Assessing Economic Impacts of Connectivity Corridors:
An Empirical Investigation

Prabir De
Sunetra Ghatak
Durairaj Kumarasamy

RIS
Research and Information System
for Developing Countries
विकासशील देशों की अनुसंधान एवं सूचना प्रणाली

AIC
ASEAN-India Centre at RIS

Assessing Economic Impacts of Connectivity Corridors: An Empirical Investigation

Assessing Economic Impacts of Connectivity Corridors: An Empirical Investigation

Prabir De
Sunetra Ghatak
Durairaj Kumarasamy

RIS
Research and Information System for Developing Countries
विकासशील देशों की अनुसंधान एवं सूचना प्रणाली

AIC
ASEAN-India Centre at RIS

ISBN: 81-7122-136-X

Published in 2018 by:

RIS
Research and Information System
for Developing Countries
विकासशील देशों की अनुसंधान एवं सूचना प्रणाली

AIC
ASEAN-India Centre at RIS

Core IV-B, Fourth Floor, India Habitat Centre
Lodhi Road, New Delhi-110 003, India
Tel.: +91-11-2468 2177-80, Fax: +91-11-2468 2173-74
E-mail: aic@ris.org.in; dgoffice@ris.org.in
Website: www.ris.org.in; http://aic.ris.org.in

Contents

Preface

Prof. Sachin Chaturvedi
Director General, RIS

India's 'Act East Policy' has been a major theme of the RIS work programme to strengthen ASEAN-India partnership. In this regard, integration of our North East Region (NER) with Southeast, East Asia and South Asia by strengthening connectivity is very important. This is also essential in the context of, among others, the Bay of Bengal Initiative for Multisectoral Technical and Economic Cooperation (BIMSTEC), Mekong-Ganga Cooperation (MGC) as well as for India's thrust for economic engagements with CLMV.

Enhanced connectivity is also important to lower trade costs, reduce trade time, enhance supply chain efficiency, and facilitate agglomeration. These, in turn, enable a country be better integrated into cross-border value chains, enhance competitiveness and productivity, generate jobs and reduce poverty. Thus, improved connectivity can contribute directly to the realization of the United Nations 2030 Development Agenda and Sustainable Development Goals (SDGs). India has successfully initiated several corridor development projects to provide cost effective and efficient logistic services.

The ASEAN-India Centre (AIC), set up at RIS, has been actively engaged in undertaking evidence-based policy research to come out with effective road map to forward in this direction. The present study entitled "Assessing Economic Impacts of Connectivity Corridors: An Empirical Investigation" has been conducted by Dr. Prabir De, Dr. Sunetra Ghatak and Dr. Durairaj Kumarasamy. It evaluates the economic impacts of the connectivity corridors in India.

The focus of the study is on developmental impact of existing East-West Corridor (EWC) and the proposed cross-border corridors such as Trilateral Highway (TH), Kaladan multi-modal transit transport corrdior, and Bangladesh-China-India-Myanmar Economic Corridor

(BCIM-EC), particularly in the context of NER. According to the study, among others, the corridor-based development projects may generate economic activities and regional development, which, in turn, would influence economic growth through higher production and consumption. The study also provides a set of recommendations for promoting economic activities and regional development.

I am sure the study would be found a valuable resource by policymakers, academics and practitioners.

Sachin Chaturvedi

Acknowledgments

This study has been conducted on request of the Ministry of External Affairs (MEA), Government of India. Authors acknowledge the annual grant extended by the MEA to ASEAN-India Centre (AIC) at RIS for the year 2016-17.

Authors are thankful to Prof. Sachin Chaturvedi, Director General, RIS for his support and encouragement. They are grateful to Prof. Ajitava Raychaudhuri, Jadavpur University, Kolkata for his guidance. Authors are thankful to Dr Sanjib Pohit, Senior Fellow, National Council of Applied Economic Research (NCAER), New Delhi; Dr Masudur Rahman, Waikato University, Hamilton, New Zealand; Prof. C. Veeramani, Indira Gandhi Institute of Development Research (IGIDR), Mumbai; and Dr Dibyendu Maiti, Associate Professor, Delhi School of Economics (DSE), Delhi for their detailed comments on the earlier draft of the paper. We would like to thank them for carefully reading the manuscript and for giving constructive comments, which substantially helped improving the quality of the paper.

Authors are grateful to the Directorate General of Commercial Intelligence and Statistics (DGCIS), Kolkata and Mr. Sandip Singha Roy for providing some of the inter-state trade data, and to Mr. Sachin Singhal for drawing the maps.

Maps drawn have are generalised illustration only, and is not intended to be used for reference purposes.

Views expressed by the authors are their own. Usual disclaimers apply. For any queries or comments, please contact the authors at prabirde@ris.org.in; durairaj@ris.org.in; sunetra.ghatak@ris.org.in

List of Abbreviations

AEP	Act East Policy
ASI	Annual Survey of Industries
AIC	ASEAN-India Centre
ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
BCIM-EC	Bangladesh–China–India–Myanmar Economic Corridor
CES	Constant Elasticity of Substitution
DGCI&S	Directorate General of Commercial Intelligence and Statistics
EWC	East-West Corridor
EU	European Union
FE	Fixed Effect
GMS	Greater Mekong Subregion
GDP	Gross Domestic Product
IMR	Infant Mortality Rate
IWT	Inland Water Transport
KMTTP	Kaladan Multi-modal Transit Transport Project
LCS	Land Custom Station
LEP	Look East Policy
MDoNER	Ministry of Development of North Eastern Region
MEA	Ministry of External Affairs
MVA	Motor Vehicle Agreement
NHDP	National Highway Development Programme
NHAI	National Highways Authority of India
NSDP	Net State Domestic Product
NVA	Net Value Added
NER	North Eastern Region
PCSE	Panels Corrected Standard Errors
PCNSDP	Per Capita Net State Domestic Product
PCBs	Policy and Cultural Barriers
RE	Random Effect
RIS	Research and Information System for Developing Countries
SAARC	South Asian Association for Regional Cooperation
SEZ	Special Economic Zone
TH	Trilateral Highway

Executive Summary

Growth theories acknowledge the importance of infrastructures for regional development. There has been a strong literature to show infrastructure endowment helps promote economic development and vice versa. More recent studies have paid closer attention to infrastructures, within and across borders, seeking to identify the real contribution made by infrastructure, particularly connecting areas within a country or countries across a region. These analyses consider infrastructural endowment is one of the factors which, together with geographical location and agglomerative sectoral structure, determine a regional development potential. Corridors, which cut across a geographical space, generate economic agglomeration, subject to location, where transportation costs and time are critical to such agglomeration. Corridor-based development promotes further economic growth and regional development of that particular area through reducing time and cost of the transaction and also contributes to poverty reduction.

The North Eastern Region of India (NER) is crucial to India's growing economic and strategic partnership with Southeast and East Asia. NER is also central to India's Look East – Act East Policy (LEP) and acts as a land-bridge between South and Southeast Asia. Owing to its geographical position, several national and international corridors may likely to pass through NER either as a point of origin or point of destination.

About 98 percent of the NER's borders form India's international boundaries. It shares borders with South Asian countries like Bangladesh, Bhutan, and Nepal and with Southeast and East Asian countries like Myanmar and China. It has been argued that the NER has the potential to grow faster than its current pace, by improving the connectivity, logistics and trade facilitation, more particularly with Bangladesh, Myanmar and other Southeast and East Asian countries. Development of (transport) corridors, which connect NER with the other states of India and the neighbouring countries, can enhance both trade and connectivity. However, NER region stands way below and ahead in comparison with the

rest of India in socio-economic indicators. The slow progress of the NER's economy is reflected in the low growth in income. Nevertheless, the border trade facilities at NER still inadequate to support the rising trade volume. In other words, NER needs drastic improvement in border infrastructure, particularly dealing trade with Bangladesh and Myanmar. Success of connectivity corridors will happen only when border infrastructure is upgraded to facilitate trade and investment at the border region.

The current study has considered four corridors of India, namely, East-West Corridor (EWC) (part of Golden Quadrilateral project), Trilateral Highway (TH), Kaladan multi-modal transit transport corrdior, and Bangladesh–China–India–Myanmar Economic Corridor (BCIM-EC) to assess their likely impacts on economic development on the connected areas. Among these four corridors, EWC is the existing corridor and part of the Golden Quadrilateral project, whereas the others are corridors proposed to connect India with neighboring countries in the eastern neighbourhood.

In this study, we have assessed the development impact of the aforesaid corridors on Indian states with particular focus on NER states based on an economic geography model. The NER has special strategic importance due to its international boundaries with Bangladesh, Bhutan, China, Myanmar, and Nepal. The aforesaid four corridors provide an entry into the international market beyond the eastern borders of the country.

In particular, this study has identified the role of corridors on freight movement in India with special reference to the NER. Higher is the freight, higher the economic activities. Here, we have attempted to see the potential of the existing freight over the corridor and GDP with other important explanatory variables in order to understand the relation between GDP and the freight across the corridor. The study has also identified the major determinants of the freight other than GDP. It has made an assessment on how the current pattern of freight can stimulate the economic activities, and whether the growth of GDP can increase the freight of the NER taking the corridors under consideration. Further, this study has estimated the results of GDP with freight for the Indian states till 2040 and provided the expected outcome of the freight due to GDP shift with respect to corridors.

This study indicates that NER states are likely to gain more in terms of growth in freight from Kaladan corridor, Trilateral Highway and BCIM-EC, respectively. Gains are robust and highly significant in case of NER states such as Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram,

Nagaland, Sikkim, Tripura, and eastern Indian states such as West Bengal, Bihar, Jharkhand and Odisha. However, we need to interpret the results with caution.

The operational models, which we have developed to trace the effects of changes in corridor on regional development, provide strong policy implications. The empirical findings tell us that corridor-based development may lead to generate further economic activities and regional development of that particular area. Intuitively, corridors we have undertaken in this study would influence GDP growth through higher production and consumption.

ASEAN and India have been working together on a number of integration and cooperation initiatives over the years. India attaches high importance to these connectivity projects, particularly, Trilateral Highway and Kaladan corridor, which are currently under implementation. As analysed in this study, these corridors are likely to facilitate new economic activities in the India-ASEAN region in general and NER in particular. Therefore, completion of the two corridors should be the priority.

Finally, while Guwahati is a connectivity node in NER, cities like Nagaon, Jorhat, Dibrugarh, Guwahati, Tinsukia, Dhubri - all in Assam, Imphal, Gangtok, Itanagar, Agartala, Shillong and Aizawl are fast emerging as economic nodes in NER. These cities perform secondary (manufacturing), tertiary (services) or quaternary (management, research, education) function of economic significance. These are the cities which have to be well connected with the corridors as outlined in this study.

1
Introduction

Growth theories acknowledge the importance of infrastructures for regional development. There has been a strong literature to show infrastructure endowment helps promote development and vice versa. More recent studies have paid closer attention to infrastructures, within and across borders, seeking to identify the real contribution made by infrastructure, particularly connecting areas within a country or countries across a region. These analyses consider infrastructural endowment is one of the factors which, together with geographical location and agglomerative sectoral structure, determine a regional development potential.[1] Corridors which cut across a geographical space generate economic agglomeration, subject to location, where transportation costs and time are critical to such agglomeration.[2] Corridors are often characterized by public good features—non-rivalry and non-excludability—though their extent could vary across services.[3]

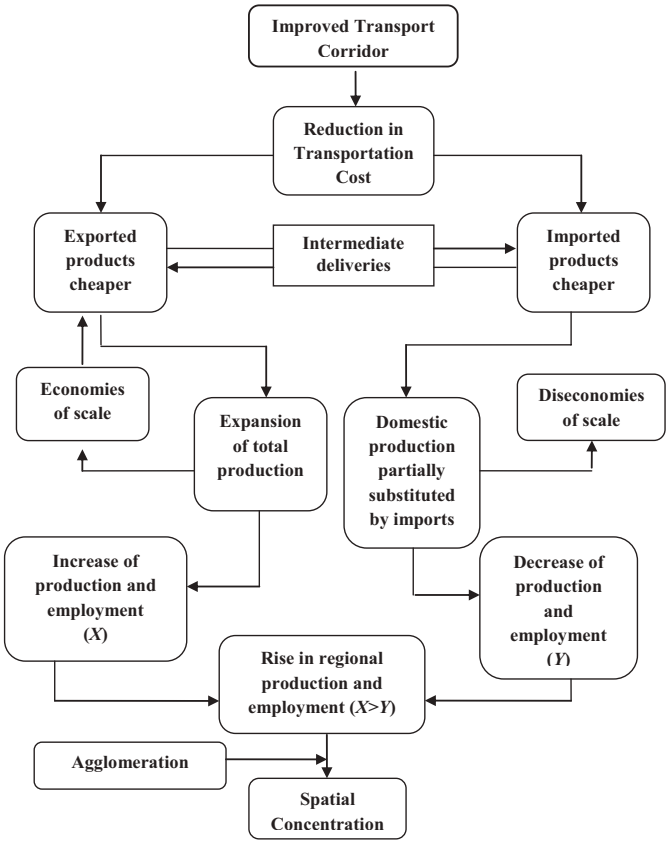
Corridor-based infrastructure development has received worldwide attention when the Greater Mekong Subregion (GMS) countries jointly decided to promote economic corridor for improvement and expansion of economic opportunities by linking cities and towns with urban centres.[4] The empirical findings tell us that corridor-based development promotes further economic growth and regional development of that particular area through reducing time and cost of the transaction and also contributes to poverty reduction.[5]

Improvement in transport corridors influences production and households consumption through a reduction in transportation costs. This may generate redistribution effects among economic groups and also among regions. The relationship between transport corridors and regional development is illustrated in Figure 1 for a case when more than one sector is considered. The caveat is that net effect is difficult to be predicted for a

region (country). However, gains come when production and employment in country 1 exceed the same in country 2 in a regional context. Economies of scale then lead to generate spatial concentration through agglomeration economies.[6] However, processes in the long run (relocation of capital and persons) caused by changes in transport infrastructure are even more difficult to predict. Therefore, operational models have to be developed to trace the effects of changes in infrastructure (corridor) on regional development. This is the subject of this study.

Corridors are multiple sets of routes connecting the economic centers within specific boundaries. It could be transport corridors, trade corridors or economic corridors. A corridor can be national (e.g. Leipzig - Frankfurt corridor, Tokyo - Osaka corridor), regional (e.g. GMS or CAREC corridors),

Figure 1. Effects of Improvement of Transport Corridors



Source: Adapted from Rietveld and Nijkamp (1993) and De (2004)

or even international (e.g. submarine telecommunication cables or energy pipelines). While there are similarities between them, each one is distinct on its own. For example, the economic corridor approach emphasizes the integration of infrastructure improvement with economic opportunities such as trade and investment, and also includes efforts to address the social and other outcomes of increased connectivity (ADB, 2006 ; 2009). Trade facilitation and logistics services are the main catalysts in the development of an economic corridor. A corridor helps strengthen industrial (or, services) agglomeration over time through the establishment of industrial zones (or, SEZs) and facilitates the cluster-type development of enterprises. To a great extent, a corridor can be interpreted as public capital summed over transportation networks, human resources, communication facilities, energy grids, and institutional infrastructure.

The North Eastern Region of India (hereinafter NER) is crucial to India's growing economic and strategic partnership with Southeast and East Asia. NER is also central to India's Look East – Act East Policy and acts as a land-bridge between South and Southeast Asia. Owing to its geographical location, several national and international corridors pass through NER, either as a place of origin or place of destination.

Historically, NER was dependent on the river system for their livelihood and trade and commerce. Sea routes were the typical transportation outlets for international trade, whereas the inland waterways were the most preferred mode for inland trade. Over the time, with the growing technology and connectivity, the NER has started using the land transportation through road and railways, in place of the inland water transportation. Transportation facilitated the international trade from the NER, particularly in Assam. With the division of the Indian sub-continent in 1947, NER became isolated from the rest of India in terms of economy and connectivity and gradually surrendered to an inward-looking economic regime with fragmented transportation networks.[7] Today, high transportation cost negates NER's advantages of having an international border.

Keeping NER in focus, there is much to be desired in terms of infrastructure development and growth of trade. The NER has the potential to become an important location in India's trade and investment. Not only natural resources, the NER also enjoys greater geo-economic space over other Indian regions. As per the Census 2011, about 4 percent of India's population lives in NER, which covers about 8 percent of India's surface area. In relative terms, it is one of India's most economically laggard regions, contributing only 3 percent of the country's gross domestic

product (GDP)[8]. Moreover, the NER imports almost every consumer goods from outside the region. The absence of adequate institutional and physical infrastructure, both national and international, has slowed down the NER's growth process.

About 98 percent of the NER's borders form India's international boundaries. It shares borders with South Asian countries like Bangladesh, Bhutan, and Nepal, and with Southeast and East Asian countries like Myanmar and China (see Table 1). It has been argued that the NER has the potential to grow faster than its current pace, provided it improves the connectivity, logistics and trade facilitation, more particularly with Bangladesh, Myanmar and other Southeast and East Asian countries such as Thailand, Malaysia, China.[9] Development of transport corridors, which connect NER with the other states of India and the neighbouring countries, can enhance both trade and connectivity. The stylized benefits of the economic corridors are manifold, and some of them, as outlined below, are assumed to be applicable in case of NER also.

- Improving national and regional connectivity by making it faster, cheaper, and easier for people and goods to move within and across borders;
- Reducing the cost of national, regional, and global trade, thus enhancing the competitiveness of national and regional production networks, and promoting greater investment;

Table 1: International Borders of the Northeastern States of India

State	Bangladesh	Bhutan	China	Myanmar	Nepal	Total
	(km)					
Arunachal Pradesh	-	217	1080	520	-	1817
Assam	263	267	-	-	-	530
Manipur	-	-	-	398	-	398
Meghalaya	443	-	-	-	-	443
Mizoram	318	-	-	510	-	828
Nagaland	-	-	-	215	-	215
Sikkim	-	32	220	-	98	350
Tripura	856	-	-	-	-	856
Total	1880	516	1300	1643	98	-

Source: Ministry of Development of North Eastern Region, Government of India.

