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INFRASTRUCTURE, KNOWLEDGE CREATION AND SPILLOVERS AND
ECONOMIC GROWTH IN CHINA

Sangaralingam Ramesh

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economics@soas.ac.uk

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Infrastructure, Knowledge Creation and Spillovers and Economic Growth in China

Dr Sangaralingam Ramesh,
Department of Economics,
School of Oriental and African Studies,
University of London,
UK.

Email: 127401@soas.ac.uk

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Abstract

The economic prosperity associated with the Coastal regions of China has not ‘trickled’ down to the Western and Central regions sufficiently enough to eliminate the disparities in income between the regions. Indeed, the disparities between China’s Coastal regions and its other regions continue to deepen to the present day. In the Mao period the Central planners held the mistaken belief that

investment in the railways and development of heavy industry in the interior parts of China would bring prosperity. In the reform period and beyond, the focus of economic development in China has been to take advantage of China's low labour costs. In the earlier part of the reform era the focus of economic reforms centred on the development of Special Economic Zones (SEZ's). In the second phase of reform policies were centred on the High Technology Development Zones [NHTIDZ's]. A characteristic feature of both SEZ's and NHTIDZ's is that they represent a concentration of infrastructure within a predefined spatial area. The framework of analysis in this paper is the New Economic Geography [NEG]. The NEG addresses the formation of agglomeration economies accruing to physical linkages in one location. However, the NEG does not address the issue of how agglomeration economies form due to knowledge creation linkages which are location independent. The main facet of this approach is that it will allow for a qualitative analysis of the spatial aspects of the infrastructural and knowledge creation factors affecting China's economic growth. Previous approaches which have been used to study infrastructure and economic growth in China have been based on Econometric techniques. These approaches use measures such as length of railway, length of roads and telephone density, while in reality the concentration of infrastructure in the SEZ's and NHTIDZ's as significantly contributed to China's post 1978 economic growth.

Key words: Income disparity, Infrastructure, Knowledge Creation, New Economic Geography, China

Introduction

The New Economic Geography [NEG] explains the formation of agglomeration economies which arise from the activities of one firm at one point on the spatial plain; and how these economies are available to other firms which locate their activities at the same location.¹ Nevertheless, the NEG is based on Neo-Classical Economics, which with its oversimplifying assumptions allows for a very

¹ Krugman, P. (1991). "Increasing Returns and Economic Geography." *The Journal of Political Economy* 99(3): 483-499.

abstract analysis of why firms do locate themselves within one region of a country, allowing other parts of the country to play a peripheral role. The specific assumption which underlies this oversimplification of reality is that of perfect knowledge. Therefore, the NEG excludes the probability that knowledge can be created. As a theoretical framework the NEG is unable to explain how agglomeration economies arise in the spatial plain due to knowledge creation. Thus, the NEG does not establish the microfoundations of agglomeration economies resulting from knowledge creation. Similarly, Old Growth Theory [OGT] assumes that long run economic growth is due to technical progress, which is independent of economic resources for its formation; and that this technical progress is freely available to all firms. Furthermore, OGT suggests that incremental increases in capital over time will lead to smaller and smaller increases in output, the diminishing returns paradigm. It was for this reason that New Growth Theory [NGT] introduced the concept of Human Capital as a component of 'Capital' in the typical Neo-Classical production function. Therefore, NGT assumes that technical progress does result from the use of economic resources, labour and capital; and that technical progress is only partially excludable.

It is within the theoretical debate outlined above that this paper, using the economic development of China, will seek answers to evaluate the contribution of infrastructure, knowledge creation and knowledge spillovers on China's economic growth. In this way, this paper seeks to extend the literature in the following ways:

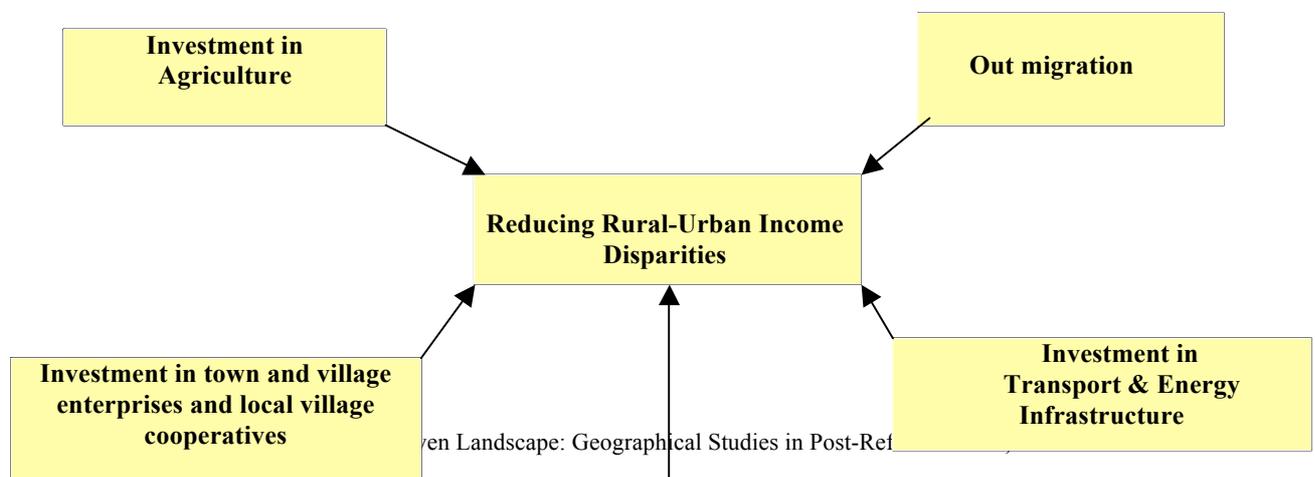
- a) Extend the NEG to allow for the creation of knowledge and establishing the microfoundations of knowledge creation.
- b) Offer an alternative view as to why income disparities have arisen and deepened in China has a consequence of the economic reforms.
- c) Show that infrastructure offers opportunities for 'in-situ' economic development has opposed to the economic development of China through the mass urbanisation of its Coastal regions.

