalore Urban district	Northern and Coastal Districts	Southern Districts
1. Permission to expansion and diversification	26.00	46.60	46.10
2. Sanction of subsidy	12.20	56.10	39.10
3. Release of subsidy	7.10	50.40	34.50
4. Power connection	9.30	17.10	10.00
5. Water connection	2.10	13.30	17.60
6. Clearance from pollution control board	17.20	32.30	13.00
7. Temporary registration	3.60	10.40	12.20
8. Permanent registration	5.00	23.70	15.30
9. Registration under Factories Act	9.40	7.60	2.20
10. Getting credit sanctioned from banks	39.10	78.00	76.00

Notes: (a) All figures refer to percent to total sample SSEs. (b) Sample size is equal to 138 SSEs in Bangalore Urban District; 105 SSEs in Northern and Coastal districts; and 130 SSEs in Southern districts.

Source: Computed by using the basic data for the study in Narayana (2005).

Table 15: Aggregate budgetary subsidy to higher education in Karnataka State: 1990-91 to 2002-03

Indicators of budgetary subsidy	1990-91	1994-95	1998-99	2002-03
1. Aggregate cost recovery in higher education (%)	1.66	2.61	2.00	3.50
2. Estimated aggregate subsidy (Rs. in billions at current prices)	2.06	2.89	4.61	7.45
3. Share of aggregate subsidy to:				
• General education	75.90	69.04	65.38	63.06
• Technical education	8.85	7.73	9.63	10.30
• Agricultural education	7.79	14.21	11.88	13.80
• Medical education	7.45	9.03	13.10	12.83
4. Share of private sector education in aggregate subsidy	79.74	75.67	70.91	72.92
	1990-91 to 1994-95	1994-95 to 1998-99	1998-99 to 2002-03	1990-91 to 2002-03
5. Annual growth rate of subsidy	6.96	9.84	20.87	8.94

Source: Government of Karnataka (2006b) and author's calculations.