- Promoting greater national, regional, and global integration, and thus making faster economic growth;
- Helping to reduce poverty by improving poor people's access to economic opportunities, lowering the cost of goods and services they consume, and providing better access to essential infrastructure services such as electricity;
- Helping to narrow development gaps among regional economies by providing small, poor, landlocked, and remote countries and areas with better access to regional markets and production networks, thereby stimulating investment, trade, and economic growth in those areas; and
- Promoting greener technologies and a more efficient use of regional resources, such as gas reserves and rivers with hydroelectric potential, by developing cross-border projects that permit regional energy trade.

1.1 Research Objectives

The current study has considered four corridors of India, namely, East-West Corridor (EWC) (part of Golden Quadrilateral project), Trilateral Highway between India, Myanmar and Thailand (TH), Kaladan multi-modal transit

Map 1: Location of North Eastern Region of India

Source: www.mapsofindia.com

transport project (KMTTP), and Bangladesh–China–India–Myanmar Economic Corridor (BCIM-EC) to assess their likely impacts on economic development on the connected areas. Among these four corridors, EWC is the existing corridor and part of the Golden Quadrilateral project initiated by the National Highways Authority of India (NHAI) under the National Highway Development Programme (NHDP) in 1998, whereas the others are corridors proposed to connect India with neighboring countries in the eastern neighbourhood.

Our objective is to assess the economic impact of the aforesaid corridors on Northeast Indian states. The NER has special strategic importance due to its international boundaries with Bangladesh, Bhutan, China, Myanmar, and Nepal. The aforesaid four corridors are the entry into the international market beyond the eastern borders of the country.

Map 1 presents the geographic location of the NER and the position of its eight states. The map of the NER indicates that the strategic location of the northeast is likely to generate economic gains from these corridors and will significantly impact the development of the region, provided the economies are connected with reduced transportation costs and time. Development of these corridors with the neighboring countries is believed to generate development, political, economic integration[10].

In particular, this study tries to find out the role of corridors on freight movement in India with special reference to the NER based on secondary data. It attempts to see the potential of the existing freight over economic corridor and GDP with other important explanatory variables to understand the relation between GDP and the freight along with the presence of corridor. The study then aims to find out the major determinants of the freight other than GDP. It tries to make an assessment on how the current pattern of freight can stimulate the economic activities and whether the growth of GDP can increase the freight of the NER taking the corridors under consideration. Further, it makes an attempt to estimate the results of GDP with freight activity of the Indian states till 2040 and to provide the expected outcome of the freight growth due to GDP shift with respect to the presence of corridors.

The rest of the study is organised as follows. Chapter 2 carries out the literature review, while the Chapter 3 discuses the socio-economic profile of Northeastern states of India. Background of the corridors is briefed in Chapter 4. Chapter 5 presents the data and methodology. Chapters 6 analyses the results of the study, whereas the conclusions and recommendations are presented in Chapter 7.

Endnotes

1. Refer, Capello (2007)
2. Refer, Weber (1929), Isard (1956), Krugman (1991), to mention a few.
3. Refer, Rimmer (2014) for a detailed discussion on corridors in Asia-Pacific region.
4. A detailed discussion is available at several seminal publications of Asian Development Bank (ADB). Refer, for example, ADB (2004)
5. See, for example, ADB (2008)
6. Refer, Fujita (1999), and also read Rimmer (2014)
7. Refer, the commentary of De and Majumdar (2014), Das (2005, 2008), Brunner (2010)
8. GDP and GSDP are taken at current price for the year 2011-12, sourced from CSO.
9. See De and Majumdar (2014)
10. This is a popular reflection in media in the region. Most of the commentaries indicate economic gains outweigh costs.

2
Spatial Economy and Corridors: Literature Survey

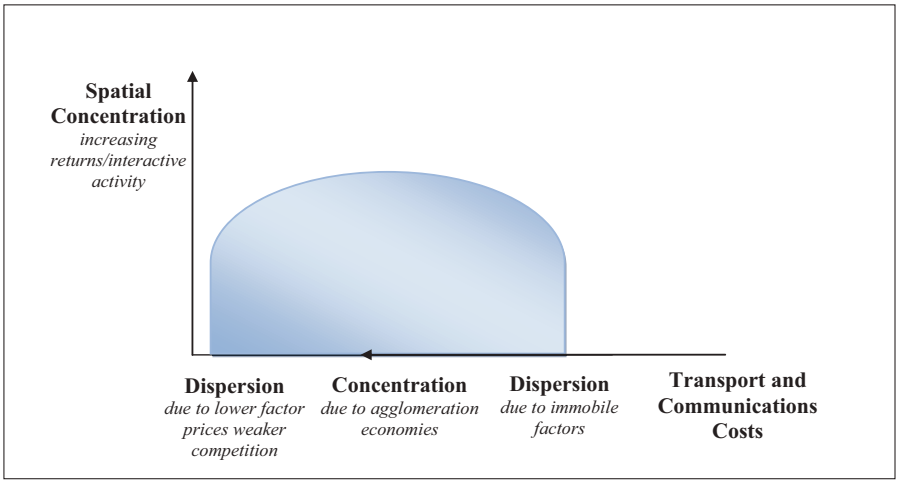
A transport corridor is a coordinated bundle of transportation and logistics infrastructure and services that facilitate trade and transportation flow between major centres of economic activities. A formal transport corridor is typically coordinated by a national or regional body, constituted by the public or private sectors or a combination of the both. Transport infrastructure is composed of transportation systems such as road, rail, sea, air, inland waterways. These transportation systems provide transportation of the raw materials and intermediate goods to the place of production and final products to the target markets. Although the transportation activities have a special importance in achieving economic development via lowering marginal costs, raising the minimum efficient scale of production, marketing, etc. Further lower costs and greater economies of scale raise the potential for increased or new sales in export markets, as well as domestically, as efforts to take advantage of economies of scale in production, procurement, or marketing lead firms to look beyond national borders for both trade and investment opportunities. The low costs related to transportation activities creates an effect of increasing productivity. For example, when the freight rate of an imported goods falls, the profit rate gained from trade increases and more goods and services are produced (Brooks and Hummels, 2009).

Theoretically, if we look at the trade literature – the new economic geography models (Krugman and Livas Elizondo, 1996; Paluzie, 2001; Monfort and Nicolini, 2000; Monfort and Ypersele, 2003; Behrens et al., 2007) talk on economic activity in general and industrial activity in particular, is concentrated in regions that are already developed, leading to large agglomerations. These agglomerations enjoy increasing returns to scale and self-reinforcing growth. The key to understanding this literature

is to think of two sets of forces that simultaneously act on large urban centers – forces of agglomeration and dispersion. The former concentrates economic activity in already industrialized regions and the later scatter economic activities across the country. Thus, trade liberalization can affect regional disparity if cross-border access to markets impacts the interaction between forces of agglomeration and dispersion (Krugman and Livas Elizondo, 1996). As economic reforms dismantle the restrictions to cross-border trade, the cost of trade can be expected to decline with liberalization, thereby strengthening the economic integration process.

The relation between spatial economy and dispersive and agglomerative forces is nicely captured by Fujita (see Figure 2).[1] A fall in transportation and communication costs leads to increase the spatial concentration of activities. The shaded area represents the degree of spatial concentration. Dispersion occurs when capital and labour, owing to lack of information, cannot respond to changes in rewards and job opportunities. Concentration stems from economies of scale, proximity to market and easy access to capital that attracts economic activities into clusters (i.e. agglomeration economies). Re-dispersion arises from congestion, reflected in wage rises, land prices, traffic jams and pollution, and the attraction of lower labour costs, that encourages some economic activities to deconcentrate to peripheral metropolitan sites or decentralize to rural locations. Here, quality of connectivity plays a catalytic role in raising the spatial concentration.

Figure 2: Spatial Economy and Dispersive and Agglomerative Forces



Source: Fujita (1999)

One of the pioneering studies in the tradition of new economic geography that analyzes the impact of trade liberalization on regional disparity is done by Krugman and Elizondo (1996). This study discusses two sets of forces that act upon industrial agglomerations - centrifugal and centripetal forces. The forces that act to disperse industrial activity from urban centers are called centrifugal forces. These forces are created by urban diseconomies (e.g. crime, congestion, pollution, high land costs in large cities, etc.). Centrifugal forces act to reduce regional disparity by spreading industrial activity across different parts of a country. In contrast, the centripetal forces attract firms, industries, and workers together to the large industrial centres. The study outlines two such centripetal forces – forward linkages and backward linkages. The forward linkages are created for final goods producers the proximity to markets by the large population of consumers in the cities. The backward linkages are created by the proximity to supplies of inputs and factors such as labour. Furthermore, these centripetal forces are self-reinforcing, which ensure that as the size of the city grows the attraction also increases due to an enlargement of the market for suppliers and consumers. The enlarged market for suppliers and consumers in the cities, in turn, lead to already existing regional clusters to grow at the expense of other regions that give rise to regional divergence within the country. However, the situation changes completely when the country liberalizes its trade barriers. According to Krugman and Elizondo (1996), as trade barriers are reduced, the cost of trade with the rest of the world declines, more outputs are bought from and sold abroad. The attraction of centripetal forces - forward and backward linkages - gradually weakens. As the dependence of the industries on domestic sources for demand for commodities and input supplies dilutes, the centrifugal forces dominate the choice of industrial location, and industries disperse from the urban centres – regional inequality declines. Therefore, according to Krugman and Elizondo, the opening of trade barriers may result in a reduction in regional disparities by weakening centripetal forces. Behrens et al. (2007) reach a similar conclusion, i.e. trade liberalization reduces regional inequality, in a model incorporating the monopolistic competition as well as immobility of agricultural workers.

In contrast to the above two models which predict a reduction in regional disparities due to trade liberalization, other new economic geography studies (e.g. Monfort and Nicolini, 2000; Monfort and van Ypersele, 2003; Paluzie, 2001) indicate that trade liberalization may foster internal agglomeration and increase regional disparity. The main difference lies in the assumptions related to the centrifugal forces. These

models do not introduce urban congestion costs and they rely on the original Dixit–Stiglitz representation of preferences. These models follow Krugman (1991), where the intensity of the dispersion force implied by the demand from the immobile agriculture sector producer's declines faster than the agglomeration forces. Once the dispersal force falls below some threshold, trade liberalization induces agglomeration. Thus, while Monfort and Nicolini (2000) and Paluzie (2001) use this mechanism to reach their conclusion i.e. increase in regional disparity, Krugman and Elizondo (1996) assume a stronger dispersion force than the agglomeration force and reach the opposite conclusion.

More realistic models, on the other hand, assume inherently different regions in contrast to the above models assumption of uniform regions. Generally, heterogeneity of regions involves a difference in access to foreign markets and unequal factor endowments in various regions. Trade liberalization induces border regions to grow faster than interior regions (Villar, 1999). This model suggests that in open economies border regions enjoy locational advantage. An agglomeration of economic activity towards border regions depends on several factors: (i) whether the border regions are already developed prior to liberalization, (ii) whether the degree of trade liberalization is very large, and (iii) whether the size of the foreign market is larger than the domestic market (Brulhart et al., 2004; Crozet and Koenig, 2004).

The models of trade liberalisation and the regional inequality are based on different assumptions but the role of infrastructure, expansion or improvement in the quality of overall infrastructure services is widely accepted in the literature to promote the economic growth in a developing region. Moreover, efficient infrastructure services increase and expand linkages to global supply chains and distribution networks for producers by lowering transaction costs, raising value added and increasing potential profitability are also most discussed topic. The more deeply a country is involved in global production networks, the more likely it will benefit from trade-related infrastructure investment. Therefore, building of corridors is expected to link regions, economies and have specific advantages. First, corridors help ease the demand for infrastructure, generating more output. Improved transport corridors help ease the demand for infrastructure services, generating more output. Second, efficient transport corridor networks are important to regional cooperation, in both absolute and relative terms, as tariff-based barriers have declined. Here, better connectivity through corridors helps facilitate trade and investment,

fostering regional integration. Third, better infrastructure (e.g. services links, logistics services) encourages fragmentation of production in a region, and enhances regional and global trade, expediting regional integration (Ghosh and De, 2005; ADB, 2006; ADB, 2009).

There are several definitions in the literature related to the transport corridors. According to common definition, one or more than one route that links the centres where economic activities are carried out is called the transport corridor (Arnold, 2006; Banomyong, 2008). In particular, transport links or corridors are essential for the movement of goods, services, capital, people, and information across countries. The development of transport corridors can be summarized in five stages. In the literature, Srivastava (2011) mentioned five transformation steps of becoming an economic corridor from a simple transport corridor. In stage one, the corridor simply acts as Transport Corridor, and it becomes Transport and Trade Facilitation Corridor in the second stage. In the third stage, it becomes Logistics Corridor, followed by Urban Development Corridor in the fourth stage. Finally, in the fifth stage, it is transformed as Economic Corridor. In general, an economic corridor is a well-planned infrastructure that helps facilitate economic activities. An economic corridor can be conceptualized as public capital summed over transportation networks, human resources, communication facilities, energy grids, and institutional infrastructure (De, 2014). This can be national (for example, Delhi—Mumbai Industrial Corridor), regional (for example, the GMS corridors), or even international (for example, submarine telecommunication cables). Trade facilitation and logistics services are the main catalysts in its development. Srivastava (2011) added that a corridor begins with physical connectivity, a road or a highway connecting two or more nodes. It is natural to view it as the means of transport, and this view is useful and practical. But, a corridor comprises not only the highway but also the areas around it that use it.

There are ample of empirical literature, which has tried to see the role and impact of the economic corridors. The study by Kumagai *et al.* (2009) tried to assess the dynamics of the location of industries as well as the population at sub-national levels in East Asia for the long run and to look the impacts of projects related to infrastructure development on the economy at sub-national level by using Geographical Simulation Model (GSM) (see Box 1). In total 220 sub-national regions from eight countries/regions have been covered in the model. On each sub-national region, data used were GDP by sector, employee by sector, longitude and latitude and area of arable land. It has shown that border costs are obstacles to

the development of regions. They found that it is necessary to reduce the border costs along with the development of physical infrastructure. Apart from border costs, nominal wage also plays a crucial role in determining the location of industries as well as populations. To reduce the border costs, Kumagai *et al.* (2008) suggested of introducing the use of technologically advanced instruments to check the cargoes even without touching them. This can reduce the time and the associated costs involved in the checking process of logistics.

The paper by Warr *et al.* (2009) aimed at studying the regional economic effects occurring due to the infrastructural improvements. Based on the input-output structure, general equilibrium model was constructed, which described an economy with two regions trading with each other and with rest of the world, individually. The study presents short run and long-run impacts of the infrastructure development. In the short run, there will be a minor increase in the inter-regional trade volumes, which is bi-directional. There will also be a modest rise in real consumption in both the provinces. In the long run, the benefits accruing to both the regions will be huge in size. The elements behind the driving force are the investors, who respond with new capital investments, and the workers, who migrate to these regions in the search for higher wage rates.

The study of De *et al.* (2013) was based on the theoretical foundation that under the regime of free trade and competitive conditions, trade pushes the growth rate of an economy which thereby acts substantially in reducing the poverty. The study aimed at assessing the impact of trade facilitation and the related causal factors on reducing poverty in the region in the SAARC Corridor 1 zone with the help of primary survey data. Results of this study had shown that there has been a significant improvement in the quality of trade infrastructures such as customs and transport. According to the authors, improvement in trade would also lead to job creation and more income opportunities will further add on to the local production. The trading firms were of the opinion that better infrastructure facilitating more trade majorly leads to the decline of poverty.

In a recent study, Sen (2014) examined how the economic corridors play a significant role in facilitating South Asian nations' way to the global production networks in East Asia and Southeast Asia. The study suggested that regional and national economic corridors can act as vital catalysts, coupled with complementary policies, for instance, development of clusters and relax the logistical constraints in the regions along with the corridors.

Box 1: Economic Impact of Economic Corridors using Geographical Simulation Model (GSM)

Kumagi et. al (2009) used IDE/ERIA-Geographical Simulation Model (IDE/ERIA-GSM) in order to estimate the economic impacts of various trade and transport measures (TTFMs) of ASEAN-India Connectivity aimed by taking 18 countries/economies in Asia and two economies of the U.S. and European Union (EU). The study is to analyse the economic impacts of infrastructure development by considering already completed projects but also some on-going projects in the baseline scenario and on the other hand, takes "no projects" scenario. The study argued the importance of physical and institutional connectivity in deepening economic integration and narrowing development gaps and highlighted the following points:

- After having the better highway, firms will get the benefit in selling and buying products in better price, due to the lowered transport costs. This stimulates economic activities and thus raises Gross Domestic Product (GDP).
- India will have greater positive impacts by reducing Policy and Cultural Barriers (PCBs), therefore several measures, such as shortening the time for procedures before shipping, providing information in appropriate languages, enhancing the capacity of medium-sized firms, and establishing more reliable dispute settlement are needed. It is implying that soft infrastructure development is a key to maximize the benefit of better connectivity.
- In order to explore the full potentials of enhanced regional connectivity, physical infrastructure alone is not sufficient enough, indicating a need for a multi-functional approach. Infrastructure for physical connectivity, such as roads, ports, airports, gas pipelines, and power grids, are of course important as necessary conditions.
- The connectivity between Myanmar and Northeast India has been limited not only by the lack of adequate physical infrastructure but also by the restrictive institutional arrangement between Myanmar and India, namely the restrictions on the tradable items and the mode of settlement. A proper enforcement of regional transport agreement would enable logistic service providers to reduce significantly the cost to cross national borders, by saving the money and time for unloading and reloading.

Box 1 continued...

Box 1 continued...

- In addition, the connectivity of people can be a facilitating factor particularly in the case of border trade. For example, there are various ethnic groups along the border between Myanmar and Northeast India, and some of them share a same language and maintain a strong cultural tie, including trade relationship whichever it is formal or informal.
- Improvement of connectivity can further boost the regional production networks as new connecting nodes of regional production networks expected to join into the regional production network. This process of fragmentation would benefit not only by providing new economic activities (such as agriculture, mining, and tourism, based on their own location advantages including the endowment of natural and cultural resources, lower wages and rents), which includes new employment opportunities,
- Finally, improved connectivity would lead to reduce trade costs, raise country's comparative advantage and trade flows, expand markets, reduced poverty, and increase country's welfare and quality of life of its citizens.