Poverty and Development Policy

The size of China has made the formulation of a national development policy which would bring prosperity to the whole country very difficult. Therefore, it was decided in the formulation of

economic policy that the Coastal regions of China would spearhead economic development .It was hoped by government planners that the resulting economic prosperity of these Coastal regions would ‘diffuse’ to the whole country .This idea was suggested by Deng Xiaoping when he stated ‘Let some prosper ,so that others may follow’.²However, this was a mistaken belief; and the prosperity of the Coastal regions would diffuse to China’s interior hinterland only if the government facilitated it .Nevertheless, the prosperity of the Coastal regions generated through the designation of SEZ’s, creation of open Coastal cities and the creation of the open delta regions has clearly not effectively diffused through to the Central and Western regions of China as anticipated by the architects of China’s reforms. Therefore, the stated policy of the post 2003 leadership of China is to reduce rural poverty by the urbanisation of developed regions of the country. The concept of urbanisation was an implicit component of the 2001-2005 Tenth Five Year Plan which encouraged the formation of small towns and cities.³The process of urbanisation would entail the mass migration of people from poor rural hinterland areas to the prosperous Coastal regions. However, while urbanisation received support at the policy level; it lacked it at the institutional level. This was due to the worker registration system [Hukou]; and the fact that rural migrant workers migrating to the urban sector received none of the benefits of urban workers.

There are at least five ways by which an anti-poverty program may be implemented; and not all of these five areas have been elaborated in the literature. In this paper the focus of reducing rural-urban income disparities will be on soft and hard infrastructure investments; and the associated policy initiatives. These five poverty eradicating solutions are shown in Fig 1.1 below:



³ Bingqin Li et al (2004), 'Poverty and Inequality and Social Policy in China', Case Paper 87, November 2004, CASE, LSE.

Investment in Knowledge Infrastructure

Figure 1.1: Five Ways to Reduce Rural-Urban Income Disparities

Source: Author

- a) Increased investment in agriculture, agriculture is the key externality-generating sector of the Chinese rural economy.⁴
- b) Development of non-farm enterprises and investment in town and village enterprises and local village co-operatives.
- c) Out migration from rural areas. The National Population Development Strategy Research Report released in January 2007 by the government stated that there were 150 million surplus rural labourers.⁵This represents a fall of 25 million workers from 1997 when the number of surplus rural workers represented an unemployment rate of 34.8%.⁶An uncontrolled move from rural to urban areas will cause serious political instability as continuing regional income disparities will also inevitably do so. In any event, it is likely that the urban industrial sector has already absorbed much surplus rural labour. For example in Shenzhen, migrant labour accounts for 50% of the total labour force.⁷
- d) Increased investment in the so-called knowledge infrastructure (telephones, computers, networks, schools, universities, research institutes and libraries) in rural areas will increase knowledge linkages in the Chinese economy and aid in the formation of a national innovation System.

⁴ Ravallion, M. "Externalities in Rural Development: Evidence for China." World Bank Policy Research Working Paper (2879).

⁵ Kwan, C.H (2007), 'China Shifts from Labor Surplus to Labor Shortage.' China in Transition, September 2007

⁶ Beijing Review (1997) 40(35): 1-7, page 5.

⁷ Tan, L. (1994). Ibid. 18-24.

The central theme of this paper is that while the market reforms of the post 1978 period; and the resulting influx of FDI into the Coastal regions of China have created the income disparities between the interior hinterland and the Coastal regions of China, it is the creation and transfer of knowledge, and the commercialisation of this knowledge which is sustaining these income disparities. This can be clearly seen in Figure 1.6, which shows that in Coastal and developed regions such as Guangdong, Zhejiang, Shanghai, Shenzhen, Jiangsu, Beijing and Shandong the knowledge creation process (as measured by the number of patents issued) is more pronounced than in Central provinces such as Hunan, Hubei and Henan. Similarly, the knowledge creation process in the Central provinces is more pronounced than the knowledge creation process in the Western provinces of China such as Tibet, Yunnan and Sichuan. An aggregate national snapshot, as seen from Figure 1.3, shows that the contribution of Infrastructure to GDP for the years 1978 – 2004 is consistently below 6% over the years. This seeks to show that even in the reform years infrastructure contributed little to overall economic growth.

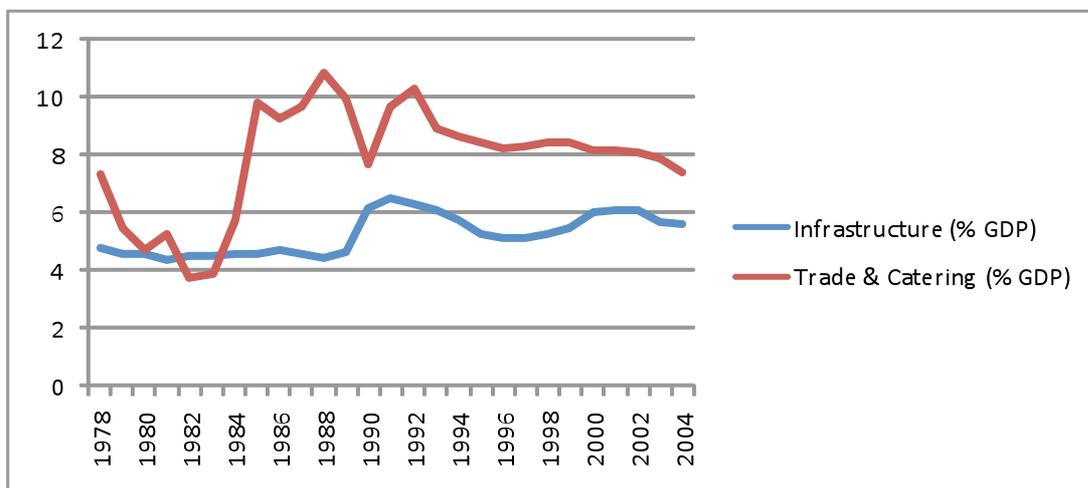


Figure 1.2: Infrastructure Contribution to GDP as a Proportion of GDP (1978 – 2004)

Source: China Statistical Yearbook 2004, Table 3.2

Note: GDP calculated in current prices.

e) The final method to reduce rural poverty is to invest in infrastructure – building roads, bridges, power stations, increasing household ownership of computers and household access to the Internet, through wireless or terrestrial methods, increasing the regions of China covered by mobile networks; and the provision of education for all. This will facilitate not only the movement of goods, resources and people but will also facilitate the creation of knowledge and the sharing of information. The result will be increased entrepreneurial activity, increased innovation and economic activity. Chen (1996) points out that investment in interior infrastructure would raise the incentive for Coastal businesses to expand into the interior and stimulate non-Coastal economic growth through the transfer of ideas as well as physical and human capital. Living in an area with relatively few physical and commercial endowments, in addition to a low population density, may not provide an incentive for farmers living in those areas to invest in local ventures as externalities may not be generated and they will be no consumption growth.⁸

The experience of economic growth in Southern China, the Pearl River Delta area, illustrates the impact of focused infrastructure investment in the SEZ's and HTDZ's on China's economic growth. The precise nature of the linkage between road infrastructure development and economic growth is unclear, although studies indicate that the building of roads is a necessary but not sufficient condition for economic growth.⁹Expansion of port facilities and improvements in the road network has reduced travel time in the region and this has enabled the efficient 'flow of human and capital resources in all directions'.¹⁰ Panyu, in the Pearl River Delta is an example of a region where heavy investment in transport infrastructure has led directly to substantial and prolonged economic growth.¹¹Two infrastructure projects, which contributed to opening up Panyu to the metropolitan area of Guangzhou,

⁸ Ravallion, M. and Jalan. (1999). "China's Lagging Poor Areas." *American Economic Review* **89**(2).

⁹ Lin, G. (1999), "Transportation and Metropolitan Development in China's Pearl River Delta: The Experience of Panyu", *Habitat Intl*, Vol.23, No.2 PP 249-270.

¹⁰ Chan, R. C. K. (1996). "Regional Development of the Pearl River Delta Region Under the Open Policy, Chapter 11 in "China's Regional Economic Development" edited by Chan, R.C.K et al" CUHK.

¹¹ Lin, G. (1999), "Transportation and Metropolitan Development in China's Pearl River Delta: The Experience of Panyu", *Habitat Intl*, Vol.23, No.2 PP 249-270.

was the building of the Ruoxi Bridge and the Humen Ferry and Humen Bridge. It can be intuitively suggested that without infrastructure investment there would be very little flow in foreign investment. The 'Third Front' program can be interpreted not only as ensuring China's productive capacity was independent of the Coastal regions during a time of war, but also has an extension of Mao's philosophy that there should be even economic development across all of China. This can be a broad interpretation of Mao's statement of the objective of the CCP has being 'to each according to their need'.¹² During the 'Third Front' program from the mid 1960's to the mid 1970's, the dispersion of Coastal industries into the interior initiated the process of urbanisation of Sichuan. This was due to the fact that much industrial activity was located along railway routes. Consequently, a growing population and an abundant supply of labour led to 'the emergence of new towns and industrial centres'.¹³ Naughton (1988) points out that the 'Third Front' program was ineffective and led to the inefficient use of physical and human capital prior to the pre-reform periods. As a result of the 'Third Front' program productive capacity was located at a distance from centres of urbanisation; and thus to the markets for goods produced. The drier climate inland often meant that productive capital assets literally rusted away; and a lack of infrastructure meant that qualified maintenance personnel could not be easily moved to where they were needed. A locality like the Pearl River Delta (PRD) of Southern China will enjoy superior factor mobility because it has better infrastructure than Yunnan Province, for example. Furthermore, private and State Owned Enterprises in the PRD will have greater access to trade because the PRD's Coastal location gets them closer to international markets. Efficiently functioning and connected factor markets, with employment opportunities, will allow individuals to improve their initial factor endowments by working, renting land or lending money. This will reduce the urban-rural income gap and can be achieved by investing in infrastructure and linking the Coastal regions to the interior of China.

¹² Veeck, G (1991), 'Preface' in 'The Uneven Landscape: Geographical Studies in Post-Reform China', Louisiana State University.

¹³ Chan, R. C. K. (1996). "Industrial Development of the Third Line Region", Chapter 11 in "China's Regional Economic Development" edited by Chan, R.C.K et al CUHK.

Recent research suggests that the urban-rural income differential is the main cause of wide spread income disparity ¹⁴ amongst China's regions. Furthermore, those working for state owned enterprises and / or living in urban centres receive benefits like subsidised housing, heating and education for their children. However, those living in the rural sector are dependent on the size of the annual harvest for their income. The annual harvest varies from year to year depending on weather conditions. The urban-rural income gap caused by fluctuations in the size of the annual harvest can, according to Chang (2002), be eliminated by 'absorbing all rural surplus labour to the modern sector'. According to Brandt (1999) if one region has different endowments from another and assuming fixed prices this will explain the income inequality that arises 'between and within localities '. Market imperfection in factor markets may increase income inequality, as the least endowed will have the lowest shadow prices.

In response to the rising disparities in income between China's Coastal region and the interior hinterland ,the Western Development Program (WDP) was initiated in 1999.At the heart of this program is investment in infrastructure in ten Western provinces and two other provinces .The WDP may go a long way to address the imbalance in investment in infrastructure between the interior and Coastal provinces of China since 1979, facilitating the movement of natural resources, goods and people from the interior to the coast; and integrating the fragmented national Chinese economy. However, the WDP is not seen as a program specifically designed to integrate the Coastal, Western and Central regions of China.

Market Structure

In China, factor markets and goods markets are highly fragmented and segmented by income and location. As one moves from the West of the country to the South a parallel shift occurs from basic-subsistence markets to the urban-port sophistication of Shanghai and the Pearl River Delta region of South China. This is shown in Figure 1.3 below:

	Market	Income	Location
	<i>Basic</i>	<i>Subsistence/barter</i>	<i>Remote areas</i>

¹⁴ Chang (2002). "The cause and cure of China's widening income disparity", China Economic Review 13,335-340

West			
	<i>Rural</i>	<i>Agricultural</i>	<i>Farming / Villages</i>
	<i>Rural-Urban</i>	<i>Agricultural/wage earner</i>	<i>Farming / Industrial</i>
	<i>Urban</i>	<i>Wage earner</i>	<i>Towns/Cities/Suburbs</i>
Coastal	<i>Urban-Port</i>	<i>Wage earner</i>	<i>Town/Cities/Port/Coast</i>

Figure 1.3: The Market Matrix

Source: The Author

The markets themselves are segmented by income with different brands of goods and shops catering for consumers with different incomes. In developed countries like the UK markets are geographically homogenous but heterogeneous by income. However, in China markets tend to be distinct both by geography and by income. This must lead to the conclusion that in China there are different firms in different geographical locations producing the same goods of differing quality for people with different incomes. The only reason for the cost of goods to differ across a homogenous market would be due to costs of transportation from the centre of manufacture of the product to the point of its sale to the consumer. However, in a fragmented market such as China's, additional costs may arise because the price mechanism cannot function effectively. There are costs associated with both manufacturers and consumers in different markets gathering information.

The formation of a homogenous price mechanism for goods and services is facilitated by the existence of store chains with a national presence. These store chains ensure, through competition, that consumers in one region will pay the same price for the same product as consumers in another region. In China's case national and regional supermarket chains are nascent with the entry of foreign MNC's such as Wal-Mart and Carrefour. Nevertheless, by ensuring standardisation of management, marketing, procurement and recruitment procedures throughout their stores nationally and regionally the 'brand' stores assist in the formation of information linkages and information spillovers.