Source: Kumagai *et al.* (2009)

ASEAN and India have been working together on a number of integration and cooperation initiatives over the years. India has undertaken several physical connectivity projects to connect ASEAN economies with India. Among these connectivity projects, two corridors, namely, Trilateral Highway and Kaladan MTTP, are under implementation. These corridors, once completed, are likely to facilitate new economic activities in the India-ASEAN region in general and NER in particular (AIC-RIS, 2015). However, none of the studies analysed the economic impact of the proposed corridors on Indian states. This study is, therefore, aimed to narrow the gap in the literature.

In particular, this study tries to find out the role of corridors on freight movement in India with special reference to the NER based on secondary data. It attempts to see the potential of the existing freight over economic corridor and GDP with other important explanatory variables to understand the relation between GDP and the freight along with the presence of corridor. The study then aims to find out the major

determinants of the freight other than GDP. It tries to make an assessment on how the current pattern of freight can stimulate the economic activities, and, whether GDP growth can increase the freight of the NER taking the corridors under consideration. In this study, another objective is to assess the development impact of the aforesaid corridors on Northeast Indian states. The NER has special strategic importance due to its international boundaries with Bangladesh, Bhutan, China, Myanmar and Nepal. Findings of this study may then help understanding the economic benefits that the aforesaid four corridors may bring to the region.

Endnote

1. Refer, Fujita (1999)

3
Changing Profile of the NER Economy

3.1 Introduction

The North East Region (NER) of India refers collectively to the eight Indian states, namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. In our case, we have considered West Bengal with these eight NER states for the purpose of discussion of the socio-economic performance. Since Kolkata (in West Bengal) is either origin or destination of corridors selected in this study, we count West Bengal while discussing the background as well as dealing with the research objectives. Here, we discuss socio-economic profile and economic performances in order to understand the homogeneity and the distinctive features of the NER states.

3.2 Socio-Economic Profile

NER states (excluding West Bengal) together cover an area of 2,62,179 sq. km., comprising 8 percent of India's geographical area and account for almost 4 percent of India's total population. [1] Most importantly, the region shares a long international boundary of around 98 percent with India's neighbouring countries such as China and Bhutan in the north, Myanmar in the east, Nepal in the west and Bangladesh in the south and west (see Map 1 in Chapter 1). The eight NER states are endowed with a vast reserve of natural resources. Although of having immense natural and human resources potentials, the NER states are isolated geographically from rest of India that has led to the deprivation of economic development in core sectors (Cappellari and Jenkins, 2006). Nevertheless, given its strategic location, the NER can be developed as a supporting base for India's growing economic links, not only with Southeast Asia but also with Bangladesh and China.

To address the concerns on the development of this particular area of India, first, the Ministry of Development of North Eastern Region (MDoNER) was created in 2001, which was later converted into a full-fledged ministry in 2004 (Sahu, 2012). Afterwards, a large number of projects were undertaken in different sectors such as infrastructure (power, road, railways, air connectivity, inland waterways, telecommunication and information technology), plantations, irrigation and flood control, tourism, human resource development (education and health), handlooms and handicrafts etc. in Northeast India.[2] The main constraint to development is high transportation cost, which has been, perhaps, negating NER's advantage of having a vast international border. It has been argued that if cross-border corridors are developed, NER may show better economic performance in medium to long run. This chapter aims to review the existing socio-economic profile of NER and border trade with the neighbouring countries.

All the eight NER states have different developmental prospects and resources to support their efforts in contributing to the regional as well as national economy. Most of the parts of the NER states are occupied by hilly areas (73 percent) and only 27 percent area of the region is in the plain. Among them, Arunachal Pradesh, Meghalaya, Mizoram, and Nagaland are mainly hilly states with a fairly high degree of diversity even within the tribal groups. There is considerable uniformity among the NER states; but, at the same time, they carry distinctive differences. Table 2 describes some important socio-economic indicators of the NER states along with West Bengal.

The region stands way below and ahead in comparison with the rest of India in socio-economic indicators. The area, as well as population of the states, is fairly distributed across the region. Arunachal Pradesh has the largest (without West Bengal) and the Sikkim has the lowest geographical area. Assam is the most populated state (31.17 million), followed by Tripura (3.67 million) and Meghalaya (2.96 million). These are the top three densely populated states in NER. Gangtok, Itanagar, and Imphal are top three fastest growing cities in terms of decadal growth of population between 2001 and 2011 (see Table 3). In NER, largest cities are found in Assam only. The NER, in general, is a rural economy; almost 82 percent of the population lives in rural areas, having an average rural population density of 176 people per sq. km. The sex ratio and the literacy rate are comparable with the country average. Barring Nagaland, Arunachal Pradesh, and Sikkim, the NER performance is above the national average

(943 per 1000 males) in sex ratio. In case of Infant Mortality Rate (IMR), the performances of NER states (except Assam and Meghalaya) are also better than the national average. NER states are also well ahead of many Indian states in literacy rate. They have witnessed 78.84 percent literacy rate, compared to 74.04 percent of national average. However, NER suffers from poor access to basic health services. NER remains one of the most underdeveloped regions in India in health sector.

Table 2: Socio-Economic Profile of NER and West Bengal, 2011

States	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	West Bengal	NER*	NER share# (%)
Area ('000 sq. km.)	83.74	78.44	22.33	22.43	21.08	16.58	7.09	10.48	88.75	262.2	7.98
Total Population (million)	1.38	31.17	2.72	2.96	1.09	1.98	0.60	3.67	91.27	45.28	3.77
Rural Population (million)	1.07	26.78	1.89	2.37	0.53	1.41	0.45	2.71	62.18	37.21	4.47
Urban Population (million)	0.31	4.38	0.83	0.59	0.56	0.57	0.15	0.96	29.09	8.35	2.22
Population Density (per sq. km.)	17	397	122	132	52	119	86	350	1028	176	368
Sex ratio (per 1000 males)	938	958	992	989	976	931	890	960	950	954	943
Literacy rate (percent)	65.38	72.19	79.21	74.43	91.33	79.55	81.42	87.22	76.26	78.84	74.04
Infant Mortality rate (per 1000 live birth)	30	47	9	42	32	12	18	20	26	30	37

Notes: *Excluding West Bengal # India average

Source: Census of India, 2011.

Population growth makes the difference among NER states in terms of nodes. Illustrated in Table 3, while Guwahati is a connectivity node in NER, cities like Nagaon, Jorhat, Dibrugarh, Guwahati, Tinsukia, Dhubri - all in Assam, Imphal, Gangtok, Itanagar, Agartala, Shillong and Aizawl are fast emerging as economic nodes in NER. These cities perform secondary (manufacturing), tertiary (services) or quaternary (management, research,

education) function of economic significance. These are the cities which have to be well connected with the transportation corridors as outlined in this study.

Table 3: Population in NER States in 2001 and 2011

NER State	City	2001	2011	Decadal growth
		('000)		(%)
Assam	Guwahati	818.81	968.46	18.28
	Silchar	146.64	178.86	21.97
	Dibrugarh	1185.07	1326.34	11.92
	Jorhat	999.22	1092.25	9.31
	Nagaon	2314.63	2823.77	22.00
	Tinsukia	1150.06	1327.93	15.47
	Dhubri	1566.39	1949.26	24.44
	Tezpur	92.26	75.54	-18.12
Tripura	Agartala	299.39	400.01	33.60
Manipur	Imphal	250.23	418.74	67.34
Nagaland	Dimapur	98.09	122.83	25.22
	Kohima	77.03	99.04	28.57
Meghalaya	Shillong	267.66	354.76	32.54
Mizoram	Aizawl	228.28	293.41	28.53
Sikkim	Gangtok	43.71	100.28	129.42
Arunachal Pradesh	Itanagar	35.02	59.49	69.87

Source: Census of India for the years 2001 and 2011.

3.3 Economic Performance

We rely on a comparative static analysis of the NSDP (Net State Domestic Product) of the eight NER states to illustrate their economic performance. We consider the NSDP at the current price (base 2004-2005) and Per Capita Net State Domestic Product (PCNSDP) to judge relative economic performance of the states. Table 4 presents the NSDP and PCNSDP for the years 2004-05 to 2014-15.

Over the period of 2004 to 2015, the compound growth rate of NSDP of India stands at 16.79 percent. Except for Arunachal Pradesh, Mizoram, and Sikkim, the rest of the NER states rank below (even West Bengal) as compared to India's average growth rate of NSDP. When we consider

the PCNSDP for the period 2004-05 and 2014-15, we find that while the PCNSDP in India at current price had increased at the rate of 15.23 percent, the corresponding growth for the NER region was 13.67 percent. In case of state-wise performance, NER's growth rate of per capita income had also lagged behind the national growth rate of the country for major states except for Sikkim. Not surprisingly, the difference in per capita incomes between the country and the region has steadily diverged. The slow progress of the NER's economy is reflected in the low growth in income.

Table 4: Net State Domestic Product (NSDP) and Per Capita Net State Domestic Product (PCNSDP) at Current Price+

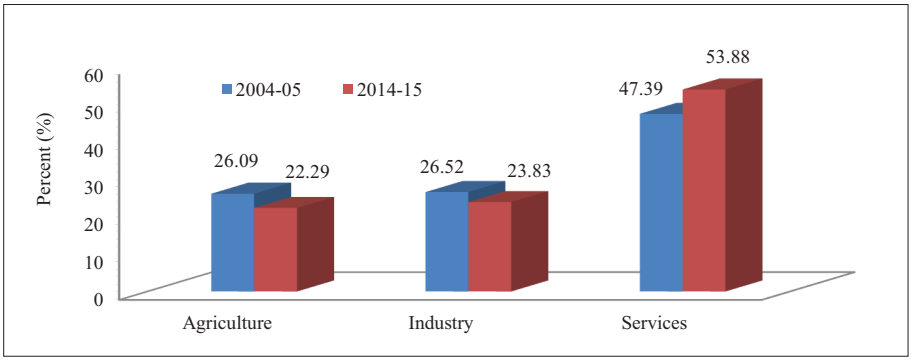
States	NSDP			PCNSDP		
	2004-05	2014-2015	CAGR*	2004-05	2014-2015	CAGR*
	(Rs. Billion)		(%)	(Rs.)		(%)
Arunachal Pradesh	31.88	147.13	18.52	26,721	96,199	13.67
Assam	471.81	1543.04	14.07	16,782	49,480	11.42
Manipur	46.03	137.18	12.90	18,547	41,573	8.41
Meghalaya	58.46	180.43	13.34	23,079	69,516	11.66
Mizoram	24.00	98.60	17.00	24,662	76,120	11.93
Nagaland	54.21	201.99	15.74	30,441	85,544	10.89
Sikkim	15.11	109.76	24.65	26,690	176,491	20.79
Tripura	81.70	292.18	15.21	24,394	69,705	11.07
West Bengal	1900.29	7289.74	16.11	22,649	78,903	13.29
NER#	97.90	338.79	16.43	23,915	83,079	13.67
India	26,515.73	107,168.89	16.79	24,143	86,454	15.23

Notes: *CAGR of 2004-05 to 2014-15; #Except West Bengal. +Base: 2004-2005

Source: Calculated based on CSO (2015).

After the trend of NSDP and PCNSDP of NER states over the period from 2004 to 2015, the next basic question arises upon the sectoral performance of the economy as it impacts directly on socio-economic performances. This can be understood by looking at the core sectoral change over the period 2004-05 to 2014-15. It is clear from the Figure 3 that the contribution of the services sector to GDP has been higher than that of agriculture and industry (also see Table 5). The services sector's

Figure 3: Trends in Sectoral Composition in NER



Source: Drawn by Authors.

Table 5: Sectoral Composition in GSDP at Current Prices during 2004 to 2015 (%)

State	Agriculture			Industry			Services			Total
	2004-05	2014-2015	CAGR (2004-05 to 2014-15)	2004-05	2014-2015	CAGR (2004-05 to 2014-15)	2004-05	2014-2015	CAGR (2004-05 to 2014-15)	CAGR (2004-05 to 2014-15)
Arunachal Pradesh	35.1	45.4	21.5	31.9	24.4	14.6	33.0	30.2	16.9	18.1
Assam	25.6	22.7	13.2	27.5	21.8	11.8	46.9	55.6	16.9	14.7
Manipur	24.7	16.4	6.6	36.7	22.9	5.9	38.6	60.7	17.4	11.6
Meghalaya	23.3	15.1	10.7	26.1	30.7	18.3	50.6	54.3	17.1	16.2
Mizoram	23.5	18.5	13.1	16.6	22.7	20.3	59.9	58.8	16.0	16.2
Nagaland	34.8	26.5	11.3	12.9	13.9	15.7	52.4	59.6	16.4	14.7
Sikkim	18.6	12.3	18.3	28.8	55.8	33.4	52.6	32.0	17.3	23.9
Tripura	25.1	19.2	10.9	24.3	25.0	14.6	50.7	55.8	15.5	14.2
West Bengal	23.9	23.6	16.0	21.7	16.2	12.4	54.4	60.2	17.4	16.1
NER# Total	26.1	22.3	13.1	26.5	23.8	13.7	47.4	53.9	16.7	15.1

Notes: Taken at the current price, Note: CAGR of 2004-05 to 2014-15; # except West Bengal

Source: Calculated based on CSO (2015).

contribution had increased during 2004 and 2015, while the contributions of the other two sectors declined in that period. The NER (excluding West Bengal) has become a services-driven economy, which has witnessed 53.88 percent share of services sector in GDP in 2014-15, followed by 23.83 percent for industry and 22.29 percent for agriculture.

To analyse the industrial sector's contribution, we have looked at the manufacturing sector separately. In the manufacturing sector, performance of Sikkim is noticeable, where manufacturing sector's contribution has increased from 3.86 percent in 2004 to 37.59 percent in 2015. The increase in the contribution has been witnessed in states like Meghalaya, Tripura, and Manipur also. Although the NER economies have been driven by the services sector, the manufacturing sector is still at a nascent stage; the region's average share, except for Sikkim, is presently below 10 percent of the state GDP, and in some states such as Arunachal Pradesh, Mizoram, and Nagaland it has moved between 1 to 2 percent of the state GDP only. Perhaps, strong growth will introduce meaningful structural change in NER economies. Therefore, from the analysis of the sector-wise share of the NER states in the GDP, we find that structural composition varies across the NER states with West Bengal taking lead in services sector. Thus, the pattern of industrial development of the NER has not grown in conformity with the standard historical trend even with respect to India.

3.4 Current Industrial Scenario

The average share of manufacturing in the GDP of the NER has been below 10 percent in 2014-15 except for Sikkim (see Table 6). Therefore, the size of

Table 6: Share of Manufacturing in Industrial Sector at Current Prices (%)

State	2004-05	2014-2015
Arunachal Pradesh	2.07	1.73
Assam	10.53	6.79
Manipur	4.42	4.60
Meghalaya	2.74	5.98
Mizoram	1.40	0.96
Nagaland	1.69	1.67
Sikkim	3.86	37.59
Tripura	4.04	6.33
West Bengal	11.15	7.76
NER# Total	7.59	7.00

Note: **#** except West Bengal

Source: Calculated based on CSO (2015)

manufacturing sector of NER has been very negligible. Industrialisation has failed to take off in the region. In relative terms, Assam is by far the largest industrialised state in the NER, having nearly 88 percent of the total industrial units of the region. Nearly 74 percent of the manufacturing output of the registered manufacturing sector (2014-15) originates in Assam, while, at the other end of the spectrum, Arunachal Pradesh has no registered manufacturing industry.[3]

In general, the NER has a very negligible share in the industrial sector in India. To review the performance, we present number of factories, number of workers and net value added (NVA) during 2012 to 2015 (Table 7). Its shares in the number of factories, the number of workers and net value added (NVA) have increased marginally in 2014-15, compared to 2012-13. The performance of the NER in terms of Net Value Added (NVA) was stagnant between 2013-14 and 2014-15. In terms of ranking, West Bengal, Assam, and Sikkim are the top three states in NVA. The shares of NER in number of factories, number of workers and NVA in India during 2012-13 to 2014-15 indicate positive change, suggesting further growth in the region.

Table 7: Important Industrial Characteristics (All Industries) in NER

State	Factories (Numbers in' 00)			Workers (Number in' 000)			Net Value Added (Rs. Billion)		
	2012-13	2013-14	2014-15	2012-13	2013-14	2014-15	2012-13	2013-14	2014-15
Assam	33.03	35.18	37.17	140.90	157.69	163.35	62.92	80.18	81.89
Arunachal Pradesh	NA	NA	NA	NA	NA	2.93	NA	NA	3.40
Manipur	1.28	1.45	1.60	5.21	4.99	6.57	0.44	0.52	0.70
Meghalaya	1.16	1.08	1.09	9.48	11.00	11.87	7.67	4.75	6.27
Nagaland	1.06	1.34	1.97	2.68	3.30	4.84	0.88	0.76	1.22
Sikkim	0.65	0.66	0.67	8.05	10.23	11.10	36.48	41.12	44.24
Tripura	5.34	5.52	5.48	25.79	26.52	26.26	3.48	3.17	4.72
West Bengal	86.07	88.59	91.12	537.28	522.24	504.15	222.81	224.38	184.26
India	2221.20	2245.76	2304.35	10051.63	10444.4	10755.3	8519.49	8953.42	9751.61
Share of NER# (%)	1.91	2.01	2.14	1.91	2.05	2.11	1.31	1.46	1.46

Note: **#** except West Bengal;

Sources: Annual Survey of Industries 2012-13, 2013-14, 2014-15, CSO, Government of India.

The industries of the NER states include coke and refined petroleum products, food products, other non-metallic mineral products, basic metals, beverages, wood and products of wood and cork, except furniture, pharmaceuticals, medicinal chemical and botanical products, chemicals and chemical products, textiles, electrical equipment, other transport equipment, fabricated metal products, except machinery and equipment, rubber and plastics products (see Table 8).