Although, this represents the transfer of existing knowledge and says nothing about the creation of knowledge, knowledge plays a key role in the functioning of the service sector.

Market Integration

The geographically fragmented markets become integrated to a greater degree and the five types of market in the ‘Market Matrix’ shown in Figure 1.3 are homogenised as more physical and soft infrastructure investment takes place in the national spatial economy. The integration effect is illustrated in Figure 1.4 below. It would seem that there are stages and requirements for market integration and the formation of knowledge linkages:

- a) Well-developed Social Capital (Government & Civil).
- b) Focused and targeted investment of funds, whether FDI or Central government, in infrastructure (transport, energy and telecommunications) projects.
- c) Investment in physical infrastructure to link villages to towns, towns to towns and towns to villages. Even in this category there is a hierarchy of infrastructure development. For example, a stable, constant and preferably renewable supply of electricity is needed before roads; railways and computer and telephone communications can be built.
- d) Manufacturers of intermediate and final goods locate to regions with good infrastructure and access to national and international markets.
- e) National and multinational chain stores enter the economy and national and regional knowledge linkages become established.

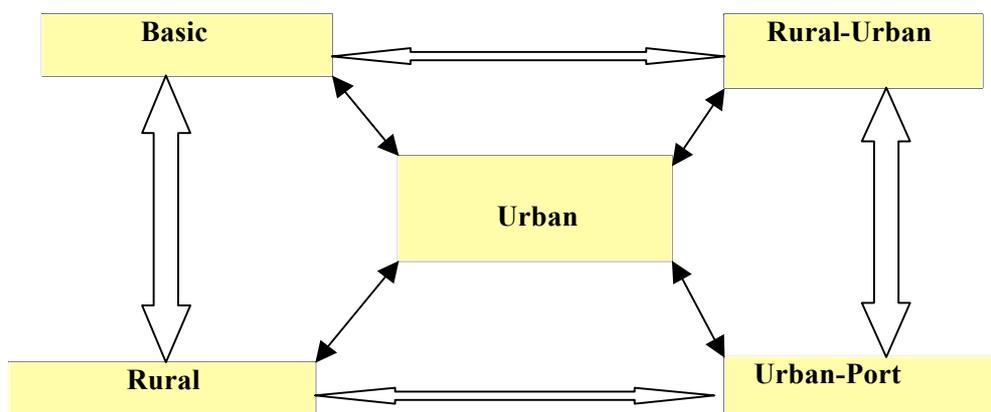


Figure 1.4: Integrated Markets.

Source: Author

In a fully integrated market like the one above, each individual 'market' becomes geographically undifferentiated from other 'markets' and the integrated markets has a whole are segmented only on the basis of the income levels of its constituents. The information relating to any changes in the basic market will be transmitted to the urban market, rural market, rural-urban and urban-port market. Thus, in an integrated market with a high level of infrastructure capital, markets will homogenise on a geographical basis. Consequently, the more integrated the market the lesser the effects of spillovers on market integration and the greater the impact on economic growth. This effect is shown in Figure 1.5 below. Conversely, in a market that is fragmented into 'distinctive markets' the effects of spillovers and positive externalities are not captured by the market and effectively 'leak'. These 'leaks' take the form of lost taxes and revenues, which would be collected by local and national government and perhaps reinvested in the economy. Thus, enhancing economic growth. 'Leaks' can be prevented by having sufficient physical and soft infrastructures in place to 'capture' the spillover effects of economic activity and knowledge creation. The implication of externalities and spillover effects on geographically fragmented markets means that a farmer living in a rural area may not invest in a venture there because he knows that the investment may not increase consumption because the effects of spillovers are not 'captured' by the market and effectively leak from the system. It is not easy for 'leaks' to happen in countries with a smaller land mass, higher population density and a high degree of infrastructure development. It is logical to assume that an economy reaches its Production Possibility Frontier when a geographically fragmented market is homogenised, through infrastructure investment and further increases in economic growth takes place through technological innovation and increased knowledge linkages. The implication is that the effects of externalities - spillovers are 'captured', do not leak and therefore leading to economic growth. It is when the PPF is reached that the theories of economic growth used to analyse/explain growth in an economy changes from endogenous growth theories to neoclassical growth theory. The former group of theories tries to explain cases where under developed economies catch up with developed ones; and the latter deals with economies, which are already at their PPF. Neo-classical growth theory limits the extent of economic growth due to government fiscal policy to either a short-term effect or counter cyclical

interventions. Long-term economic growth is due to exogenous technological innovation. Endogenous growth theories, however, assert that government fiscal policy has long-term effects on economic growth.

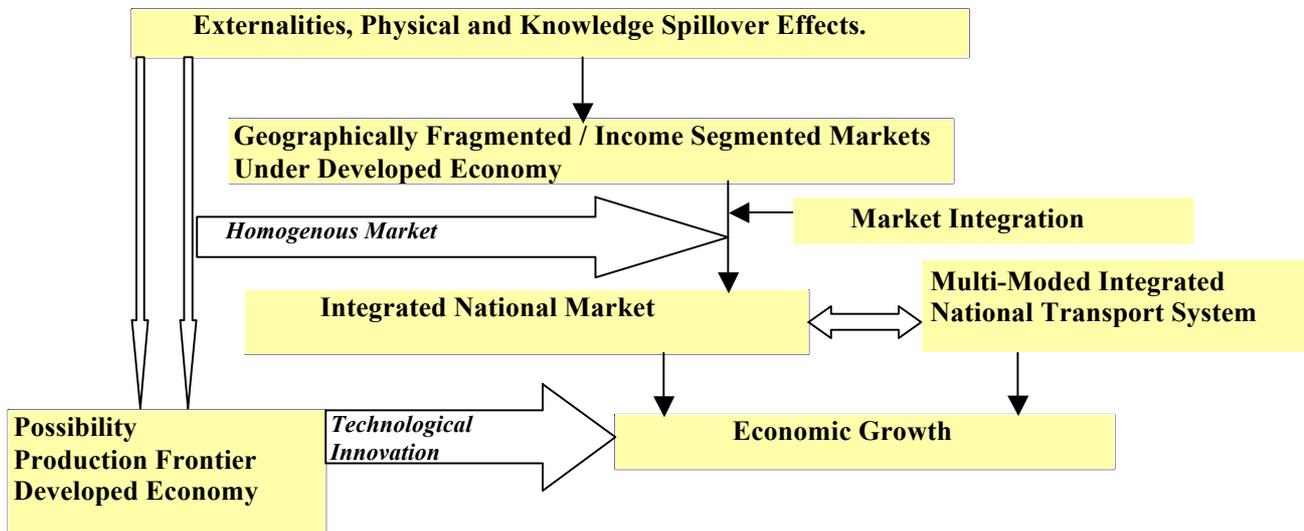


Figure 1.5: The effects of externalities / spillover effects on Markets.

Source: Author

Effects of Infrastructure

Investment in soft and hard infrastructure brings substantial benefits to the economy:

- a) The factors of production and manufactured goods can be moved from one point on the spatial plain to another, in a shorter period of time. Therefore, infrastructure facilitates in the efficient allocation of resources, the division of labour, fostering economic growth.
- b) Commuter belts form so people will travel to work from places where they live which may be a long distance from where they actually work.
- c) Infrastructure reduces the costs associated with relocating people from undeveloped rural areas to urban developed areas; and the social costs which arise from urbanisation by facilitating 'in-situ' development.

- d) Infrastructure facilitates ‘in-situ’ urbanisation because increased access to the hinterland through a well-developed transport network will allow the economic development of towns and villages.
- e) Infrastructure facilitates entrepreneurship because the lack of infrastructure in the rural, remote areas of the country prevents MNC’s from building factories and other businesses from taking root in these locations.
- f) Increased investment in educational programs, literacy campaigns and universal access to ICT facilitates the knowledge creation process.

Infrastructure, thus brings a number of benefits to the economy by facilitating knowledge linkages, the efficient allocation of resources and the division of labour .However, unless a closed economy is assumed overseas companies will act as a conduit to transfer knowledge into the Chinese economy. In the case of China this transfer of knowledge from the developed economies to China has taken place due to:

- a) The flow of Foreign Direct Investment into China and,
- b) Joint ventures between Chinese companies. Foreign companies setting up joint ventures with Chinese companies will bring with them technical and managerial expertise and transfer other functional knowledge such as Marketing, Finance and Human Resources practices. However, this does not really shed any light on how knowledge is created in the Chinese economy or how agglomeration economies result from knowledge linkages generated by knowledge externalities.

Why the Case Study Methodology?

The main problem with using officially available Chinese datasets is the reliability, integrity and limited time period over which the datasets are available. Another problem is that not all the datasets are available for each of the provinces of China .There is, therefore, a question about how effectively any intra-China provincial analysis can be carried out with the same level of consistency using standard econometric techniques. Furthermore, the role of infrastructure on economic growth has not been considered in a spatial context; and econometric studies use different proxies for infrastructure to

analyse the effects of infrastructure on economic growth.¹⁵ Thus, econometric studies do not provide a consistent body of results which can be used to determine policy. However, the results of a qualitative case study analysis allows for policy determinacy. The work by Yin (2003) on case study methodology is the most prominent in the literature. According to Yin (2003) 'the distinctive need for case studies arises out of the desire to understand complex social phenomena'. Furthermore, Yin(2003) suggests that a case study research strategy should be used when :

- a) The research question begins with a how or a why ,
- b) Where there is a distinct lack of behavioural control and ,
- c) When contemporary events are being investigated.

Specifically, in this case a case study research strategy is appropriate because:

- a) The economic effects of infrastructure, knowledge creation, spillovers on the growth of the Chinese economy are being studied in its real life context at the national and regional level.
- b) The economic effects of infrastructure, knowledge creation and spillovers on Chinese economic growth are not clearly evident; and more clarity is needed. This is especially true with regards to the effects of infrastructure, knowledge creation and spillovers on market integration. A literature survey will reveal that no analysis of China's economic growth has been carried out within the context of the New Economic Geography. Furthermore, the simultaneous impact of both transport infrastructure and knowledge creation and spillovers on Chinese economic growth (GNP) have not researched or documented.
- c) In this paper the focus is on the 'how' and 'why' of the effects of infrastructure, knowledge creation, spillovers on the economic growth of the Chinese economy.
- d) There is a distinct lack of behavioural control of the effects of infrastructure, knowledge creation, spillovers on the Chinese economy .However; the focus of research should be on the contemporary effects of infrastructure, knowledge creation, spillovers on the growth of the Chinese economy as measured by GDP.

Yin (2003) identifies five components of a successful case study design: research questions, research

¹⁵ Straub,S(2008), 'Infrastructure and Growth in Developing Countries: Recent Advances and Research Challenges,' Policy Research Working Paper 4460, World Bank.

propositions, the unit(s) which will be analysed, criteria linking propositions to the data; and the guidelines for interpretation of the findings. Furthermore, once a case study has been designed four tests have been established to evaluate the quality of the case study design. These are a) Construct Validity b) Internal Validity c) External Validity; and d) Reliability. In this paper the same five component case study methodology discussed above will be used to carry out a comparative case study on the physical infrastructure, knowledge creation, spillovers and their impact on regional economic growth has represented by a Coastal province[Jiangsu], a Central province[Hubei] and a Western province [Gansu] of China.

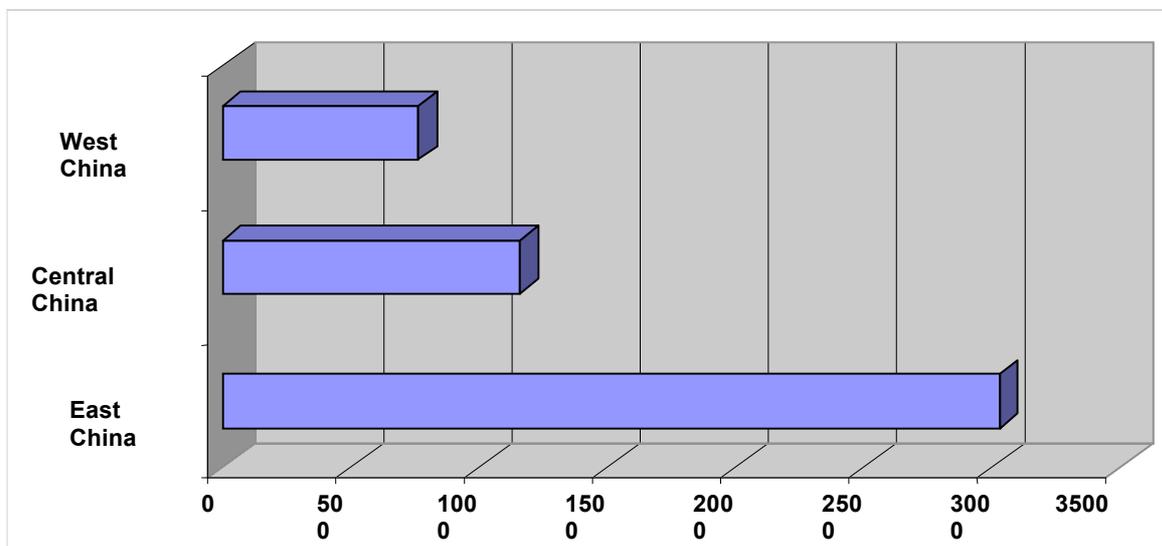


Figure 1.6 Domestic Patents (Invention) Granted By Region 2005

Source: China Statistical Yearbook 2005

Case Study: Variables

The variables to be analysed on a qualitative basis are aggregated within the following major headings: a) Infrastructure, b) Manufacturing, c) S&T Research Parks, d) Education and e) Indicators of knowledge creation.