The manufacturing activities are based on locally available resources for which the optimal plant sizes are not very large. Industries requiring large-scale production such as petrochemicals, cement, steel, and sugar are completely absent, despite the fact that the region is a rich source of the basic raw materials required for the production of such goods. For instance, there is an abundance of limestone (in Meghalaya and Assam),

Table 8: List of Major Industries in NER in 2014-2015

Industry	Tripura	Manipur	Meghalaya	Assam	Nagaland	Sikkim	West Bengal	India
	Annual Output (Rs. Billion)							
23. Other Non-Metallic Mineral Products	3.34 (0.14)	1.73 (0.07)	20.00 (0.86)	55.09 (2.38)				2311.78
10. Food Products	4.46 (0.05)	0.94 (0.01)		133.33 (1.55)	0.76 (0.01)		406.91 (4.72)	8622.76
24. Basic Metals	1.05 (0.01)		12.40 (0.15)				696.19 (8.17)	8519.17
20. Chemical and Chemical Products						12.13 (0.14)	203.32 (2.39)	8519.17
19. Coke and Refined Petroleum Products				284.99 (2.76)			418.96 (4.06)	10327.82
11. Beverages			2.95 (0.41)	0.00	0.00	0.00	0.00	719.97
16. Wood and Products of Wood					2.41 (1.18)			204.28

Table 8 continued...

Table 8 continued...

21. Pharmaceuticals, Medicinal Chemical and Botanical Products						62.43 (2.69)		2318.34
13. Textiles							114.82 (3.01)	3820.54
25. Fabricated Metal Products, except Machinery and Equipment							75.39 (0.04)	1738.08
27. Electrical Equipment							110.45 (0.05)	2322.37
30.Other transport equipment							76.43 (0.05)	1500.58
22. Rubber and plastics products							69.61 (0.03)	2389.53

Note: Industry at 2-digit NIC 2008;

Source: Summary Results for Factory Sector: ASI 2014-15, CSO, Government of India.

but the region is yet to have large-scale cement industry to effectively utilise this resource.

Assam has the largest oil reserves (on-shore), but the state has no large downstream manufacturing unit of petrochemical products. On the other hand, we have also observed that some industries like insulated wires and cables have come up in the region, although the region has no known reserve of copper. The state of West Bengal has industries such as textiles, fabricated metal products, except machinery and equipment, electrical equipment, leather and leather related products, printing and production of recorded media, repair, and installation of machinery and equipment, and publishing activities.

Based on the ASI data (2014-15), coke and refined petroleum products, food products, other non-metallic mineral products, chemicals and chemical products, pharmaceutical products and preparations, and basic metals are appeared to be the major industries in the NER that have a comparatively increasingly higher output. Besides, some small-scale industries such as tobacco products, beverages, wood and products, and rubber and plastic products also have positively increasing outputs, which can also be facilitated for the region's growth and for improving industrial competitiveness.

3.5 Current Stock of Infrastructure

The NER does not have the same level of economic development as the rest of the country. The people of the region often do not have access to basic social and infrastructure services.[4] The literacy rate in the region is high, but there is also a high rate of unemployment and underemployment. The incidence of poverty in the region is high and the official income-poverty measure does not accurately reflect the deprivation. [5] Compared to the rest of India, the NER states suffer from inadequate infrastructure and inefficiency. People in the NER do not have adequate access to social infrastructure such as healthcare facilities, education and public services, the availability of which in NER is below the national average. Physical infrastructure such as electricity, communication, transportation, and banking and finance are also very sporadic and unevenly distributed among urban and rural areas. Amenities are limited in nature, and the lack of economic opportunities encourages migration, particularly that of skilled resources to work and live in better-developing parts of India.

Table 9 presents basic infrastructure and logistics indicators of the NER for the year 2014. Roads are of particular importance in the region because they provide access to inland parts of the NER. However, geographic constraints make the construction of roads an expensive endeavour in the NER. Assam, Nagaland, and Tripura are relatively better endowed with roads. Not all the NER states railway links. Except, Assam, Tripura and

Table 9: Infrastructure Indicators of NER, 2014

States	Road*	Rail*	IWT*	Airport**	Tele-density^	Electricity$
Arunachal Pradesh	33.55	0.14	-	7.16	32.34	1.75
Assam	367.34	31.14	47.17	11.47	46.61	0.43
Manipur	93.33	0.06	-	4.48	37.77	0.68
Meghalaya	54.92	0.39	-	8.92	41.23	1.61
Mizoram	51.89	0.07	26.52	4.74	31.89	0.98
Nagaland	230.90	0.67	56.52	6.03	34.33	0.67
Sikkim	92.59	-	-	14.09	34.85	2.24

Notes: *km per 1000 sq. km. of area. **Number per 100,000 sq. km. of area. ^Per 100 population. $ Installed electricity per 10,000 population

Source: Calculated based on various issues of Statistical Abstract, Government of India.

Arunachal Pradesh, remaining NER states have either no railway lines or very negligible railway presence. The NER has many large and small rivers providing facilities for water transportation. The Brahmaputra and Barak rivers have been commonly used as the medium of water transportation. Except Assam, Tripura and Nagaland, the remaining NER states are yet to utilise the inland waterways for transportation of goods and passengers. However, airports are in use in every NER states with one or multiple airports, and most of India's major airlines serve the NER states. At the same time, NER suffers from the unavailability of electricity; many of the NER states are yet to have an adequate supply of electricity. There has been huge variation in availability of electricity and railway across the NER states. In what follows the NER has gained higher tele-density, but lacks in other physical infrastructures. Developments of corridor(s) would provide further infrastructure support in NER.

3.6 Border Trade of NER

NER presents 98 percent of country's international border with neighbouring countries. Border trade has special significance for the economies of the NER states. Border trade pattern between NER and Bangladesh follows a strong resource-industry linkage between Bangladesh and NER.[6]

3.6.1 Border Trade with Bangladesh

Currently, NER has 26 trading points (known as LCSs) with Bangladesh, of which 20 are functional (see Table 10). Tripura and Meghalaya have seven and eight functional LCSs, respectively. Importantly, three LCSs in Assam are yet to be functional.

NER contributes only 8 to 10 percent of India's export to Bangladesh. Table 11 presents the trends in NER's export and import with Bangladesh. NER's export to Bangladesh has increased in recent years, whereas import

Table 10: Trading with Bangladesh: Number of LCSs

NER State	Functional	Non-functional	Total
Assam	5	3	8
Meghalaya	8	2	10
Mizoram	0	1	1
Tripura	7	0	7
Total	20	6	26

Source: De (2013) based on various sources.

Table 11: Trends in NER's Trade with Bangladesh

Year	NER's Export to Bangladesh	NER's Import from Bangladesh	NER's Total Trade with Bangladesh
	(US$ million)		
2010-11	91.56	64.51	156.07
2011-12	134.62	81.94	216.56
2012-13	171.23	75.77	247.00
2013-14	172.71	80.89	253.60
2014-15	221.30	85.54	306.84
2015-16	229.39	83.88	313.27

Source: Authors' own.

is rising at a slower pace. NER has trade surplus with Bangladesh. The total trade between NER and Bangladesh is turned out to be US$ 313.27 million in 2015-16, which has increased from US$ 156.07 million in 2010-11. Table 12 presents LCS-wise border trade with Bangladesh. NER's exports to Bangladesh are mostly primary horticulture items and minerals such as coal, quick lime, ginger, oranges, dry fish and other citrus fruits, boulder stones, dry fish, raw hides, woven fabrics & synthetic filament, etc. On the other, NER's imports from Bangladesh is well diversified and mostly secondary items such as cement, processed foods, plastics, knitted & crocheted synthetic fabrics, garments, cement, fish, PVC pipes, wooden furnitures, etc.

Table 12: NER's Trade with Bangladesh, 2015-16

Sl. No.	Name of LCS	Top Five Products Traded	
		Export	Import
1	Sutarkandi (EX > IM)	Coal & quick lime	Cement, Misc food item and plastic items
2	Karimganj Steamer & Ferry Station (KSFS) (EX > IM)	Ginger, Oranges, dry fish and other citrus fruits	Knitted & crocheted synthetic fabric
3	Mankachar (IM > EX)	Coal, Boulder Stone	Cement, Vest, Cloak & Religious Book
4	Borsora (Only EX)	Coal & Lime stone	-

Table 12 continued...

Table 12 continued...

5	Bholaganj (Only EX)	Lime Stone, Boulder stone & Quartz stone	-
6	Dawki (EX > IM)	Coal, Lime stone, Raw hides, quartz stone, stone boulders seasonal fruits & vegetables	Food Items, Fire clay & bricks
7	Shellabazar (Only EX)	Lime stone & boulder stone	-
8	Bagmara (Only EX)	Coal	-
9	Dalu (EX > IM)	Coal	Cement, Syn, Fabrics
10	Ghasuapara (Only EX)	Coal	-
11	Mahendraganj (IM > EX)	Coal. Crushed stone, Boulder stone. Dry fish, ginger	Cotton waste, synthetic fabric, food product
12	Agartala (IM > EX)	Other craft paper, vulcanized rubber tread, acmesip & mango classic	Stone, cement, fish, PVC pipes, & furniture
13	Srimantapur (IM > EX)	Raw hides, woven fabrics & synthetic filament	Stone, Cement, Plastic sheet of polymers
14	Khowaighat (only IM)	-	Stone & cement
15	Manu (IM > EX)	-	Broken stone, Bricks & Cement
16	Muhurighat (only IM)	-	Stone, Bricks & Cement
17	Old Raghnabazar (IM > EX)	Citrus fruits	Textile items, cotton vest & others

Note: IM: Imports; EX: Exports

Source: Indian Customs.

3.6.2 Border Trade with Myanmar

NER's border trade with Myanmar has been rising fast. NER's informal trade volume with Myanmar at border has been more than its formal trade.[7] Table 13 presents number of LCSs dealing border trade with Myanmar. All the four NER states have functional LCSs with Myanmar, of which Moreh LCS (in Manipur) has been the biggest one in terms of volume of trade whereas the Zokhawthar / Champai LCS (in Mizoram) comes next.

NER's export to Myanmar through land-border has increased from US$ 4.50 million in 2010-11 to US$ 18.62 million in 2015-16 (Table 14). NER's import from Myanmar was almost three times more than its export in 2015-16. In 2015-16, NER's import from Myanmar has increased to US$ 53.02 million from US$ 8.30 million in 2010-11. The total trade with Myanmar stands at US$ 71.64 million in 2015-16. Table 15 presents LCS-wise border trade. NER's exports to Myanmar are cumin seed, cotton yarn, auto parts, soya bean meal, wheat flour and pharmaceuticals, whereas imports are

Table 13: Trading with Myanmar: Number of LCSs

NER State	LCS in India	LCS in Myanmar
Arunachal Pradesh	Nampong (Pangsau Pass)	Pangsu
Manipur	Moreh	Tamu
Mizoram	Zokhawthar (Champai)	Rih
Nagaland	Avangkhu	Somara

Source: De (2013) based on various sources.

Table 14: Trends in NER's Trade with Myanmar

Year	NER's Export to Myanmar	NER's Import from Myanmar	NER's Total Trade with Myanmar
	(US$ million)		
2010-11	4.50	8.30	12.80
2011-12	6.54	8.87	15.41
2012-13	11.67	26.96	38.63
2013-14	17.71	30.92	48.63
2014-15	18.11	42.61	60.72
2015-16	18.62	53.02	71.64

Source: Authors' own.

Table 15: NER's Trade with Myanmar

Name of LCS	Major Commodities Traded (Formal Trade)	
	Export	Import
Moreh (Manipur)	Cumin seed, cotton yarn, auto parts, soya bean meal, wheat flour and pharmaceuticals	Betel nuts, dry ginger, green mung beans, black matpe beans, turmeric roots, resin and medicinal herbs
Zokhawthar (Mizoram)	-	Betel nuts

Source: Manipur Government, based on Indian Customs.

betel nuts, dry ginger, green mung beans, black matpe beans, turmeric roots, resin and medicinal herbs. However, informal trade between NER and Myanmar have been carried out extensively, and some of the Indian products traded between them through informal channels are food items, cosmetics, wood and timber products, construction materials, garments, gas cylinder, medicines, plastics and materials, rubber products, solar and electrical items, betel nuts, auto parts, petroleum products, etc. Nevertheless, the border trade facilities at NER still inadequate to support the rising trade volume. In other words, NER needs drastic improvement in border infrastructure, particularly dealing trade with Bangladesh. Success of connectivity corridors will happen only when border infrastructure is upgraded to facilitate trade and investment at the border region. Connectivity corridors may also add economic impetus to the NER-Centric regional integration.

Endnotes

1. Area as per the latest year and population data has taken from Census of India, 2011.
2. For details, kindly see Annual Reports of the Ministry for the Development of North East Regions for various years.
3. Refer, the Summary Results for Factory Sector: ASI 2014-15, CSO, Government of India.
4. The standard development indicators such as road length, access to healthcare, and power consumption in the region are below the national average (NEC, 2012).
5. In Assam, Meghalaya, Manipur, Mizoram and Nagaland, poverty in 2009-10 has increased. Refer, press note on poverty estimates, 2009-10, Government of India, Planning Commission, 17 March 2012.
6. Refer, for example, Das (2008).
7. Refer, for example, RIS (2012)

4
Outline of the Corridors under Study

We consider four corridors in this study. All the corridors are either passing through or proposed to pass through NER. Here, we provide the basic information of the selected corridors. Table 16 presents brief outline of the selected four corridors (also see Map 2).

Table 16: Corridors Overview

Corridors	Length (km)	Origin	Destination	Connecting region
East-West Corridor	3300	Silchar (Assam)	Porbandar (Gujarat)	India
Trilateral Highway	1360	Moreh (India)	Mae Sot (Thailand)	India-Myanmar-Thailand
Kaladan Multi-Modal Transit Transport Project	539	Kolkata (India)	Sittwe (Myanmar)	India-Myanmar
	158	Sittwe (Myanmar)	Paletwa (Myanmar)	Myanmar
	210	Paletwa (Myanmar)	Zorinpuri (India)	Myanmar-India
BCIM-EC	2800	Kolkata (India)	Kunming (China)	India-Bangladesh-Myanmar-China

Source: Authors' own.

4.1. East-West Corridor (EWC)

The National Highways Authority of India (NHAI) initiated the National Highway Development Programme (NHDP) in 1998 to ease road capacity constraints by upgrading key arteries of the national highways network in

the country. This programme has upgraded India's national highways into four lanes connecting the major metropolitan cities of India, namely, Delhi, Mumbai, Chennai, and Kolkata, also known as the Golden Quadrilateral (GQ) project. The East-West Corridor is one of the GQ projects, which connects Assam with Gujarat. It starts at Silchar (Assam) and ends at Porbandar (Gujarat), and aims to improve the connectivity of the NER with the rest of India through a 3,300 km long four-lane divided highway between Silchar and Porbandar.

Map 2: Corridors under Study

Source: AIC at RIS.

This project is managed by the NHAI under the Ministry of Road Transport and Highways. The East-West Corridor has seen an expenditure of Rs 27,000 crore so far.[1] The first phase covers Gujarat, Rajasthan, Punjab, Jammu & Kashmir, Himachal Pradesh, Uttarakhand, part of Uttar Pradesh, Bihar and West Bengal and then move to Sikkim, Assam, Arunachal Pradesh, Manipur and Mizoram in the second phase. As of 31 March 2015, 6375 km of the total approx 7,300 km NS-EW corridor project has been completed.

Map 3: East-West Corridor

Source: AIC at RIS.

This is a (3,300 km) long corridor via NH 8B (Porbandar–Rajkot), NH 8A (Rajkot–Samakhiali), NH 15(Samakhiali–Radhanpur), NH 14 (Radhanpur–Pindwara), NH 76 (Pindwara – Shivpuri), NH 25 (Shivpuri–Lucknow), NH 28 (Lucknow–Muzaffarpur), NH 57 (Muzaffarpur–Darbhanga-Purnia), NH 31 (Purnia–Galgalia), NH 31C (Galgalia–Bijni), NH 31(Bijni–Guwahati), NH 37 (Guwahati–Nagaon), NH 36 (Nagaon–Dabaka), and NH 54 (Dabaka–Silchar). In combination with the Golden Quadrilateral network, and port connectivity highways, the EW corridor (see Map 3) forms a key part of the Indian highway network, connecting many of its important manufacturing, commerce and cultural centers.

This project aims to improve the connectivity of the NER with the rest of India through a 670 km long four-lane divided highway between Srirampur and Silchar. The corridor does not go beyond Assam. While the larger portion of this corridor has been completed, small phases are still

under construction in NER. According to the NHAI, reasons for delay, inter-alia, problems inland acquisition, forest clearance for cutting trees, transfer of electric poles, etc.[2]

4.2 Trilateral Highway (TH)

The Trilateral Highway (TH) was first proposed at a Trilateral Ministerial meeting on transport linkages in Yangon in April 2002. This corridor is to connect Moreh, the Manipur State of India to Mae Sot, Tak Province of Thailand via Myanmar. This India–Myanmar–Thailand Trilateral Highway is a highway, which is aimed to connect India with the ASEAN region. The length of the Trilateral Highway is approximately 1360 km. Under the Trilateral Highway project, India assumes the responsibility of building 78 km of missing links, upgrade 58 km of existing roads, and improves a further 132 km of road in Myanmar.

On the Trilateral Highway, the Tamu and Kalewa Friendship Road is being constructed with India's assistance. About 132 km have been completed and handed over to Myanmar. India has also undertaken the task of repairing/upgrading 69 bridges on the Tamu-Kalewa Friendship Road and upgrading the 120 km Kalewa-Yargyi segment to highway standard. Myanmar has completed the upgrading of the Yargyi to Monywa stretch of the highway. This project will help in establishing trilateral connectivity from Moreh in India to Mae Sot in Thailand via Myanmar. India has also announced the extension of the Trilateral Highway to Cambodia, the Lao People's Democratic Republic (Lao PDR) and Viet Nam.

The Trilateral Motor Vehicle Agreement (MVA) is being negotiated. This Agreement will allow vehicles and passengers to move seamlessly for regional and international trade transportation purpose along the Trilateral Highway. The MVA will provide a series of procedures that would facilitate movement of cargo and passengers along the corridors such as operating procedures (OP) for vehicles, customs procedures, etc. and facilitation measures. The MVA will also provide the transit and transportation rights and obligations through Annexes and Protocols. This Agreement will have a critical role in realizing seamless movement of passenger, personal and cargo vehicles along Trilateral Highway.

Map 4: Trilateral Highway Corridor

Source: AIC at RIS.

The alignment of the Trilateral Highway falls within the Asian Highways 1 and 2. Shown in Map 4, the agreed route of the TH (1,360 km) is as follows: Moreh (India)–Tamu–Kalewa–Yargi–Monywa–Mandalay–NayPyiTaw–Yangon–Thaton–Hypaan–Kawkareik–Myawaddy–Mae Sot (Thailand). Along this corridor, there are two border crossings (India–Myanmar and Myanmar–Thailand), four customs check-points, three international time zones, three customs EDI systems, two different vehicle driving standards and three different motor vehicle laws. Challenge is to reach convergence in standards and procedures along the corridor.

This project would help in establishing trilateral land connectivity between India, Myanmar and Thailand. The project is likely to be completed by 2020. It has been also decided to extend the Trilateral Highway to Lao PDR, Vietnam and Cambodia in order to add greater momentum to the growing trade and investment linkages between ASEAN and India.

4.3 Kaladan Multi-modal Transit Transport Project

The Ministry of External Affairs (MEA), Government of India entered into a Framework Agreement with the Myanmar Government in April 2008 to facilitate implementation of the Kaladan Multi-modal Transit Transport Project. The Kaladan Project has been jointly identified by India and Myanmar to create a multi-modal transportation of cargo from the eastern ports of India to Myanmar as well as to the north-eastern part of India through Myanmar. This project connects Sittwe Port in Myanmar to the India-Myanmar border and is expected to contribute to the economic development of the NER states of India, by opening up the sea route for the products. This project envisages connectivity between Indian ports and the Sittwe port in Myanmar and road and inland waterway links from Sittwe to India's northeastern region (see Map 5). The Kaladan project is aimed to provide an alternate route for transportation of goods to northeastern India through Myanmar. KMTTP has two major components — (a) development of the port and IWT development between Sittwe and Kaletwa in Myanmar along Kaladan River, and (b) building a highway (129 km) from Kaletwa to the India–Myanmar border in Mizoram. The components of this project include (a) construction of an integrated Port and Inland Water Transport (IWT) terminal at Sittwe including dredging; (b) development of navigational channel along river Kaladan from Sittwe to Paletwa (158 km); (c) construction of an IWT — Highway transshipment terminal at Paletwa; (d) construction of six IWT barges (each with a capacity of 300 tonnes) for transportation of cargo between Sittwe and Paletwa; and (e) building a highway (109 km) from Paletwa to the India-Myanmar border (Zorinouri) in Mizoram. The Framework Agreement and two protocols (Protocol on Transit Transport and Protocol on maintenance) were signed by India and Myanmar on 2 April 2008.

Construction of the integrated port-IWT jetty at Sittwe is substantially completed. Construction work of the IWT terminal at Paletwa was started in April 2013 and is expected to be completed by 2018. The construction of the India-Mizoram border at Zorinpuri to NH 54 (Lawngtlai) road on the Indian side in Mizoram is in progress under India's Ministry of Road Transport and Highways, which is also termed as National Highway 502A (NH 502A). About 66 percent of the new 99.83 km NH 502A, starting from NH 54 at Lawngtlai to Zorinpui in Mizoram, is done and will be completed by 2018.[3] However, the 109 km road from Zorinpui on the India-Myanmar border to Paletwa in Myanmar is yet to be completed. In 2015, the Government of India approved the revised cost estimate (about

Rs.29 billion) for construction of the Kaladan multi-modal transit transport project. Once completed, this corridor will provide a strategic link to the NER, thereby reducing transportation load on the Siliguri Corridor. In the absence of an alternate route, the development of this project not only serves the economic, commercial and strategic interests but also contributes to the development of Myanmar, and its economic integration with India. Since the project is of political and strategic significance, it was decided to execute it through India's grant assistant to Myanmar.

Map 5: Kaladan Multi-modal Transit Transport Project

Source: AIC at RIS.

4.4 BCIM Economic Corridor (BCIM-EC)

One of the major policy initiatives among national governments in Asia in recent years is directed towards developing sub-regional, regional and trans-regional corridors with the aim to further connect and integrate their economies. One such corridor is proposed Bangladesh, China, India and Myanmar-Economic Corridor (BCIM-EC). This is the corridor, which connects China, Bangladesh and Myanmar with India and vice-versa. The BCIM-EC encompasses Kolkata in India to Kunming in China's Yunnan Province, passing through the Bangladesh and Myanmar.

Map 6: BCIM Economic Corridor

Source: AIC at RIS.

The proposed corridor covers 2800 km, encompassing an estimated 440 million people in China's Yunnan Province, Bangladesh, Myanmar, and West Bengal and NER in India (see Map 6) through the combination of road, rail, water and air linkages in the region. BCIM-EC has been determined as follows: Kolkata – Dhaka – Silchar – Imphal – Mandalay – Tengchong – Kunming. A large part of this route overlaps with the Trilateral Highway (TH), and follows Asian Highway (AH) 1 (up to Mandalay) and AH 14 (from Mandalay to Kunming). Link routes connecting other nodes in North East Region (NER) such as Shillong, Dimapur, Aizawl, Agartala, Nagaon and Dibrugarh may also be established. These are the major urban cities in the Northeast region, which will become major economic centres along the BCIM-EC. Along this about 2490 km corridor, there are four border crossings between China – Myanmar; Myanmar – India; and two in India – Bangladesh, eight customs check-points, four international time zones, two different working weeks, four Customs EDI systems, two different vehicle driving standards, and four different motor vehicle laws. This interconnectedness is likely to facilitate the cross-border flow of goods and services between the four countries.

Endnotes

1. Refer, NHAI
2. Based on the conversation had with NHAI.
3. Refer, Indian Parliament question and reply by Gen. V K Singh, Minister of State (External Affairs) in April 2016.

5
Data and Methodology

5.1 The Model

The corridors considered in this study are BCIM-EC, Kaladan MTTP and Trilateral Highway (TH). These corridors pass-through some of the states of India, especially NER states, and connect India with the neighbouring countries in the east such as Bangladesh, China, Myanmar, Thailand and beyond. Several literatures indicate that these corridors would generate further economic activities, ceteris paribus. States having better connectivity and access to the neighbouring markets through improved corridors may gain from intra- and inter- state economic activities as well as with neighbouring countries. On the other, the states which have less proximity to the transport corridors might face more connectivity challenges and relatively little access to the international market.

To assess the impact of transport corridors on economic growth in Indian states, we follow the classical constant elasticity of substitution (CES) function, for both production (CES production function) and consumption (CES utility function).

In a closed economy framework, each state i potentially produce varieties of goods and engages in inter-state production and consumption, thereby generating trade across states. The preferences of consumer in state j given the supplier of varieties of goods from state i would be as follows:

$$U_j = \left(\sum_{i=1}^{S} \lambda_{ij} x_{ij}^{1/\theta}\right)^{\theta} \qquad (1)$$

The utility function is the constant elasticity of substitution (CES) functional form, which is the sum of the consumer preference of varieties of goods (v) from state i, (each of which is weighted equally) also called as Armington aggregator.[1] x_{ij} is the quantity of goods traded from state i is consumed in state j, given the unit price of x_{ij} can be p_{ij}. λ is a preference

parameter related to the share of expenditure by state j spent on the goods from state i, assuming $\theta = \sigma / (1- \sigma)$ and σ is the constant elasticity of substitution.

Given the utility function of the varieties of goods v from state i, the budget constraint of the consumer in state, i would be:

$$Y_i = \sum_{s=1}^{S} \{ \int p_i^s(v)\, x_i^s(v)\, dv \} \equiv \sum_{s=1}^{S} Y_i^s \quad (2)$$

where Y_i is total expenditure in that state, and Y_i^s is state i's total expenditure in sector s. The problem of consumer in state i is to choose $x_i^s(v)$ for all v to maximise the utility (in equation (1)), subject to budget constraint (in equation (2)). Let λ_j be the Lagrange multiplier on the country-i budget constraint.

$$\mathcal{L} = \left(\sum_{i=1}^{S} \lambda_{ij} x_{ij}^{1/\theta} \right)^{\theta} - \lambda \sum_{s=1}^{S} \{ \int p_i^s(v)\, x_i^s(v)\, dv \} \quad (3)$$

Taking the first order condition with respect to quantity and setting it equal to zero gives:

$$\frac{\delta \mathcal{L}}{\delta x_i^s(v)} = \theta \left(\sum_{i=1}^{S} \lambda_{ij} x_{ij}^{\frac{1}{\theta}}\, dv \right)^{\theta} \frac{1}{\theta} \left(x_{ij}^{\frac{1}{\theta}} \right) - \lambda p_i^s(v) = 0 \quad (4)$$

The derived demand function after imposing Lagrangian (in equation (3)) and first order condition with respect to quantity (x_i^s) (in equation (4)) would be:

$$x_i^s(v) = \left\{ \frac{p_i^s}{P_i^s} \right\}^{-\sigma_s} \frac{Y_i^s}{P_i^s} \quad (5)$$

where P_i^s is the CES price index for sector s in state i.

With respect to the production side, assuming each state specializes in the unique goods in every sector ($x_i^s(v)$), which is produced using capital k and labour l with linear homogeneous production functions. Then, the resource constraint for the producer in state i to produce $x_i^s(v)$ is:

$$x_1^{s1} + x_2^{s2} + \cdots + x_i^s(v) = Y_i^s = F(k_i^s(v), l_i^s(v)) \quad (6)$$

Given the resource constraint, profit maximisation for producers in state i is:

$$\pi_i^s(v) = p_i^s(v)\, x_i^s(v) - w a_i^s x_i^s(v) - f_i^s(v) \quad (7)$$

where w, a_i^s and f_i^s is the wage rate, variable cost and fixed cost, respectively. The first order condition for profit maximization with respect of price $p_i^s(v)$ of equation (7) can be written as:

$$\frac{\partial \pi_i^S(v)}{\partial p_i^S(v)} = x_i^S(v) + p_i^S(v)\frac{\partial x_i^S(v)}{\partial p_i^S(v)} - wa_i^S\frac{\partial x_i^S(v)}{\partial p_i^S(v)} = 0 \quad (8)$$

Rearranging the equation (8) to solve the prices $p_i^s(v)$ gives:

$$p_i^S(v) = wa_i^S + x_i^S(v)\frac{p_i^S(v)}{\sigma_s x_i^S(v)} \quad (9)$$

Given $x_i^s(v)$ in equation (5), applying the partial derivation of $\frac{\partial x_i^S(v)}{\partial p_i^S(v)}$ in equation (8) gives:

$$p_i^S(v) = wa_i^S - \frac{x_i^S(v)}{\frac{\partial x_i^S(v)}{\partial p^S(v)}} \quad (10)$$

Rearranging and solving for prices for equation (10) gives:

$$p_i^S(v) - \frac{1}{\sigma_s}p_i^S(v) \equiv p_i^S(v)\left(1 - \frac{1}{\sigma_s}\right) = wa_i^S \quad (11)$$

Therefore, we get:

$$p_i^S(v) = \left(\frac{\sigma_s}{\sigma_s - 1}\right)wa_i^S \quad (12)$$

where $\left(\frac{\sigma_s}{\sigma_s - 1}\right)$ is the constant elasticity of substitution and wa_i^s is the marginal cost of production.

Here, we relax the assumption of closed economy framework by considering India's inter- and intra- trade relations with neighbouring countries and assessing the impact of economic corridor which is proposed to pass through some of the Indian states especially NER states to the neighbouring countries such as Bangladesh, Myanmar, Thailand and China. In this case, we consider that the trade relation exists among within the state and across the borders with the neighbouring countries. Thus, states which are closer to or passing through the transport corridors incur less trade costs compare to the states which are relatively far away from the corridors. Therefore, the price of the goods consumed in state i would vary depending on how close or far away from the production

and transportation of the goods is from state / country *j*. To illustrate, we extend the CES functional form by introducing trade costs τ_{ij}, where if state *j* consumes x_{ij} units of good from state *i*, units are transported from state *i*, $x_{ij}(1 + \tau_{ij})$ Therefore, the unit price of p_{ij} would be $p_{ij} = p_{ii}(1 + \tau_{ij})^2$. Here, the changes in the price in state *j* of goods produced in state *i* including the trade costs would be as follows:

$$p_i^s(v) = \left(\frac{\sigma_s}{\sigma_s - 1}\right)\tau_{ij}^s w a_i^s = \tau_{ij}^s p_i^s(v) \tag{13}$$

Now, combining the price equation (12) with the demand function in equation (5) gives:

$$x_i^s(v) = \left\{\frac{\tau_{ij}^s p_i^s(v)}{P_i^s}\right\}^{-\sigma_s} \frac{Y_i^s}{P_i^s} \tag{14}$$

Here, equation (14) explains the demand for variety of products *(v)* at state *i*. The aggregate expression of the equation (14) for the total sectoral demand for state *i* from state *j* $\left(X_{ij}^s\right)$, would be multiplied by N_j. Where, the measure of N_j of active firms in state *j* is in production process of (x_j) for total sectoral export to state *i, i.e.*, Σx_{ij}. Assuming that all firms in state *j* are symmetrical in terms of marginal cost, sales, price, etc., we get:

$$X_{ij}^s = N_j \left\{\frac{\tau_{ij}^s p_{ij}^s(v)}{P_i^s}\right\}^{-\sigma_s} \frac{Y_i^s}{P_i^s} \tag{15}$$

Separating the trade cost τ_{ij}^s from the equation (15) and keeping $Y_i = \frac{Y_i^s}{P_i^s}$ τ_{ij}^s, we get:

$$X_{ij}^s = Y_i \left(N_j \left\{\frac{p_i^s(v)}{P_i^s}\right\}^{-\sigma_s} \tau_{ij}^{s\,-\sigma_s}\right) \tag{16}$$

Equation (16) shows the sectoral (s) demand for the product of state *i* from state *j*. Now, we further simplify the equation (16) for deriving aggregate demand for the product of state *i* from state *j*, which can be written as:

$$X_{ij} = Y_i \left(\frac{\gamma_i}{p_i}\right)^{\sigma} \tau_{ij}^{-\sigma} \tag{17}$$

where X_{ij} is state *i* demand for the product from state *j* (i.e. Σx_{ij}). Y_i is the total expenditure of state *i*, $\left(\frac{\gamma_i}{p}\right)$is the real consumption of state *i* from state *j*, given $\gamma_i = x_{ij}p_{ij}$and τ_{ij} is the trade cost. The log-linear form

of the equation (17) can be as follows:

$$lnX_{ij} = lnY_i + \sigma ln\left(\frac{\gamma_i}{p_i}\right) - \sigma ln\tau_{ij} \quad (18)$$

Further, we extend the model by including the factors determining the demand for product between the states such as infrastructure development, political factors, geographical factors and transport corridors, respectively. The augmented model with other external factors considered is given as:

$$X_{it} = \alpha + \beta_1 Y_{it} - \beta_2 \tau_{ij} + \beta_3 I_{it} + \beta_4 C_{ki} + \beta_5 Z_i + \varepsilon_i \quad (19)$$

where, X_{ij} is proxied by freight movement between states i and j. Therefore, the total consumption of a good in state i is equal to its endowment.

$$\sum_{j=1}^{F} X_{ij} = X_i \quad (20)$$

where X_i is the total freight by aggregating the freight movement via land, air and sea routes at states. In case of China, we consider freight at province-level, and in case of Bangladesh, Myanmar and Thailand, we consider total freight at the country level[3]. Y_i is the real expenditure on a good consumed from state j, which is proxied by state-wise gross domestic product (GDP) for India and China; and country-level GDP for Bangladesh, Myanmar and Thailand. $\left(\frac{\gamma_i}{p_i}\right)$ in equation (18) is not observable. Besides, both state-level and country-level GDP include the consumption component. Hence, to avoid multicolinearity problem, we omit the consumption variable.

Trade cost, τ_{ij} is proxied by remoteness measure to capture the distance between state/country capitals. Remoteness measures (D_i) is a relative measure to capture the location-specific advantages and disadvantages through a ratio of the aerial distances between India's capital (C) Delhi to respective states capital (c_i) by the aggregate distance from Delhi to all the capitals.

$$D_i = \frac{C - c_i}{\Sigma(C - c_{i-1})} * 100 \quad (21)$$

Numerator is the distance between India's capital Delhi to the i-th state's capital and the denominator represents the aggregate distance from Delhi to rest of the (i-1)-th states' capitals. D_i accesses the accessibility and availability of services of the particular states or country which is closer proximity to Delhi (capital of India). Suppose two particular places (i.e.

capital of two states) are same in the aerial distance from Delhi but as per their location Remoteness Measure (D_i) we can capture the barriers to service access in relative terms. We assume that closer the distance better the accessibility and economic activity.

I_i presents the infrastructure development in the state/country, particularly accessibility and quality of physical connectivity. To measure better access to land route connectivity, we have used road density, the ratio of total road in km to the total area in square km of that states/country. We expect to have positive relationship with the freight movement, as higher the road density better would be the freight flow between and within the states. Similarly, to measure the quality of physical connectivity, we proxy it by the average speed of the vehicle[3]. Both durability and stretch of the road connectivity tend to improve timely delivery and increases the freight movement in a country.

C_{ki} is the dummy variable to caputre the effect of proposed and ongoing transport corridor on state-level freight movement, where, corridor (k) is East-West corrdior, Kaladan corridor, Trilateral Highway and BCIM-EC, respectively. We keep this corridor in our model as categorical variable, where it takes '1' when the corridor (k) crosses the respective states/country or '0' otherwise.

Z_i is the series of interaction variables to capture the effect of economic corridors on freight movement. We have interacted the corridor (k) dummy variable with Y_i, to capture the state/province level GDP effect of corridor versus non-corridor state on freight movement. We have also interacted the corridor (k) dummy variable with state/province wise speed variable to capture the effect of improvement in the quality of infrastructure development in the Northeastern region due to proposed corridor versus rest of other Indian states.