Case Study: Propositions and Criteria

Criteria linking propositions to data:

- a) **Proposition 1:** Knowledge creation has sustained income disparities between the Coastal regions of China and the interior hinterland since the post 1978 economic reforms.

Data: [Education][Patent Registration]

Criteria: [University Graduates, R&D Spend, Patents registered]

- b) **Proposition 2:** Infrastructure simulates the effects of urbanisation by increasing the geographical and population densities of space by facilitating the mobility of people and resources.

Data: [Physical Infrastructure]

Criteria: [Freight Traffic, Passenger Traffic, highway and railroad length]

- c) **Proposition 3:** Transportation infrastructure leads to the specialisation of labour leading to the integration of fragmented local markets and market integration.

Data: [Manufacturing Output].

Criteria: [GIOV][Imports][Exports]

- d) **Proposition 4:** The ‘New Economic Geography’ is inadequate in accounting for how agglomeration economies form due to knowledge creation because it is missing the micro-foundations of agglomeration economies arising from knowledge linkages caused by knowledge externalities.

Data: [Scientific Personnel] [R&D Expenditure] [S&T Parks]

Criteria: [How research carried out by one firm benefits another?]

- e) **Proposition 5:** The speed with which knowledge is transmitted varies with the type of infrastructure.

Data: [Infrastructure]

Criteria: [Road transport -face to face contact] [Telecommunications – Instant]

The guidelines to be used in the interpretation of the findings:

a) How accurate is the data?

b) Is the data consistently available for each province in each time period?

Case Study Structure

In order to view the effects of the post 1978 reforms with a wider perspective, the case study will be focused on three Chinese provinces [Jiangsu, Hubei and Gansu] on three political periods as follows:

- a) The Maoist period, 1952- 1977
- b) Deng Xiaoping's "Four Modernizations" (Agriculture, Industry, Science/Technology, Defence) 1978 – 1995.
- c) The projection of China's Economic Future, 1996-2010. This period includes the Western Development Strategy started in 1999.

Moreover, the impacts of economic development policy on the following components of a competence block will be evaluated:

- a) Physical Infrastructure (Roads, Railways, Telephone and Internet),
- b) Manufacturing,
- c) S&T Research Parks, High Tech Zones and Universities and,
- d) Education.

Economic growth in China since the reforms of 1978 has in the main been achieved through growth in exports. Consumption by Chinese consumers has played a contrastingly insignificant part in China's economic growth. However, this has been changing in recent times with government initiated programs such as the Western Development Program; and increasing investments in infrastructure by the Chinese government. Figure 1.7 below, shows how the factors listed in a)-d) facilitate the formation of linkages in the Chinese economy and how these linkages interact to influence economic growth in China. Education facilitates knowledge creation, the agglomeration economies of which in the Chinese case materialise in Universities, Research Institutes and foreign multinational R&D centres in Science and Technology Parks, High Technology Development Zones and university incubators. Universities and other research institutes established links with industry due to the implementation of government policies in the 1980's and 1990's. These policies tended to encourage the horizontal integration of knowledge transfer and spillover activities of research institutes with

manufacturing industry.

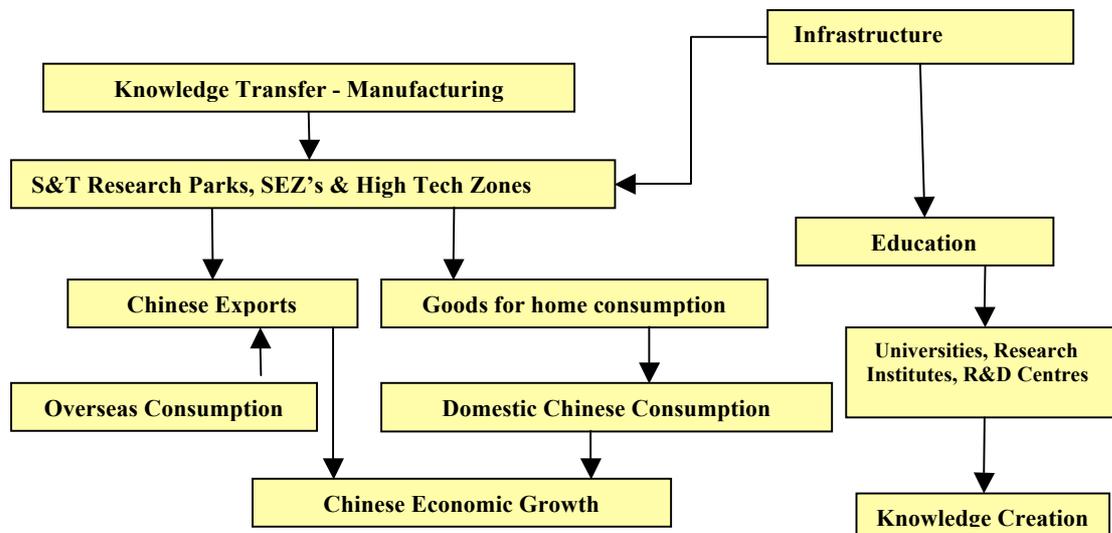


Figure 1.7: Infrastructure, Knowledge Transfer & Creation, Economic Growth

Source: Author

Knowledge transfer and spillover effects occurred because of joint ventures between Chinese companies and foreign multinationals within the SEZ's, NHTIDZ's and Science and Technology Parks. Physical infrastructure has a role both in knowledge creation and in manufacturing. In the latter case it facilitates the movement of resources to sites of manufacturing; and the movement of final goods to markets. The economic implication of transport infrastructure is that it lowers the costs of production. Physical infrastructure also facilitates the creation of knowledge by facilitating the movement of people. The economic effects of the latter are that knowledge can be disseminated through seminars and workshops. Moreover, the process of innovation and transmission of knowledge is facilitated through the use of technological infrastructure such as the Internet and computers.