Overall, the empirical model in equation (19) attempts to explain how economic activity at state-level in India influences the freight movement across the states and neighbouring countries. In particular, we aim to analyse how does the NER economy having a proposed corridor would benefit from the economic activities by gaining inter- and intra- regional trade within and between the states and neighbouring countries. For instance, an increase in economy activity in terms of growth of GDP would positively influence the growth of freight movement, ceteris paribus. In addition, infrastructure development, better connectivity, vehicle speed, political and cultural factors also influence the growth of freight movement.

We use several databases to collect the freight movement for the years 2010 to 2014. The list of 29 Indian states and other selected countries included in our analysis are given in Appendix 1. The list of Indian states and countries passing through the economic corridors of East-West corridor, Kaladan corridor, Trilateral Highway, BCIM-EC are given in Appendix 2. The definitions of variables and its corresponding data source are given in the Appendix 3.

5.2 Projecting the Impact of Economic Corridor

We have further projected the impact of corridors till 2040. To carry out the future projections over a long time horizon, the growth rate of freight movement *i* has been obtained using equation (19). Here, we assume that there will be no change in any factor (such as road density, political, speed of vehicle) except state-level GDP.[4] Therefore, the growth rate of freight movement *i* can be derived using equation (19), *ceteris paribus*:

$$\ln X_{it} = \alpha + \beta_{it1} \ln Y_i \tag{22}$$

Differentiation of the demand equation (19) for freight movement *i* with respect to time yields the relation (where a hat (^) on the top of a variable denote its rate of growth):

$$\hat{X}_{it} = \beta \hat{Y}_{it} \tag{23}$$

This simpler equation can be used to project future freight demand $\hat{X}_{it}$ by using the income elasticity α_{it} of the freight demand and the expected future growth rate, *g*, of GDP. Our projections till 2040 are based on the average growth rate of state-level real GDP for the past 10 years (2004 to 2014). Correspondingly, we have forecasted the growth rate of state-level GDP for the years 2020, 2030 and 2040. We consider that the forecasted growth rate of state-level GDP has the baseline scenario and they are appropriate for long-term growth of demand for freight movement and are not meant as accurate short-term forecasts.

Endnotes

1. Refer, for example Armington (1969).
2. Where p_{ii} is price of the units of goods within state *i*.
3. State level freight data are not readily available in these countries.
4. Based on authors' own observation.
5. Thus, our results should be taken with caution.

6
Analysis and Results

We have estimated the empirical model, derived from the CES functional form to assess the freight demand along with four proposed corridors (see equation 19 in Chapter 5): (i) East-West Corridor, (ii) Trilateral Highway, (iii) Kaladan Corridor, and (iv) BCIM-Economic Corridor. We have used panel fixed effect models, Prais-Winsten regressions with panels corrected standard errors (PCSE) model and Driscoll-Kraay standard errors estimates model (SCC)[1] for our analysis based on country-level and state-level data of India, China, Thailand, Myanmar and Bangladesh for the period 2010 to 2014.

The baseline regression model in Table 17 shows estimated results under the fixed effect (FE) and random effect (RE) model. The diagnostic tests in Table 17 suggest that both fixed and random effect models suffer from contemporaneous correlations within the panel. Therefore, presence of heteroskedasticity and auto-correlation in the panel would result in inefficient estimates. Moreover, both fixed and random effect models do not allow the contemporaneous correlation among the residuals. In this case, the panel suffers from cross-section dependence due to spatial dependence that affects the reliability of the estimates. For instance, if the unobserved components that create interdependencies across the cross-section are correlated with the explanatory variables, the fixed effect would be biased as well as inconsistent.

To address the aforesaid issues, we have used panels corrected standard errors (PCSE) model and also Driscoll-Kraay (1998) standard errors estimates (SCC) model. The Prais-Winsten panel corrections standard error (PCSE) estimates cross-sectional time series models, where the parameters are estimated by either ordinary least square or fixed effect regression. PCSE assumes that residuals can be either heteroscedastic across panels or heteroscedastic and contemporaneously correlated across

panels. Similarly, Driscoll and Kraay (1998) standard error estimates of commonly applied covariance matrix estimation propose a nonparametric covariance matrix estimator which produces heteroskedasticity consistent standard errors that are robust to general forms of spatial and temporal dependence. Therefore, assuming fixed effect models in Table 17 suffer from cross section dependence and heteroskedasticity, both PCSE and SCC models are supposed to give robust estimates.

Table 17: Baseline Regression Models with Fixed and Random Effects for all Corridors

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	FE	RE	FE	RE	FE	RE
Log of GDP	0.5***	0.38***	0.5***	0.42***	0.4***	0.4***
	(4.4)	(3.8)	(4.4)	(3.7)	(4.4)	(5.6)
Log of Remoteness Measure	-0.5**	-1.3	-1.1	-0.8	1.1*	-0.39
	(2.1)	(1.3)	(1.5)	(0.8)	(1.8)	(0.7)
Log of Road Density	0.5***	0.5***	0.5***	0.54***	0.5***	0.4***
	(5.1)	(6.1)	(5.03)	(6.0)	(3.3)	(3.77)
Log of Speed	-0.3	1.16*	-0.9***	1.13*	-0.9**	0.88**
	(-0.6)	(1.56)	(3.2)	(1.6)	(2.4)	(2.0)
East West Corridor	1.7***	0.95	0.5	0.73	-1.1	0.99*
	(-8.4)	(1.46)	(0.9)	(1.2)	(1.2)	(1.9)
Trilateral Highway	-1.8	-1.07	-	-	-	-
	(16.01)	(1.5)				
Kaladan Corridor	-	-	-0.7*	-1.23*	-	-
			(1.7)	(1.8)		
BCIM-EC	-	-			1.1	-1.2***
					(1.6)	(3.2)
Constant	-3.9	-5.09	-1.1	-6.05	0.2	-4.9
	(-1.6)	(1.6)	(0.3)	(1.8)	(0.1)	(2.3)
N	128	128	120	120	248	248
State/Province effect	Yes		Yes		Yes	
Adjusted R-squared	0.42	0.64	0.53	0.68	0.42	0.59
F	31.12***	-	30.0***	-	16.91***	-
Wald chi2	-	109.7***	-	114.6***	-	116.8***

Table 17 continued...

Table 17 continued...

Hausman Test (1)	4.56*		5.17*		0.98	
Serial Correlation (2)	9.1***	22.2***	9.0***	20.8***	3.2*	41***
Heteroske-dasticity (3)	2792.1***	-	2789***	-	1452***	-
Cross-section dependence (4)	19.8***	18.6***	25.1***	22.8***	17.8***	19.83***
Functional Form (5)	47.28***	27.4***	543***	354.8***	47***	3.42**

Notes: 1. Hausman test whether the unique errors are correlated with the regressors to verify the robustness of the fixed effect model compare to random effect model; 2. Lagrange multiplier test of residual serial correlation; 3. Modified wald statistics for groupwise heteroskedasticity in the residuals of a fixed effect model (Greene, 2000) 4. Pesaran (2004) cross section dependence test. 5. Ramsey's (1969) regression specification error test (RESET) using the square of the fitted value; parentheses show standard error. *** statistical significance at 1%, ** statistical significance at 5%, * statistical significance at 10%.

Table 18 shows both PCSE and SCC estimated models with the respective dummies of the corridors. Table 18 investigates the impact of different economic corridors on freight movement to capture the individual corridor effect in the regression model. Model 1 and Model 2 include dummy for Trilateral Highway, Model 3 and Model 4 include Kaladan corridor and Model 5 and Model 6 include BCIM corridor, respectively. It is clearly evident from the Table 18 that the coefficients of the core variables are robust and consistent between PCSE and SCC models.

Table 18: Estimated Results

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	PCSE	SCC	PCSE	SCC	PCSE	SCC
Log of GDP	0.5**	0.5*	0.5**	0.5*	0.4***	0.4***
	(-2.1)	(-1.9)	(1.9)	(1.8)	(3.8)	(5.0)
Log of Remoteness Measure	-0.5	-0.3	-1.1	0.3	-1.1*	0.7
	(1.3)	(0.7)	(0.7)	(0.5)	(1.7)	(1.3)
Log of Road Density	0.5***	0.5***	0.5***	0.5**	0.5***	0.5***
	(3.08)	-2.8	(2.9)	(2.7)	(3.08)	(3.8)
Log of Speed	0.3	1.4	0.9*	1.6	0.9**	0.8
	(0.3)	(1.01)	(1.5)	(1.0)	(2.4)	(1.6)

Table 18 continued...

Table 18 continued...

East West Corridor	1.7***	2.01***	0.5	2.03***	-1.1	1.9***
	(-4.9)	(5.01)	(0.4)	(5.2)	(1.2)	(4.6)
Trilateral Highway	-1.8	-1.8	-	-	-	-
	(-10.7)	(-2.9)				
Kaladan Corridor	-	-	-0.7	-1.9**	-	-
			(0.7)	(2.6)		
BCIM-EC	-	-	-	-	1.1*	-2.4***
					(1.7)	(3.5)
Constant	-3.9	0.0	-1.1	0.0	0.2	0.0
	(-0.8)	-	(0.1)	-	(0.1)	-
N	128	128	120	120	248	248
State/ Province effect	Yes	Yes	Yes	Yes	Yes	Yes
F	12901***	976.7***	34893***	1069.2***	3301***	6.66**
RESET Test	58.2***		270.4***		3.3***	

Notes: Ramsey's (1969) regression specification error test (RESET) using the square of the fitted value; parentheses show standard error. ***statistical significance at 1%, **statistical significance at 5%, *statistical significance at 10%

Table 18 shows that state GDP and road density (proxy for infrastructure development) are the important determinants of freight flow. For every one per cent increase in GDP, total freight in the region is expected to increase by 0.5 per cent over time. Road density and speed variables have positive effect on freight. The positive and significant relationship between road density and the freight implies that the higher the road density, higher would be the flow of freight between and within the states. The relative remoteness measure with the negative sign implies that the states closer to the capital region get better political attention, in terms of sanctioning infrastructure projects that leads to more economic activities compare to the states that are away from the capital region. The existing East-West corridor shows positive and significant coefficient, thereby suggesting the states which connect the East-West corridor perform better than other (non East-West corridor) states in India. In terms of dummies for the proposed corridor shows negative and mostly insignificant results. Dummy for the Trilateral Highway corridor shows negative and insignificant estimates in Model 1 and Model 2, whereas the dummy for Kaladan corridor shows negative and mixed results in Models 3 and 4, whereas the dummy for BCIM-EC show negative and significant results. This may be due to the fact that the growth of freight is considerably higher in non-corridor

states, compared to the corridor states like Northeastern states of India and the other neighbouring countries such as Myanmar, Bangladesh. In case of the dummy for BCIM-EC, both corridor states and non-corridor states in China's provinces are expected to benefit substantially, whereas, the corridor and non-corridor states in India are likely to witness mixed results due to the structural differences in the economic size. The results also reflect the relatively poor performance of proposed corridor states in terms of freight. Overall, Table 18 shows the growth of state GDP and better infrastructure would positively influence the growth of freight.

Table 19: Results of Corridors with GDP Interactions

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	PCSE	SCC	PCSE	SCC	PCSE	SCC
Log of GDP	0.3*	0.3*	0.3*	0.3*	0.2*	0.2**
	(1.4)	(1.4)	(1.4)	(1.4)	(1.3)	(2.3)
Log of Remoteness Measure	-1.1***	-1.7***	-1.3***	-3.1***	0.8	-0.2
	(4.3)	(3.9)	(5.6)	(10.4)	(1.6)	(0.3)
Log of Road Density	0.5***	0.5***	0.5***	0.5***	0.5***	0.5***
	(2.9)	(2.9)	(3.04)	(2.9)	(2.9)	(3.4)
Log of Speed	1.4***	-0.04	2.2***	-0.1	0.5*	0.6
	(3.4)	(0.03)	(5.4)	(0.09)	(1.7)	(0.9)
East-West Corridor	2.3***	7.0***	24.6***	6.4***	18.4***	1.5***
	(6.09)	(2.9)	(5.4)	(3.6)	(3.5)	(3.4)
Interaction of TH*GDP	0.6***	0.6***				
	(3.9)	(3.7)				
Interaction of Kaladan*GDP			1.1***	1.1***		
			(5.4)	(6.0)		
Interaction of BCIM-EC*GDP					0.8***	0.8***
					(3.6)	(6.2)
Constant	-38.4***	-30.0**	-81.6***	20.0***	0.4	(22.0)**
	(4.8)	(4.2)	(6.4)	(5.2)	(0.2)	(2.4)
N	128	128	120	120	248	248
State/Province effect	Yes	Yes	Yes	Yes	Yes	Yes
F	1681***	3989***	2468***	1943***	2523.0**	1681.5***
RESET Test	58.5***		268.58***		3.3***	

Notes: Ramsey's (1969) regression specification error test (RESET) using the square of the fitted value; parentheses show standard error. ***statistical significance at 1%, **statistical significance at 5%, *statistical significance at 10%

It is clearly evident from the Table 18 that state GDP has positive influence on freight. Now, we would like to investigate the contribution of GDP growth in corridor and non-corridor states on freight. Table 19 shows the interaction effect of GDP with dummy for Trilateral Highway, Kaladan corridor and BCIM-EC along with other core variables. The coefficient of GDP shows the expected results, and it is positive and significant in all the models. Remoteness measure shows negative and significant in most of the models. Coefficient of road density has come out positive and significant in every model implying infrastructure is crucial to increase freight movement. The coefficient of speed shows mixed results. The coefficient of existing East-West corridor has a positive and significant impact on freight movement in all the models. In terms of GDP interaction, Models 1 to 6 in Table 19 clearly show that the coefficients of corridor states and GDP interaction variable are highly positive and statistically significant. In fact, the size of coefficient of interaction variable with GDP has come out greater than that of coefficient of GDP in non-corridor states, implying that the NER states having corridors would gain relatively higher freight, compared to the non-corridor states. For instance, the coefficient of interaction effect of GDP with dummy for Trilateral Highway shows that one per cent rise in GDP growth in corridor states would lead to 0.6 per cent rise in freight, compared to the non-corridor states. Similarly, the interaction effect of GDP with Kaladan corridor and BCIM-EC shows significant higher impact on freight movement in NER states. We then use the coefficient of GDP and the interaction variable with GDP to forecast the freight for different corridors and the likely growth of freight flow till 2040.

Forecast of Freight

We forecast the freight movement for the Indian states based on the estimated parameters of Table 19. To forecast, we have used annualised growth rate of state-level real GDP for the past 10 years (2004 to 2014); and correspondingly we have projected the growth rate of state-level GDP for the years 2020, 2030 and 2040. The projections for corridors linking NER with the neighbouring countries such as Bangladesh, Myanmar, Thailand, and China are given in Table 20.[2] It briefly summarizes the effect of corridors and non-corridor states on the freight flow till 2040. For instance, in case of Kaladan corridor, the Indian states, mostly NER states, may likely to witness an increase in freight movement by 74.37 per cent in 2040, compared to the states with "no corridor". Similarly, in case of Trilateral Highway, the states with corridor would witness an increase of the freight by 34.75 per cent in 2040, compared to the states with "no corridor".

Table 20: Forecast of Freight

Corridor		2014	2020	2030	2040
Trilateral Highway	With*	296.68	354.42	477.09	642.90
	GR (%)		19.46	34.61	34.75
	Without**	1514.33	1670.84	1968.77	2320.33
	GR (%)		10.33	17.83	17.86
Kaladan Corridor	With*	210.44	292.33	507.54	885.02
	GR (%)		38.92	73.62	74.37
	Without**	1600.58	1764.95	2077.64	2446.27
	GR (%)		10.27	17.72	17.74
BCIM-EC	With*	296.68	376.09	559.29	833.23
	GR (%)		26.77	48.71	48.98
	Without**	1514.33	1616.94	1803.76	2012.35
	GR (%)		6.78	11.55	11.56

*Notes:**States with corridor, **States without corridor, GR: Growth Rate

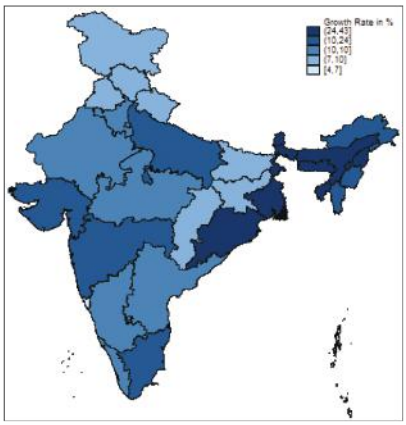
Map 8 to Map 10 present the graphical illustration to understand the state level impact of GDP on freight movement due to corridors till 2040. In case Kaladan corridor, Maps 8(a), 8(b) and 8(c) show the annualised growth rate of projected freight for the periods 2014-2020, 2020-2030 and 2030-2040, respectively. From Map 8, it is clearly evident that the dark (blue) colour states in India may likely to witness higher growth of freight till 2040. Kaladan corridor is planned to connect NER states and West Bengal with Myanmar. We find that the growth rates of freight have come out high in NER states, particularly, Manipur, Meghalaya, Nagaland, Assam, Sikkim, Tripura and West Bengal through which the Kaladan corridor is designed to pass-through.

Similarly, Map 9 presents the projected growth of freight for the Trilateral Highway. This project connects NER states with the neighbouring Southeast Asian countries such as Thailand and Myanmar. Maps 9(a), 9(b) and 9(c) show that darker states are likely to witness higher growth in freight till 2040, compared to non-corridor states. The pattern is remained same and also visible in all the three maps; the growth of freight is likely to be higher in the states like Arunachal Pradesh, Assam, Bihar, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Sikkim, Tripura and West Bengal as compared to the states not falling in the direct catchment of the Trilateral Highway. Similarly, Map 10 for BCIM-EC shows positive impact on freight in NER states, particularly Assam, Bihar, Jharkhand, Manipur, Tripura and West Bengal.

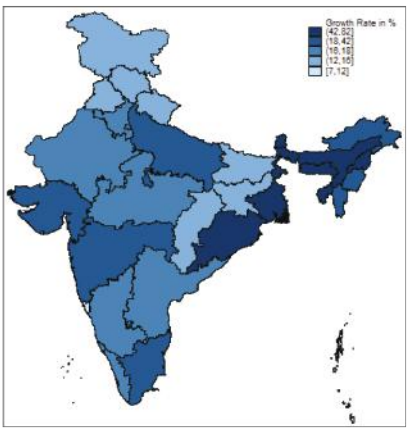
Therefore, in view of the analysis carried out in this study, it may be concluded that NER states are forecasted to gain more in terms of freight from Kaladan corridor, Trilateral Highway and BCIM-EC. The caveat is that this is a static analysis and may miss many dynamic relations between the known variables. The analysis does not talk about causal direction neither relations between freight and development. It simply illustrates a likely future scenario based on simulations of economic geography model. Therefore, we need to interpret the results with caution.

Map 8: State-wise Growth Rate of Projected Freight: Kaladan Corridor

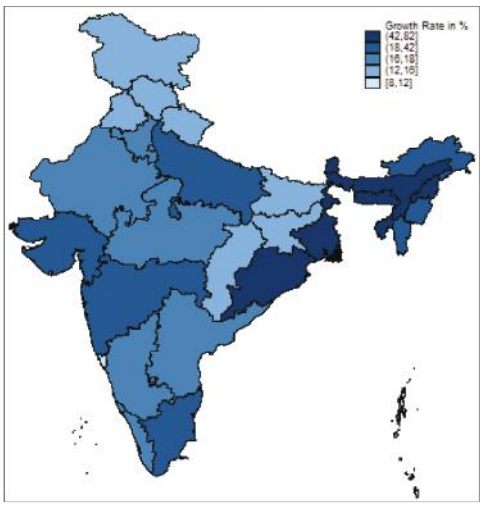
(a) 2014 to 2020



(b) 2020 to 2030



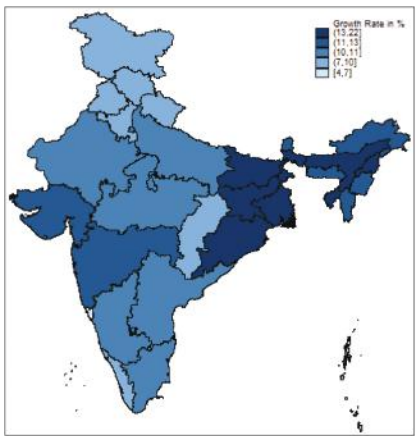
(c) 2030 to 2040



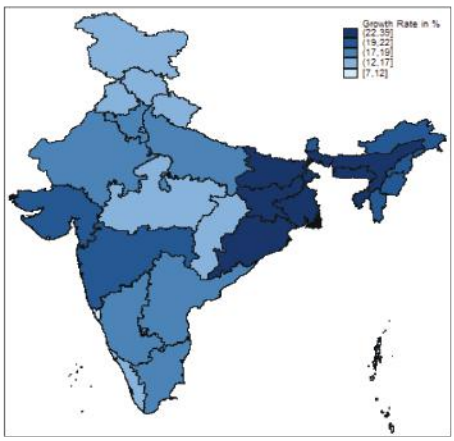
Source: AIC at RIS

Map 9: State-wise Growth Rate of Projected Freight: Trilateral Highway

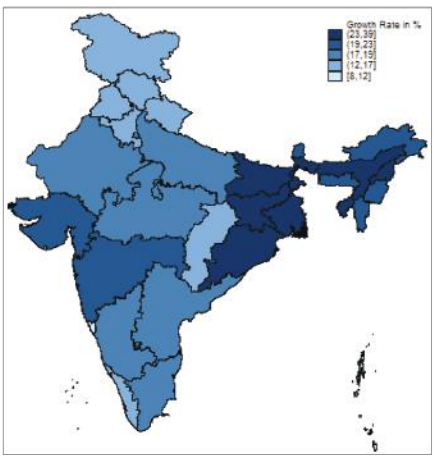
(a) 2014 to 2020



(b) 2020 to 2030



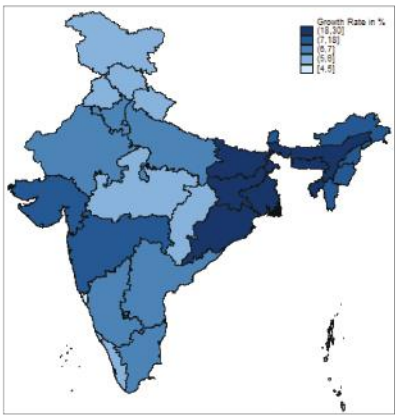
(c) 2030 to 2040



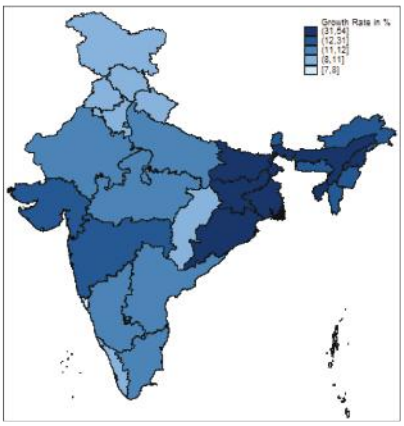
Source: AIC at RIS

Map 10: State-wise Growth Rate of Projected Freight: BCIM-EC

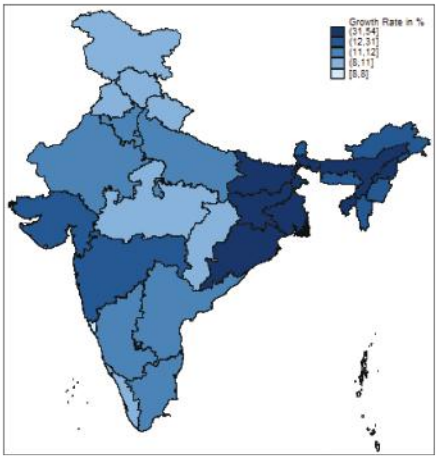
(a) 2014 to 2020



(b) 2020 to 2030



(c) 2030 to 2040



Source: AIC at RIS

Endnotes

1. Several studies have used Input-Output Model (Shen 1960; Schaffer 1972; Stokes et al. 1991), Economic Simulation Models (Weisbrod and Beckwith 1992), Spatial CGE Model (Ivanova 2004; Martino et al. 2005), and Geographical Simulation Model (Kumagai et al. 2008; 2009; 2010; 2011). Due to lack of data availability at state level in India, and for other countries considered in the model, we are constraint to use panel fixed effect related model for our estimation.
2. The detail state level projected results are given in Appendix 4 to Appendix 7.

7
Recommendations and Conclusions

The North Eastern Region of India (NER) is crucial to India's growing economic and strategic partnership with Southeast and East Asia. NER is also central to India's Look East – Act East Policy and acts as a land-bridge between South and Southeast Asia. Owing to its strategic location, several national and international corridors may likely to pass through NER either as a point of origin or point of destination.

About 98 percent of the NER's borders form India's international boundaries; on one hand, it shares borders with South Asian countries like Bangladesh, Bhutan, and Nepal and with Southeast and East Asian countries like Myanmar and China, on the other. It has been argued that the NER has the potential to grow faster than its current pace, by improving the connectivity, logistics and trade facilitation, more particularly with Bangladesh, Myanmar and other Southeast and East Asian countries. Development of transport corridors, which connect NER with the other states of India and the neighbouring countries, can enhance both trade and connectivity.

NER region stands way below and ahead in comparison with the rest of India in socio-economic indicators. The NER, in general, is a rural economy. NER states are well ahead of many Indian states in primary and secondary education. However, NER suffers from poor access to basic health services; it remains one of the most underdeveloped regions in India in the health sector.

The services sector's contribution to GDP in NER has increased during the period 2004 and 2015, while the contribution of the other two sectors has declined in the same period. The NER (except West Bengal) has become a services-driven economy. Except for Arunachal Pradesh, Mizoram,

and Sikkim, the rest of the NER states rank below (even West Bengal) as compared to India's average growth rate of NSDP. In case of state-wise performance, NER's growth rate of per capita income had also lagged behind the national growth rate of the country for major states except for Sikkim. Not surprisingly, the difference in per capita incomes between the country and the region has steadily diverged. The slow progress of the NER's economy is reflected in the low growth in income.

Nevertheless, the border trade facilities at NER still inadequate to support the rising trade volume. In other words, NER needs drastic improvement in border infrastructure, particularly dealing trade with Bangladesh and Myanmar. Success of connectivity corridors will happen only when border infrastructure is upgraded to facilitate trade and investment at the border region.

The current study has considered four corridors of India, namely, East-West Corridor (EWC) (part of Golden Quadrilateral project), Trilateral Highway (TH), Kaladan corrdior, and Bangladesh–China–India–Myanmar Economic Corridor (BCIM-EC) to assess their likely impacts on economic development on the connected areas. Among these four corridors, EWC is the existing corridor and part of the Golden Quadrilateral project, whereas the others are corridors proposed to connect India with neighboring countries in the eastern neighbourhood.

In this study, we have assessed the development impact of the aforesaid corridors on Northeast Indian states based on a special economic geography model. The NER has special strategic importance due to its international boundaries with Bangladesh, Bhutan, China, Myanmar, and Nepal. The aforesaid four corridors are the entry into the international market beyond the eastern borders of the country.

In particular, this study has identified the role of corridors on freight movement in India with particular reference to the NER. Higher is the freight, more the economic activities. Here, we have attempted to assess the potential of the existing freight and GDP with other important explanatory variables in order to understand the relation between GDP and the freight along the corridors. The study has also identified the major determinants of the freight other than GDP. It has made an assessment to understand how the current pattern of freight can stimulate the economic activities, and whether the GDP growth can increase the freight in NER factoring the corridors under consideration. Further, this study has estimated the results of GDP with freight for the Indian states till 2040 and provided

the expected outcome of the freight growth due to GDP shift with respect to corridors.

This study indicates that NER states are likely to gain more in terms of growth in freight from Kaladan corridor, Trilateral Highway and BCIM-EC, respectively. Gains are robust and highly significant in case of NER states such as Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, and eastern Indian states such as West Bengal, Bihar, Jharkhand and Odisha. However, we need to interpret the results with caution.

The operational models, which we have developed to trace the effects of changes in corridor on regional development, provide strong policy implications. The empirical findings tell us that corridor-based development may lead to generate further economic activities and regional development. Intuitively, corridors that we have selected in this study would influence GDP growth through higher production and consumption.

First, development of corridor would promote the economic activity that in turn would enhance inter- and intra- regional trade within and between the states and across the neighbouring countries. Infrastructure development and better connectivity would bring the potential benefit of corridor and improve production and consumption activities among the region.

Second, corridor development, if managed properly, would lead to reduce the cost of national, regional, and global trade, thereby enhancing the competitiveness of national and regional production networks, and promoting higher investments.

Third, national and regional connectivity will make faster, cheaper, and easier for people and goods to move within and across borders.

Fourth, corridors would help narrowing the development gaps among regional economies by providing small, poor, landlocked, and remote countries and areas with better access to regional markets and production networks, thereby stimulating investment, trade, and economic growth in those areas.

Fifth, ASEAN and India have been working together on a number of integration and cooperation initiatives over the years. India attaches high importance to these connectivity projects, particularly, Trilateral Highway and Kaladan corridor, which are currently under implementation. As

analysed here, these corridors are likely to facilitate new economic activities in India-ASEAN region in general and NER in particular. Completion of these two corridors should be the priority.

Finally, while Guwahati is a connectivity node in NER, cities like Nagaon, Jorhat, Dibrugarh, Guwahati, Tinsukia, Dhubri - all in Assam, Imphal, Gangtok, Itanagar, Agartala, Shillong and Aizawl are fast emerging as economies nodes in NER. These cities perform secondary (manufacturing), tertiary (services) or quaternary (management, research, education) function of economic significance. These are the cities which have to be well connected with the corridors as outlined in this study.

References

ADB-UNESCAP. (2009). *Designing and Implementing Trade Facilitation in Asia and the Pacific.* Asian Development Bank (ADB), Manila, and UNESCAP, Bangkok.

Alonso Villar, O. (1999). Spatial Distribution of Production and International Trade: A Note. *Regional Science and Urban Economics*, 29(3): 371-380.

Anderson, E. J. & Eric van, W. (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review,* 93(1): 170-192.

Armington & S Paul (1969). A Theory of Demand for Products Distinguished by Place of Production. *International Monetary Fund Staff Papers*, Vol. 16, No. 1, pp. 170–201.

Arnold, J. (2006). *Best Practices in Corridor Management*. The World Bank Publications, Washington.

ASEAN Logistics Network Map, 2nd Edition (2009). Published by Japan External Trade Organization. Japan.

Asian Development Bank (2004). *Hardship and Poverty in the Pacific*, Pacific Studies Series. Manila.

Asian Development Bank (2006). *Regional Cooperation and Integration Strategy*. Manila.

Asian Development Bank (2008): *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank*, 2008–2010. Manila.

Banomyong, R. (2008). Logistics Development Study of The Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT), The 2nd Working Group Meeting on Infrastructure and Transportation, Langkawi, Malaysia.

Banomyong, R. Kumagai, S. & Isono, I. (2011). *Geographical Simulation Analysis for Logistics Enhancement for ASEAN, China and India.* ERIA Research Project Report 2010.

Batra, A. (2006). India's global trade potential: The gravity model approach. *Global Economic Review*, 35(3), 327-361.

Behrens, K., Gaigné, C., Ottaviano, G. I. P. & Thisse, J. F. (2007). Countries, Regions and Trade: On the Welfare Impacts of Economic Integration. *European Economic Review*, 51(5): 1277- 1301.

Bhattacharya, B. N., Kawai, M. & Nag, R. M.(eds). (2012). *Infrastructure for Asian Connectivity*. A joint publication of the Asian Development Institute and Asian Development Bank with Edward Elgar Publishing, USA.

Brooks, D. H. & Hummels, D. (eds). (2009). *Infrastructure's role in lowering Asia's trade costs: Building for trade*. A joint publication of the Asian Development Institute and Edward Elgar Publishing, USA.

Brooks., D. H. & Stone., S. F. (eds). (2010). *Trade facilitation and regional cooperation in Asia*. A joint publication of the Asian Development Institute and Edward Elgar Publishing, USA.

Brülhart, M., Carrère, C., & Trionfetti, F. (2010). How Wages and Employment Adjust to Trade Liberalisation: Quasi-Experimental Evidence from Austria. *Mimeo*, University of Lausanne.

Brülhart, M., Crozet, M., Koenig, P. (2004). Enlargement and the EU periphery: the impact of changing market potential. *World Economy*. 27 (6), 853–875.

Brunner, H. P. (ed.). (2010). *North East India: Local Economic Development and Global Markets*, Sage Publications, New Delhi

Capello, R. (2007). *Regional Economics*, Routledge, London, it. (ed). *Economia Regionale*, (2004) Il Mulino, Bologna.

Cappellari, L., & Jenkins, S. P. (2006). Summarizing multiple deprivation indicators. *ISER Working Paper 2006-40*. Colchester: University of Essex.

Crozet, M. & Koenig, P. (2004). EU Enlargement and the Internal Geography of Countries. *Journal of Comparative Economics*, 32(2): 265-278.

Das, G. & Thomas, C. J. (2008). *India's Border Trade with Bangladesh*. New Delhi: Akansha Publishing House.

Das, G. (2005). *Structural Change and Strategy of Development: Resource Industry Linkages in North Eastern Region*. New Delhi: Akansha Publishing House.

De, P. & Iyengar, K. (2014). *Developing Economic Corridors in South Asia*. Asian Development Bank, New Delhi

De, P. & Majumdar, M, (2014). *Developing Cross-Border Production Networks between North Eastern Region of India, Bangladesh and Myanmar: A Preliminary Assessment*. RIS, New Delhi.

De, P. & Majumdar, M. (2014). *Developing Cross-Border Production Networks between North Eastern Region of India, Bangladesh and Myanmar: A Preliminary Assessment*. RIS, New Delhi.

De, P. (2004). Trade Facilitation and Its Dimensions, Presentation Made at the TrainingProgramme at Trade Policy and Analysis, Held at Jadavpur University on 16-20 September 2014, Kolkata

De, P. (2013). Assessing barriers to trade in services in India: an empirical investigation. *Journal of Economic Integration,* 28 (1), 108- 143.

De, P. (2014). Economic Corridors and Regional Economic Integration, in Prabir De and Kavita Iyenger (eds.) *Developing Economic Corridors in South Asia.* Asian Development Bank (ADB), Manila.

De, P. (2016). India's Look East to Act East Policy: What It Means for Regional Connectivity, in Magnus C. M. Brod et al. (eds.) *Regional Infrastructure Investment Initiatives: Zero-Sum Game or Win-Win Collaboration*?, German Development Corporation (GIZ), Bonn.

De, P., Raihan,S. & Ghani, E. (2013). What does MFN trade mean for India and Pakistan? Can MFN be a panacea?, *World Bank Policy Research Working Paper 6483*. Washington, DC: World Bank,

Dixit, A. & Stiglitz, J. E. (1977). Monopolistic Competition and Optimum Product Diversity. *The American Economic Review*, Vol.67, No.3. pp. 297-308.

Driscoll, J. C., and A. C. Kraay. (1998). Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. Review of Economics and Statistics, 80(3): 549–560.

Fujita, M, Krugman, P & Anthony J. V. (1999). *The Spatial Economy: Cities, Regions, and International Trade*. Cambridge, MA: MIT Press.

Fujita, M., & Krugman, P. (2004). The new economic geography: Past, present and the future. *Regional Science*.

Ghosh, B. & De, P. (2005). Investigating the linkage between infrastructure and regional development: Era of planning to globalisation, *Journal of Asian Economics*, vol. 15, No. 1; pp.1023-1050.

Greene, W. (2000). *Econometric Analysis*. Prentice–Hall,Upper Saddle River NJ.

Head, K. & Mayer, T. (2000). Non-Europe: The Magnitude and Causes of Market Fragmentation in Europe. *Weltwirschaftliches Archiv*, Vol.136, pp. 285-314.

Hirschman, A. O. (1958). *The Strategy of Economic Development*. Yale University Press, New Heaven.

Hummels, D. (1999). Toward a geography of trade costs. *GTAP Working Paper No. 17*.

India Trasport Report: Moving India to 2032, Volume III: Sector Reports part II (2014). Published by Routledge, New Delhi.