Knowledge transfer, spillovers and the manufacture of high technology goods takes place in the High Tech Development Zones which were set up around the country beginning the early part of the 1990's. Light Manufacturing industry played a role in economic growth through the manufacture of products which are at the same time imitations of existing products and not innovative products. The manufacture of light goods takes place in Special Economic Zones which were created in the first round of economic reforms in the 1980's. It is only recently that the Chinese economy has begun to

move on a trajectory of economic growth caused by knowledge creation. This is entirely due to the reform of the educational and R&D sectors which the government focused on in the 1980's and 1990's. The knowledge trajectory of the Chinese economy coincides with the governments 2006-2011 plan objective of economic growth through endogenous harmony and innovation.

Results

Some key points were established as a result of the comparative case study. Firstly, the number of S&T personnel, Internet usage and population density decreases moving from Coastal to Western China. Secondly, government grants and bank loans as sources of funding for innovation increases moving from West to East. Thirdly, Hubei has the largest capacity compared to other provinces with regards to length of railway, highway and navigable inland waterway. It also has the largest capacity, compared to Jiangsu and Hubei with respect to the number of waterway passengers and railway freight traffic carried. With regard to Proposition 1, it is intuitive to suggest that there has been a 'brain drain' from China's interior regions to the Coastal regions. Moreover, due to their prosperity, and the decentralisation of funding for education, the Coastal provinces have been better able fund provincial education than the interior provinces have been able to. Propositions 2 and 5 are justifiable on the grounds that the economic growth of the Coastal region has made a bigger contribution to China's economic growth in the reform year's. Furthermore; exports from Jiangsu and internet usage have been greater than comparable figures for Hubei or Gansu. Moreover, as shown in Fig 1.8 below, after 1980 adjusted TIFA in Jiangsu overtook that in Hubei or Gansu, although after 1995 this trend reversed. The former effect maybe due to the creation of SEZ's and high technology development zones in the Coastal regions. The latter effect may be due to the Western Development Program. Proposition 3 is justifiable on the grounds that exports are greater in Jiangsu than Hubei or Gansu, especially in the reform years. The adjusted GIOV of Jiangsu began to diverge from Hubei and Gansu in 1972, the divergence becoming greater after 1980. This may be accounted for the emergence of primordial TVE's in the early 1970's; and the start of economic reforms after 1978. With regards to Proposition 4, it is apparent that knowledge creation seems to be more significant in the Coastal regions due to the larger number of S&T Personnel; and patents registered in that region. In summary, the reliance on heavy industry and natural resources increases moving from

the East of China to Its West. Furthermore, the population becomes less homogenous, the geographical terrain becomes more difficult; and there is a significant reduction in population density. The overall impact must be a reduction in the effectiveness of education.

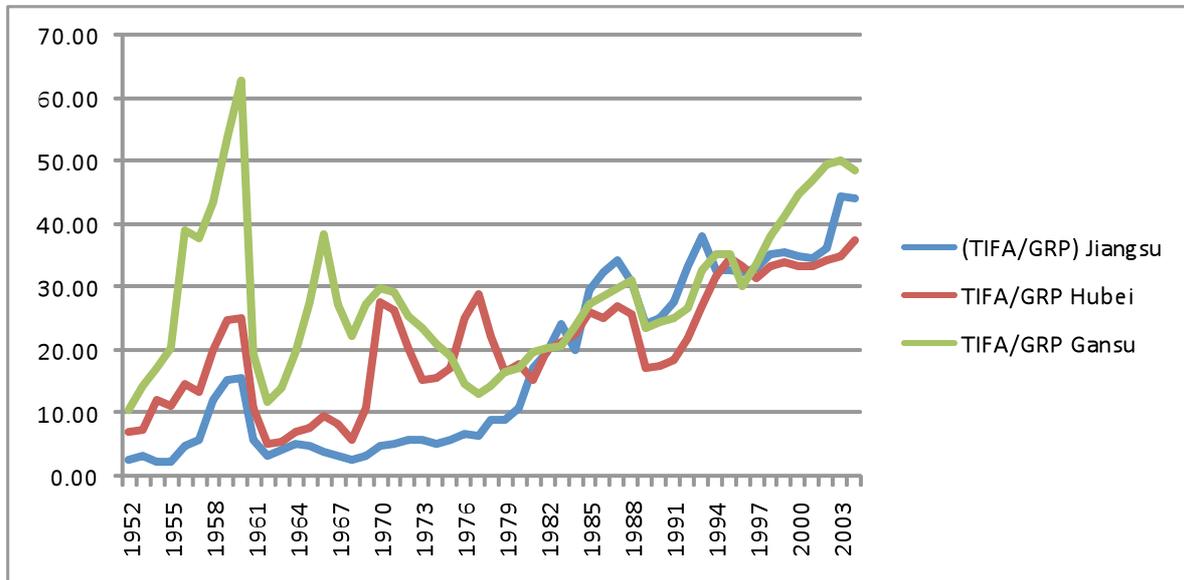


Figure 1.8: Adjusted Total Investments in Fixed Assets (TIFA) 1952-2004

Source: National Bureau of Statistics .China Compendium of Statistics 1949-2004.

Note: Total Investment in Fixed Assets (TIFA) adjusted for inflation by dividing by the respective provincial Gross Regional Products (GRP).

Conclusion

From 1949 to 1977, government policy placed great emphasis on the misplaced judgement that the railways, central planning and heavy industry would bring prosperity to China. For example in the period 1953 to 1977, Gansu registered the largest percentage increases in the length of railways, numbers of railway passengers, and railway freight. In the same period, Hubei registered the largest percentage increases in the numbers of waterway and highway passengers, as well as waterway and highway freight transported. The importance of the interior of China in this period is further exhibited by the high and almost equal percentage increases in the levels of adjusted TIFA [Figure 1.8] in Hubei and Gansu compared to Jiangsu. Nevertheless, after 1980 the percentage increases in adjusted TIFA in Jiangsu overtook that of both Hubei and Gansu. This is clear evidence of the impact of the

economic reforms which began in 1978. However, after 1995 the percentage increases in adjusted TIFA of Gansu overtook that of both Jiangsu and Hubei. These may be an indication of an emerging Western Development Plan. The results discussed suggest that in the pre-reform period, the government invested in railway infrastructure for the purposes of supporting heavy industry in northern China, closely following the Soviet model of development. Light manufacturing industry which was to have great significance in the years following 1978 did not have any place in the Central command economy of the years 1949 to 1977. However, small scale rural enterprises, the near relatives of TVE's, which specialised in the manufacture of light goods began to be established in Jiangsu from the early 1970's while SoE's constituted the Central plan 'backbone' of the interior hinterland. It is notable that it was in 1972 that the Gross Input Output Value of Jiangsu and Gansu began to diverge. The results discussed relate to Proposition 3.