Isard, W. (1956). *Location and Space Economy*. Cambridge, MA: MIT Press.

Ivanova, O. (2004). Evaluation of infrastructure welfare benefits in the Spatial Computable General Equilibrium (SCGE) Framework. Department of Economics, University of Oslo.

Krugman, P. & Livas Elizondo, R. (1996). Trade Policy and the Third World Metropolis. *Journal of Development Economics*, 49(1): 137-150.

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

Kumagai, S. T. Gokan, I. Isono, & S, Keola. (2008). Geographical Simulation Model for ERIA. International Infrastructure Development in East Asia, ed. Nagesh Kumar, *ERIA Research Project Report 2007 No.2.*

Kumagai, S. T. Gokan, I. Isono, & S, Keola. (2009). The Second Generation of Geographical Simulation Model: Predicting the Effects of Infrastructure Development by Industry. Development of Regional Production and Logistic Networks in East Asia, ed. Kitti Limskul, *ERIA Research Project Report 2008 No. 4-1.*

Kumagai, S. T. Gokan, I. Isono, K. Hayakawa, & S. Keola. (2010). Geographical Simulation Analysis for Logistic Enhancement in East Asia, *ERIA Research Project Report 2009 No.7-2.*

Kumagai, S. T. Gokan, I. Isono, K. Hayakawa, & S. Keola. (2011). IDE/ERIA-GSM v4.0. in Geographical Simulation Analysis for Logistics Enhancement for ASEAN, China and India, Banomyong R., S. Kumagai and I. Isono eds., *ERIA Research Project Report 2010.*

Martino, A. D. Fiorello, E. Zecca, M. Ponti, & S Maffii. (2005). Macro-economic impact of the White Paper policies, Annex XII of ASSESS Final Report, DG TREN, European Commission.

Midelfart-Knarvik, K. H., Overman, H. G. & Venables, A. J. (2001). Comparative advantage and economic geography: Estimating the determinants of industrial location in the EU. CEPR discussion paper.

Midelfart-Knarvik, K.H., Overman, H.G., Redding, S. & Venables, A. J. (2002). Integration and industrial specialisation in the European Union. Revue Économique. Vol. 53, No.3, May 2002. Pp. 469-481.

Monfort, P. and Nicolini, R. (2000). Regional Convergence and International Integration. *Journal of Urban Economics*, 48: 286-306.

Monfort, P. and van Ypersele, T. (2003). Integration, Regional Agglomeration and International Trade. *CEPR Discussion Paper* #3752.

Noguer, M. and Marc, S. (2003). Language as a Barrier to International Trade? An Empirical Investigation. *Second Job-market Paper*, November. 2003.

Pal, P. (2016). Intra-BBIN Trade: Opportunities and Challenges, *ORF Issue Brief*, Issue No. 135.

Paluzie, E. (2001). Trade Policies and Regional Inequalities. *Papers in Regional Science*, 80(1): 67-85.

Peter, J. R. (2014). *Asian Pacific Rim Logistics: Global Context and Local Policies*, Edward Elgar publishing Limited, UK.

Plummer, M. G., Morgan, P. J. & Wignaraja (eds). (2016). *Connecting Asia: Infrastructure for Integrating South and Southeast Asia*. Edward Elgar Publishing, USA.

Rietveld, P. & Nijkamp, P. (1993). *Transport and regional development*. In: J. Polak and A. Heertje (1993) European Transport Economics Blackwell, Oxford.

Rimmer, A. M. (2014). *Asian-Pacific Rim Logistics: Global Context and Local Policies*, Edward Elgar Publishing, Cheltenham UK and Northampton, MA, USA.

Sahu, P. P. (2012). Employment Situation in North Eastern Region of India: Recent Trends and Emerging Challenges. V.V.Giri National Labour Institue, *NLI Research Studies Series*, No. 096/2012.

Schaffer, W. (1972). Estimating regional input–output coefficients. *Review of Regional Studies* II-3:57–71.

Sen, K. (2014). Global Production Networks and Economic Corridors: Can They Be Drivers for South Asia's Growth and Regional Integration?, *ADB South Asia*, Working Paper No. 33.

Shen, G. (1960). An input–output table with regional weights. *Papers of the Regional Science Association,* 6:113–119.

Srivastava, P. (2011). Regional Corridors Development in Regional Cooperation. *ADB Economics Working Paper Series No 258. Manila: Asian Development Bank.*

Stokes, R. W, Pinnoi, N. & Washington, E. J. (1991). Economic development impacts of expenditures for state highway improvements in texas, Texas Transportation Institute for Texas DOT.

Villar, O. A. (1999). Spatial distribution of production and international trade: A note. *Regional Science and Urban Economics*, 29(3):371–380.

Warr, P, Menon, J. & Yusuf, A. A. (2009). Regional economic impacts of cross-border infrastructure: A general equilibrium application to Thailand and Lao PDR. No. 35. *ADB Working Paper Series on Regional Economic Integration*.

Weber, A (1929). *Theory of the Location of Industries*. translated by C. J. Friedrich. University of Chicago Press, Chicago

Weisbrod, G. & Beckwith, J. (1992). Measuring economic development benefits for highway decision-making: The Wisconsin case. *Transp Q,* 46(1):57–79.

Appendix

Appendix 1: Selected States/Provinces of India and China

Sl. No.	Country	States / Provinces
1	India	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Jharkhand, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Chhattisgarh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand, West Bengal, Delhi.
2	China	Chongqing, Sichuan, Tibet, Guizhou, Yunnan, Beijing, Shanghai, Jiangsu, Fujian, Inner Mongolia, Zhejiang, Guangdong, Liaoning, Shandong, Jilin, Hubei, Shaanxi, Ningxia, Hunan, Qinghai, Hainan, Hebei, Xinjiang, Heilongjiang, Henan, Jiangxi, Anhui, Guangxi, Shanxi, Gansu, Tianjin.

Appendix 2: List of Indian States and Neighbouring Countries Connected by Corridors

Sl.No.	Corridor	Connecting Indian States and Countries	
		Indian States	Neighbouring Countries
1	Kaladan corridor	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Sikkim, Tripura, West Bengal	Myanmar
2	Trilateral Highway	Arunachal Pradesh, Assam, Bihar, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Sikkim, Tripura, West Bengal	Bangladesh, Thailand, Myanmar
3	BCIM-EC	Arunachal Pradesh, Assam, Bihar, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Sikkim, Tripura, West Bengal	Bangladesh, Myanmar, China
4	East-West corridor	Assam, Bihar, Gujarat, Madhya Pradesh, Rajasthan, Uttar Pradesh, West Bengal	Not applicable

Appendix 3: Data Sources and Definition

Sl. No.	Variable Name	Description	Sources
1	F (Freight)	For India, state-wise total freight is calculated by aggregating the freight movement via land, air and sea routes in billion tonnes. For China, province-level total freight in billion tonnes. In case of Bangladesh, Myanmar and Thailand, we consider total freight at country level in billion tonnes.	(i) Directorate General of Civil Aviation, Ministry of Civil Aviation (ii) Road Transport Year Book, Transport Research Wing, Ministry of Road Transport & Highways, Govt. of India (iii) World Development Indicators
2	Y (Gross Domestic Product)	Gross State Domestic Product (GSDP) at current prices are taken for India and China in US$ million. GDP at current prices are used for Bangladesh, Myanmar and Thailand in US$ million.	(i) Directorate of Economics & Statistics of respective State Governments (ii) Reserve Bank of India (iii) World Development Indicators
3	RM (Remoteness Measure)	Remoteness measures calculated based on aerial distance between India's capital Delhi and respective state/country capital in km.	Distance data has been collected with the help of the Google Map
4	RD (Road Density)	Ratio of total road in km to the total area in square km of that states/country. $RD = \frac{\text{Total available road in km in the respective state/country}}{\text{Total area in square km in the respective state/country}}$	(i) Ministry of Road Transport and Highways, Govt. of India (ii) Statistical Year Book India, 2016 (iii) Census of India, 2011
5	SPD (Speed)	Average speed of the vehicle in km per hour	Based on Authors' own observation.

Appendix 4: State-wise Forecast of Freight Movement

(a) State-wise Growth Rates of Freight Movement

Sl. No.	State	CAGR of SGDP at Constant Prices (2004-05 to 2014-15) (%)	State-wise Projected Annualised Growth Rate of Freight		
			Kaladan corridor	Trilateral Highway	BCIM-EC
	States with corridors				
1	Arunachal Pradesh	3.10	3.47	1.88	2.51
2	Assam	4.35	4.90	2.65	3.54
3	Bihar	4.99	1.51	3.04	4.07
4	Jharkhand	4.62	1.40	2.81	3.76
5	Manipur	3.12	3.49	1.89	2.52
6	Meghalaya	3.38	3.78	2.05	2.74
7	Mizoram	3.16	3.54	1.92	2.56
8	Nagaland	3.39	3.80	2.06	2.75
9	Odisha	4.84	5.47	2.95	3.95
10	Sikkim	3.23	3.62	1.96	2.62
11	Tripura	3.70	4.16	2.25	3.01
12	West Bengal	5.44	6.16	3.32	4.45
	States without corridors				
13	Andhra Pradesh	5.13	1.55	1.55	1.03
14	Goa	3.61	1.09	1.09	0.72
15	Gujarat	5.78	1.75	1.75	1.16
16	Haryana	5.13	1.55	1.55	1.03
17	Himachal Pradesh	4.19	1.26	1.26	0.84
18	Jammu & Kashmir	3.94	1.19	1.19	0.79
19	Karnataka	5.44	1.64	1.64	1.09
20	Kerala	5.11	1.55	1.55	1.03
21	Madhya Pradesh	5.13	1.55	1.55	1.03
22	Chhattisgarh	4.62	1.39	1.39	0.93
23	Maharashtra	6.19	1.87	1.87	1.25
24	Punjab	4.91	1.48	1.48	0.99
25	Rajasthan	5.24	1.58	1.58	1.05
26	Tamil Nadu	5.77	1.75	1.75	1.16
27	Uttar Pradesh	5.58	1.69	1.69	1.12
28	Uttarakhand	4.54	1.37	1.37	0.91
29	Delhi	5.19	1.57	1.57	1.04

Source: Authors' calculations

Appendix 5: State-wise Forecast of Freight Movement of Trilateral Highway

(Billion Tonnes)

Sl. No.	State	Actual	Projections		
		2014	2020	2030	2040
	States with corridors				
1	Arunachal Pradesh	2.39	2.67	3.22	3.88
2	Assam	28.91	33.81	43.90	57.00
3	Bihar	54.56	65.30	88.09	118.84
4	Jharkhand	31.68	37.41	49.36	65.12
5	Manipur	2.63	2.95	3.55	4.28
6	Meghalaya	3.51	3.97	4.86	5.95
7	Mizoram	1.69	1.89	2.29	2.76
8	Nagaland	2.69	3.04	3.72	4.56
9	Odisha	45.21	53.81	71.95	96.20
10	Sikkim	2.22	2.49	3.03	3.68
11	Tripura	4.33	4.95	6.18	7.71
12	West Bengal	116.86	142.13	196.95	272.92
	States without corridors				
13	Andhra Pradesh	153.94	168.84	196.95	229.74
14	Goa	6.65	7.09	7.90	8.81
15	Gujarat	130.74	145.06	172.50	205.13
16	Haryana	64.48	70.71	82.48	96.20
17	Himachal Pradesh	15.23	16.42	18.62	21.11
18	Jammu & Kashmir	14.98	16.09	18.10	20.38
19	Karnataka	134.26	148.06	174.28	205.15
20	Kerala	76.87	84.28	98.25	114.54
21	Madhya Pradesh	70.70	77.55	90.45	105.50
22	Chhattisgarh	34.48	37.47	43.04	49.43
23	Maharashtra	261.51	292.33	351.99	423.82
24	Punjab	53.70	58.66	67.97	78.76
25	Rajasthan	89.33	98.17	114.87	134.42
26	Tamil Nadu	159.43	176.89	210.34	250.12
27	Uttar Pradesh	152.25	168.35	199.05	235.36
28	Uttarakhand	23.64	25.65	29.40	33.69
29	Delhi	72.15	79.22	92.57	108.17

Source: Authors' calculations

Appendix 6: State-wise Forecast of Freight Movement of Kaladan Corridor

(Billion Tonnes)

Sl. No.	State	Actual	Projections		
		2014	2020	2030	2040
	States with corridors				
1	Arunachal Pradesh	2.39	2.93	4.13	5.80
2	Assam	28.91	38.53	62.19	100.38
3	Manipur	2.63	3.23	4.56	6.42
4	Meghalaya	3.51	4.39	6.36	9.22
5	Mizoram	1.69	2.08	2.94	4.17
6	Nagaland	2.69	3.36	4.88	7.09
7	Odisha	45.21	62.23	105.98	180.51
8	Sikkim	2.22	2.75	3.92	5.60
9	Tripura	4.33	5.53	8.31	12.48
10	West Bengal	116.86	167.31	304.27	553.35
	States without corridors				
11	Andhra Pradesh	153.94	168.84	196.95	229.74
12	Bihar	54.56	59.69	69.33	80.52
13	Jharkhand	31.68	34.43	39.54	45.42
14	Goa	6.65	7.09	7.90	8.81
15	Gujarat	130.74	145.06	172.50	205.13
16	Haryana	64.48	70.71	82.48	96.20
17	Himachal Pradesh	15.23	16.42	18.62	21.11
18	Jammu & Kashmir	14.98	16.09	18.10	20.38
19	Karnataka	134.26	148.06	174.28	205.15
20	Kerala	76.87	84.28	98.25	114.54
21	Madhya Pradesh	70.70	77.55	90.45	105.50
22	Chhattisgarh	34.48	37.47	43.04	49.43
23	Maharashtra	261.51	292.33	351.99	423.82
24	Punjab	53.70	58.66	67.97	78.76
25	Rajasthan	89.33	98.17	114.87	134.42
26	Tamil Nadu	159.43	176.89	210.34	250.12
27	Uttar Pradesh	152.25	168.35	199.05	235.36
28	Uttarakhand	23.64	25.65	29.40	33.69
29	Delhi	72.15	79.22	92.57	108.17

Source: Authors' calculations

Appendix 7: State-wise Forecast of Freight Movement of BCIM-EC

(Billion Tonnes)

Sl. No.	State	Actual	Projections		
		2014	2020	2030	2040
	States with corridors				
1	Arunachal Pradesh	2.39	2.77	3.56	4.56
2	Assam	28.91	35.62	50.46	71.48
3	Bihar	54.56	69.33	103.34	154.04
4	Jharkhand	31.68	39.54	57.22	82.79
5	Manipur	2.63	3.06	3.92	5.03
6	Meghalaya	3.51	4.13	5.41	7.09
7	Mizoram	1.69	1.96	2.53	3.26
8	Nagaland	2.69	3.16	4.15	5.44
9	Odisha	45.21	57.03	84.01	123.74
10	Sikkim	2.22	2.59	3.36	4.35
11	Tripura	4.33	5.17	6.95	9.35
12	West Bengal	116.86	151.71	234.38	362.09
	States without corridors				
13	Andhra Pradesh	153.94	163.72	181.42	201.04
14	Goa	6.65	6.94	7.46	8.02
15	Gujarat	130.74	140.12	157.27	176.53
16	Haryana	64.48	68.57	75.98	84.19
17	Himachal Pradesh	15.23	16.01	17.41	18.94
18	Jammu & Kashmir	14.98	15.71	17.00	18.39
19	Karnataka	134.26	143.31	159.76	178.11
20	Kerala	76.87	81.73	90.53	100.28
21	Madhya Pradesh	70.70	75.19	83.32	92.32
22	Chhattisgarh	34.48	36.45	39.97	43.84
23	Maharashtra	261.51	281.67	318.80	360.81
24	Punjab	53.70	56.96	62.84	69.32
25	Rajasthan	89.33	95.13	105.64	117.30
26	Tamil Nadu	159.43	170.87	191.78	215.26
27	Uttar Pradesh	152.25	162.80	182.04	203.55
28	Uttarakhand	23.64	24.96	27.34	29.94
29	Delhi	72.15	76.79	85.19	94.51

Source: Authors' calculations

Corridor-based infrastructure development promotes economic growth and regional development through reduction in time and cost of the transportation; creates employment opportunities due to higher transportation activities, and contributes to poverty reduction. India's several infrastructure development initiatives are aimed to provide cost effective and efficient logistic services. In particular, India's Northeastern Region (NER) aims to deepen connectivity with national and cross-border corridors. NER is crucial to India's growing economic and strategic partnership with Southeast and East Asia. NER acts as a land-bridge between India and Southeast Asia. Owing to its strategic location, development of transport corridors, which connect the NER with rest of India and the neighbouring countries, has the potential to grow faster and can boost trade and connectivity with Southeast and East Asian countries.

This study has examined the developmental impact of existing East-West Corridor (EWC) and the proposed cross-border corridors such as Trilateral Highway (TH), Kaladan multi-modal transit transport corrdior, and Bangladesh–China–India–Myanmar Economic Corridor (BCIM-EC) on the Indian states with particular focus on the NER states based on economic geography model. The study finds that corridor-based development projects may generate economic activities and regional development, which, in turn, would influence economic growth through higher production and consumption. The study has important policy implications in promoting economic activities and regional development.

About the Authors

Dr. Prabir De, Professor, Research and Information System for Developing Countries (RIS), and Coordinator, ASEAN-India Centre (AIC) at RIS, New Delhi

Dr. Sunetra Ghatak, Research Associate, ASEAN-India Centre (AIC), Research and Information System for Developing Countries (RIS), New Delhi

Dr. Durairaj Kumarasamy, Consultant (Assistant Professor), ASEAN-India Centre (AIC), Research and Information System for Developing Countries (RIS), New Delhi

RIS
Research and Information System for Developing Countries
विकासशील देशों की अनुसंधान एवं सूचना प्रणाली

AIC
ASEAN-India Centre at RIS

Core IV-B, Fourth Floor, India Habitat Centre, Lodhi Road, New Delhi-110 003, India
Tel.: +91-11-2468 2177-80, Fax: +91-11-2468 2173-74, E-mail: aic@ris.org.in; dgoffice@ris.org.in,
Website: www.ris.org.in; http://aic.ris.org.in