Knowledge creation has sustained income disparities between the Coastal regions of China and its interior since 1978. Patent data does to an extent confirm this statement. For example in the period 1985 to 2005, more patents were granted, [Figure 1.6], on a year by year basis in Jiangsu compared to Hubei or Gansu. Moreover, the trend in innovation is greater amongst industrial and mineral enterprises; and enterprises are more significant in the Coastal regions than in the interior. However, other results conflict with this view. For example, the rate of increase in telephone subscribers and teachers employed in secondary schools was more notable in Gansu after 1978 than in Hubei or Jiangsu. The same thing can be said about university enrolments. However, despite Gansu's predominant growth rates, Jiangsu has a larger aggregate balance with regards to these factors. Other results can be used to reinforce this point. For example, in 2001 Jiangsu had the largest number of full-time teachers, graduates, numbers of new products, scientists and engineers as well as the number of Natural Science topics under research. Moreover, Jiangsu has the greatest source of funds for innovation, whether bank loans, enterprise funds or government grants. In this respect entrepreneurship seems also to be predominant in Jiangsu because it has the greatest number of LME's than either Hubei or Gansu. Nevertheless, the paradox is that Gansu has more LME's than Hubei. Aspects of Proposition 4 and Proposition 1 have been relevant here. Knowledge spillovers have in the main been facilitated through FDI and government reforms which have facilitated the

horizontal integration of the activities of research institutes with commercial enterprises. Data with regards to knowledge spillovers have not been specifically analysed, although specific reforms have been evaluated.

The post 1978 economic reforms have created deepening income disparities between China's Coastal regions and its interior hinterland. Nevertheless, the government instituted the Western Development Plan; and the Eleventh Five Year Plan in order to address this problem. However, in hindsight, had the government followed a dual track reform policy in 1978 these increasing income disparities would have been neutralised at an earlier date. The dual track reform policies could have for example used pro-poor policies such as increased infrastructural investment in China's Western and Central provinces to ignite rural development in combination with the reform policies associated with the Coastal regions. The emphasis of post 1978 economic policies focused on the development of SEZ's and Open Coastal areas in the 1980's and the High Technology Development Zone's and Science and Technology Parks in the 1990's. Indeed China's development strategy and development model was a combination of 'islands of Capitalism in an ocean of Central planning' diffused with national reforms focusing on R&D and education. Here, the 'islands of Capitalism' refer to the SEZ's and other development zones. The role of infrastructure focused around the development of these areas. In the period 1979-1995, percentage increases in waterway and highway freight was greatest in Jiangsu as well as the percentage increases in the length of highways and highway passengers. It is possible to suggest that the changes in the length of highways in Jiangsu, at this time, maybe be attributable to the development of SEZ's. The development of highways in Jiangsu followed the same pattern in the period 1997 to 2004. However, in the same period Gansu showed the largest increase with respect to highway freight. But with respect to percentage changes in the numbers of railway and highway passengers, Gansu registered bigger increases than Jiangsu. Nevertheless, where has the aggregate length of railways in the period 1949 to 1977 is significant in Jiangsu, there is an overall decrease to the period 1995 to 2004. The same can be said for railway stock in Hubei and Gansu, but the decline in railway stock is more indicative in Jiangsu. This decline may be accounted for by the requirement of sectors to produce a rate of return; and the dependence of the interior of China on heavy industry. The development of Coastal industry focused on the manufacture of light goods with

a high technology content, as well as cost effective access to international markets.

The role of education within Chinese society has changed during the reform period. Before the reforms there was much emphasis on ensuring that the masses were politically educated with an emphasis on vocational education to suit the needs of central planning and heavy industry. During this period there was no need for fostering creative thinking in students. The only requirement of education was to produce workers who would fulfil the requirements of the respective five year plan. However, after 1978 the emphasis of educational policy was on quality, choice and creativity. This approach was underlined in the Eleventh Five Year Plan with the slogan of ‘endogenous innovation and harmony’. However, China’s educational reforms have been more effective in the Coastal regions such as Jiangsu because of the provinces ability to better fund provincial education due to its increased prosperity .Moreover, interior provinces such as Gansu suffer from lack of resources, difficult terrain ,a non-homogeneous population; and a ‘brain drain’ to the Coastal regions .These factors reduce the effectiveness of education in these regions. There is thus a need for China to establish a consistent and coherent national education system with common standards ,adequate funding Central educational funding for poor provinces ;and the efficiency of Central government in making the Internet available to all for educational purposes. If China follows such a path, then China can break from the mould cast by the 1978 reforms; and ensure that a national innovation system is created and enhanced. At present regional innovation systems may exist in China, but an effective national innovation system is dysfunctional.

Postscript and Further Research

The Chinese development model of ‘islands of Capitalism in an ocean of state planning’ is applicable, at least in part to other developing countries such as India and Brazil .For example the SEZ Act 2005 was passed in India to facilitate the development of SEZ’s in Indian states. Nevertheless, the problem with infrastructure development in India is illustrated by the construction of the new airport at Bangalore .The airport was built but getting there from the urban centre was the problem ,the need for a road network had not been factored in during the airports planning stage. Thus, amongst the Indian

bureaucracy there is ‘an inability to plan for India’s future and fix its sagging infrastructure’.¹⁶ Yet during the election campaign for Mayor of Bangalore, the election promise had been to turn the city into an Indian Shanghai. However, ‘it is a far cry from China where an authoritarian government can more easily direct resources, yet in a thriving democracy such as India, the very definition of progress is debated, and the law is a tangle’.¹⁷ Moreover, China has used its development model to establish SEZ like structures in other countries, which itself operates. An example can be found in Mauritius where China has acquired land near Port Louis, in order to construct an SEZ like structure which will specialise in farming.

The analytical framework developed in this paper can be used to evaluate infrastructure, knowledge creation, knowledge spillovers and economic growth in other developing countries. For example, using the NEG has a framework of analysis, the distribution of infrastructure within a country can be surveyed; and knowledge linkages facilitated by knowledge creation and transfer can be established. However, using the same framework of analysis ,data can be gathered using surveys focusing on aspects of manufacturing industry ,infrastructure ,education and centres of knowledge creation. In this way, the analysis offered in this paper can be built upon to specifically establish how infrastructure, knowledge creation and knowledge spillovers have impacted on the Chinese economy since 1978.

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¹⁶ International Herald Tribune May 22nd 2008.

¹⁷ Ibid.

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